Q. Please provide the 2007 and 2015 *Conservation and Demand Management Potential Studies*.

A. Please refer to PUB-NLH-001, Attachments 1, 2, and 3 for the 2015 Conservation and Demand Management Potential Studies by sector and PUB-NLH-001, Attachments 4, 5, and 6 for the 2007 Conservation and Demand Management Potential Studies by sector.

Newfoundland and Labrador Conservation and Demand Management Potential Study: 2015

Commercial Sector Final Report

August 2015

Submitted to:
Newfoundland Power Inc. and
Newfoundland and Labrador Hydro

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Executive Summary

Background and Objectives

Since the initial launch of takeCHARGE, NL's Conservation and Demand Management (CDM) market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and demand management potential in the province. Similar to the 2007 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

Scope

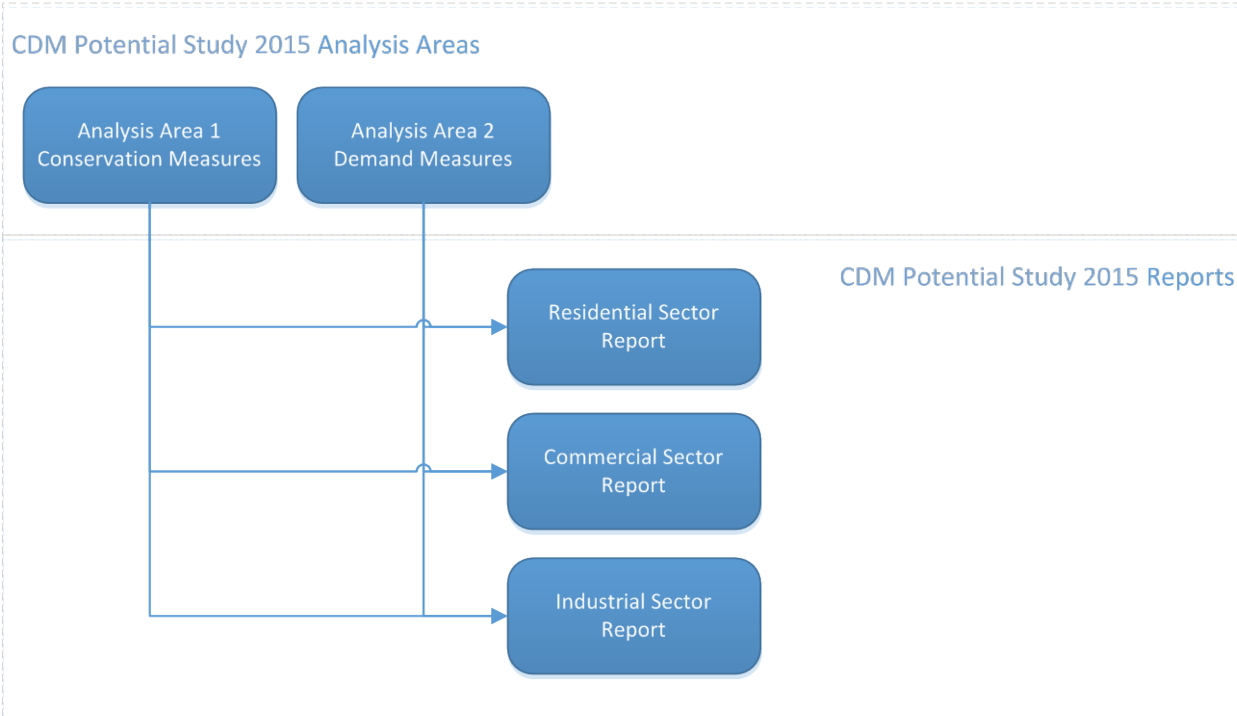
The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).
- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.
- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.
- **Technologies:** This study addresses a range of electricity conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

CDM Potential Study 2015 has been organized into two analysis areas and the results are presented in three reports, as show in Exhibit ES 1, below.

Exhibit ES 1 Overview of CDM POTENTIAL STUDY 2015 Organization – Analysis Areas and Reports

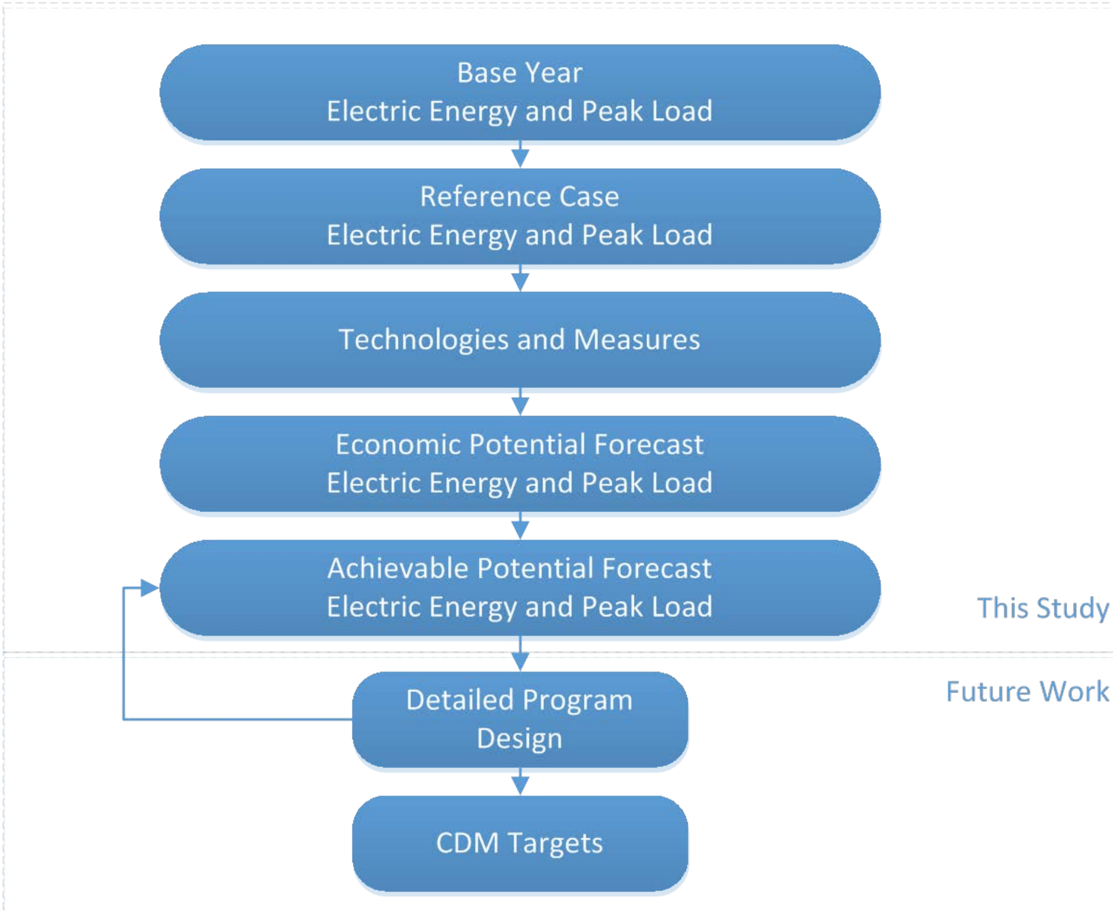


This report presents the results of both Analysis Area 1: Energy-efficiency Technologies and Behaviours and Analysis Area 2: Demand Measures, for Commercial sector customers. This report addresses all commercially available electric energy-efficiency and peak load reduction measures that are applicable to NL's Commercial sector. It includes the potential for electrical efficiency and peak load reduction technologies expected to be commercially viable by the year 2029; residential customer behaviour measures and commercial and industrial operation and maintenance (O&M) practices are also addressed.

Approach

The detailed end-use analysis of electrical efficiency opportunities in the Commercial sector employed two linked modelling platforms: CEEAM (Commercial Electricity and Emissions Analysis Model), an in-house, simulation model developed in conjunction with Natural Resources Canada (NRCan) for modelling electricity use in commercial/institutional building stock and CSEEM (Commercial Sector Energy End-use Model), which is also an ICF in-house spreadsheet-based macro model.

Exhibit ES 2 CDM POTENTIAL STUDY 2015: Main Analytic Steps



The major steps involved in the analysis are shown in Exhibit ES 2 and are discussed in greater detail in Section 2 of this report. As illustrated in Exhibit ES 2, the results of *CDM Potential Study 2015*, and in particular the estimation of Achievable Potential,[1] support on-going conservation and demand management (CDM) work; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific CDM targets or with program design.

Overall Commercial Study Findings

As in any study of this type, the results presented in this report are based on a number of important assumptions. Assumptions such as those related to the current penetration of efficient technologies and the rate of future growth in the building stock are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the NL utilities. However, the reader is referred to a number of caveats throughout the main text of the report. Given these assumptions, the CDM Potential Study 2015 findings confirm the existence of significant potential cost-effective opportunities for electricity consumption and peak load savings in NL's commercial sector.

[1] The proportion of savings identified that could realistically be achieved within the study period.

Efficiency improvements would provide between 209 and 640 GWh/yr. of electricity consumption savings by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. The most significant Achievable Potential savings opportunities were in actions that addressed the HVAC end uses, specifically space heating. Besides space heating, there are significant savings to be found in lighting and refrigeration, as well as smaller opportunities in many of the other end uses, such as domestic hot water (DHW), food service and plug loads.

The electricity consumption savings would provide associated peak load reductions of approximately 32 to 118 MW during NL's winter peak period by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. Demand reduction measures would provide further peak load reductions of approximately 1.2 to 4.2 MW by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. All told, this amounts to peak load reduction potential of between 6% and 20% with respect to the Reference Case commercial peak load. Demand reductions do not include demand curtailment; rather, existing and future demand curtailment is included in the industrial sector report.

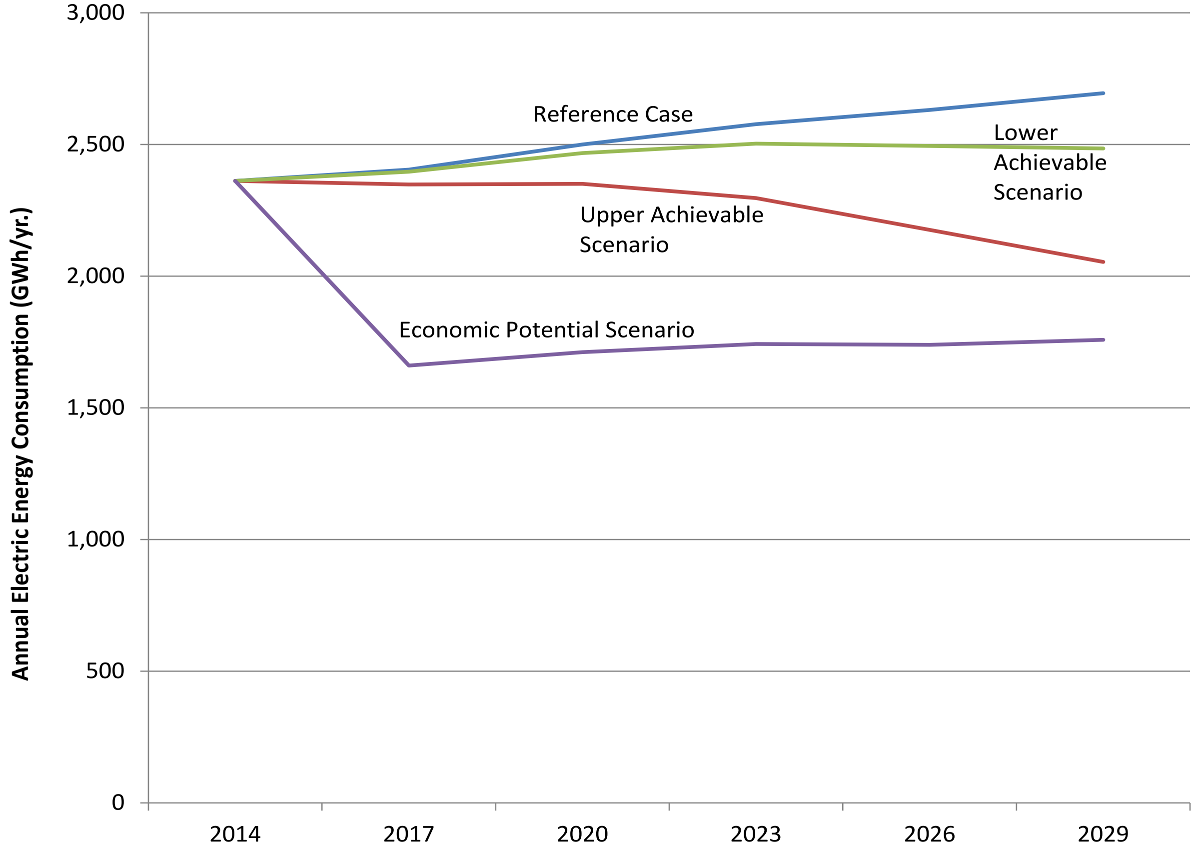
Summary of Electric Energy Savings in the Commercial Sector

A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by CDM Potential Study 2015 is presented in Exhibit ES 3 and Exhibit ES 4, by milestone year.

Exhibit ES 3 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	744	31%	56	2.3%	8	0.3%
2020	789	32%	149	6.0%	32	1.3%
2023	834	32%	280	11%	73	2.8%
2026	892	34%	456	17%	137	5.2%
2029	936	35%	640	24%	209	7.8%

Exhibit ES 4 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Commercial Sector, (GWh/yr.)



Base Year Electricity Use

In the Base Year of 2014, NL's Commercial sector consumed about 2,360 GWh/yr. Exhibit ES 5 shows that space heating accounts for about 27% of total commercial electricity use. Lighting accounts for the second largest percentage, at 17%. These are followed by HVAC Fans and Pumps at 12%, miscellaneous equipment at 9%, refrigeration at 8%, secondary lighting at 5%, and domestic hot water (DHW) at 5%. Other end uses account for 4% or less of the total. Indeed, some end uses are extremely small. Block heaters are assumed to be used only in Labrador. The same exhibit also presents the Reference Case consumption by end use in 2029, at the end of the study period, for comparison. Overall, NL's Commercial sector is forecast to rise to about 2,700 GWh/yr. by 2029 in the absence of new utility CDM initiatives.

Exhibit ES 6 shows the distribution of Base Year electricity consumption by sub sector. As illustrated, large offices account for the largest share (12%) of Commercial sector Base Year electricity use. The same exhibit also presents the Reference Case consumption by sub sector in 2029, at the end of the study period, for comparison.

Reference Case – Electric Energy

Exhibit ES 5 Electricity Use by End Use, Commercial Sector, 2014 and 2029

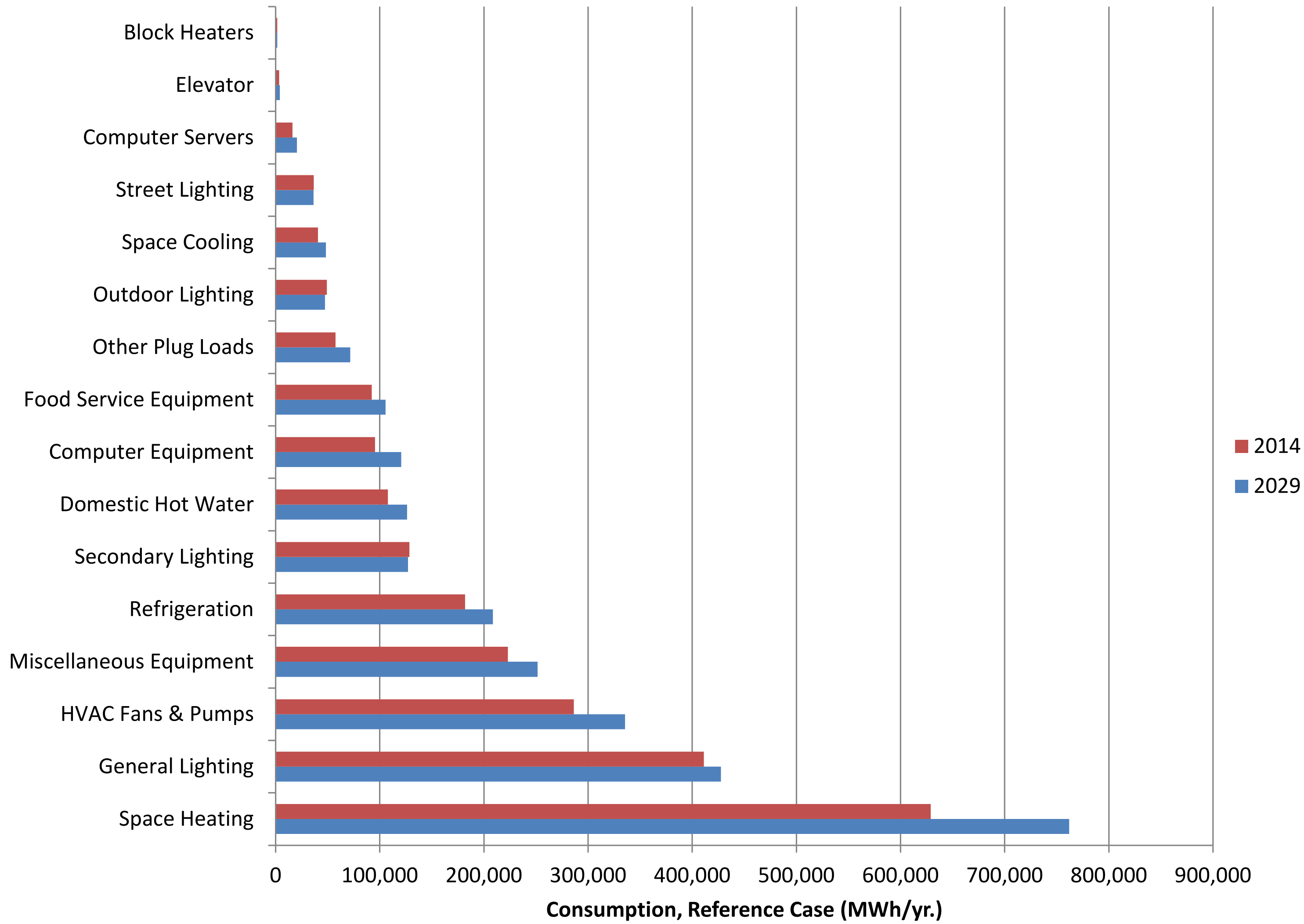
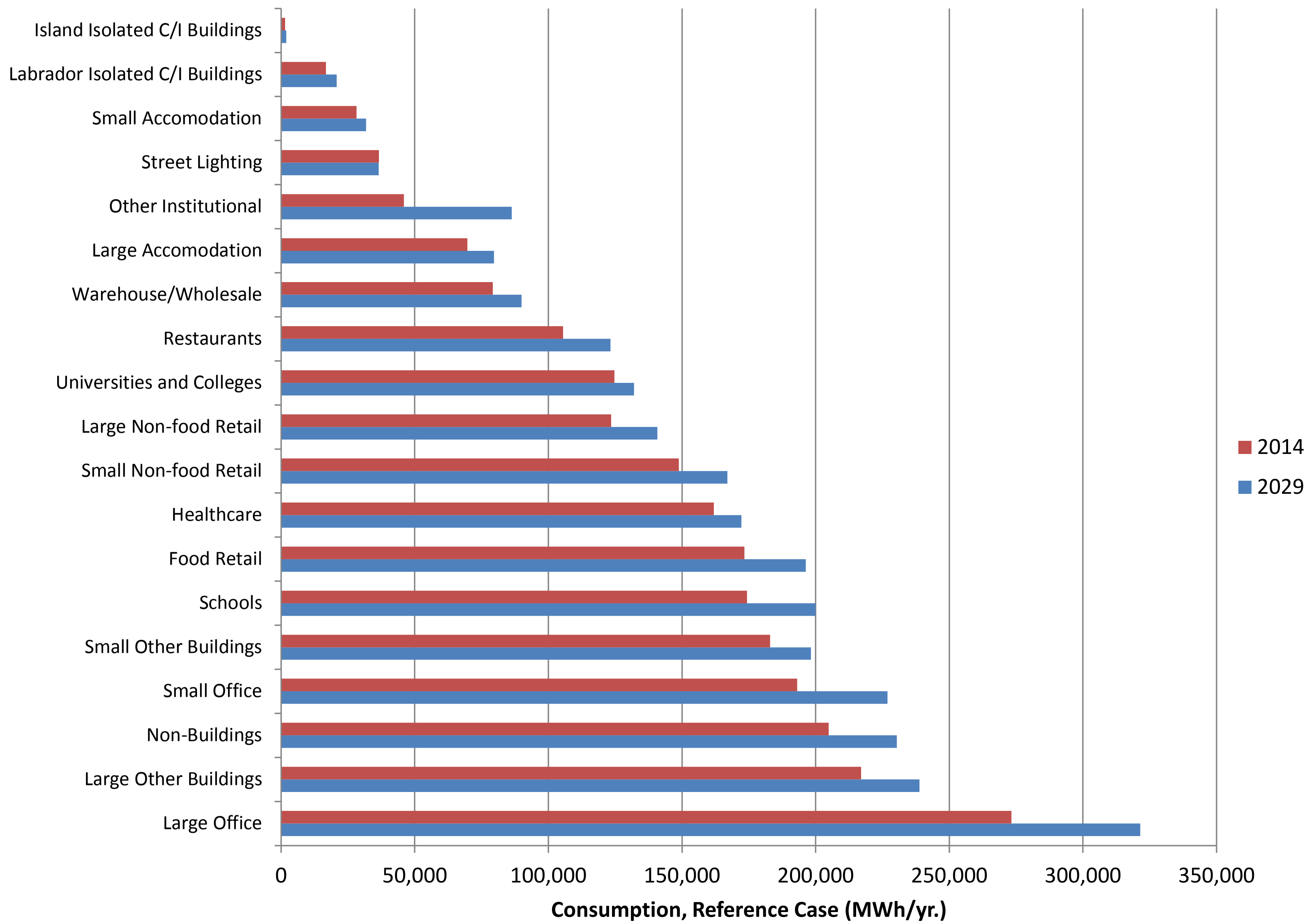


Exhibit ES 6 Electricity Use by Sub sector, Commercial Sector, 2014 and 2029



Economic Potential Forecast – Electric Energy

Under the conditions of the Economic Potential scenario,[2] the study estimated that electricity consumption in the commercial sector would decrease to approximately 1,758 GWh/yr. by 2029. Savings relative to the Reference case would be approximately 936 GWh/yr. or about 35%. The Economic Potential savings in the intermediate milestone years are 1,660 GWh/yr. in 2017, 1,711 GWh/yr. in 2020, 1,743 GWh/yr. in 2023, and 1,739 GWh/yr. in 2026. In each case, the savings amount to approximately 31-35% of the Reference case consumption. The Economic Potential savings are dominated by measures that are cost-effective based on their full cost (versus the "do-nothing" option), and therefore within the definitions of the scenario they would be adopted immediately and provide savings starting in the first milestone period.

Achievable Potential – Electric Energy

The Achievable Potential is the portion of the Economic Potential savings that could realistically be achieved within the study period.[3] In the commercial sector, the Achievable Potential for electricity savings was estimated to be 209 and 640 GWh/yr., respectively, in the Lower and Upper Achievable Potential scenarios. The savings in the intervening milestone years show a more realistic ramp-up pattern than that observed in the Economic Potential scenario.

The most significant Achievable Potential savings opportunities were in actions that addressed HVAC. In fact, savings in the HVAC end uses account for 57% of the opportunities in 2029. Of this, the ductless mini-split heating systems and building recommissioning measures offer the largest savings potential in the commercial sector. Besides HVAC, there are significant savings to be found in lighting and refrigeration as well as smaller opportunities in many of the other end uses.[4]

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[2] The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value , which has been set at different prices per kWh for the different regions. (One kWh from the Labrador hydroelectric grid is much less expensive than one kWh from an isolated diesel grid.)

[3] The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.

[4] It should be noted that measures are applied separately for each combination of region, sub sector, and milestone year. Some of the parameters that are used to assess measures in each circumstance can vary. For example, the potential savings or cost for a measure in one sub sector or region may be different from the savings or cost in another sub sector or region. In addition, the economic threshold value that is used to assess cost-effectiveness varies for each of the milestones. As such, measures that are marginally cost-effective, such as multi-split heat pumps, are only cost-effective in a subset of the regions, sub sectors, and milestone years being considered.

Summary of Peak Load Reductions

Based on discussions with utility personnel, the following peak period definition was used for this study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[5]

Exhibit ES 7 and Exhibit ES 8 show the peak load reductions from both the energy efficiency measures and from measures targeted specifically at load management. More details on peak load reduction opportunities are provided in the main body of the report. Highlights of the findings include the following:

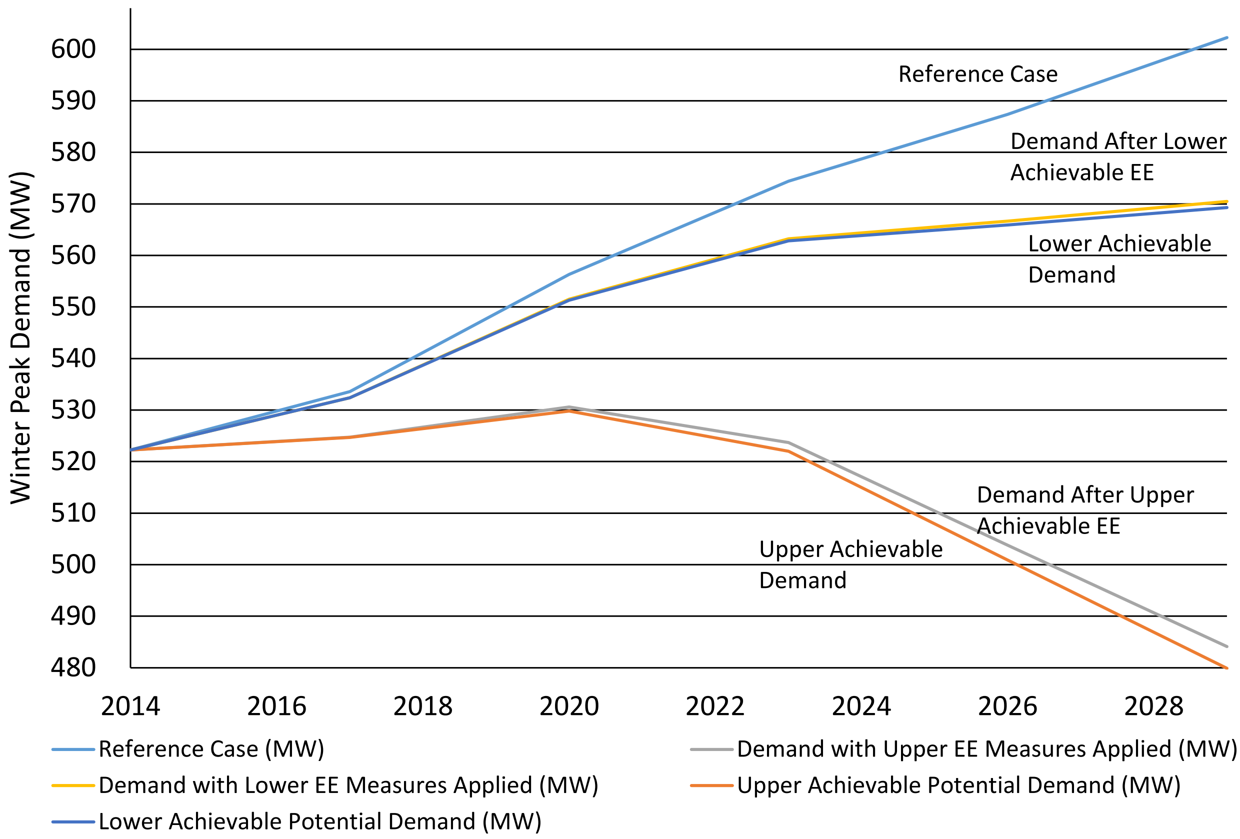
- Electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 32 to 118 MW by 2029, a decrease of between 5% and 20% relative to the reference case.
- Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 1.2 to 4.2 MW by 2029, a decrease of up to a further 1%.
- Demand reduction potential is dominated by the reductions associated with energy efficiency measures in both of the achievable potential scenarios.

Exhibit ES 7 Peak Demand Reductions by Milestone Year for Three Scenarios (MW)

Year	Economic Potential		Upper Achievable		Lower Achievable	
	Potential Reductions (MW)	% Reduction Relative to Reference Case	Potential Reductions (MW)	% Reduction Relative to Reference Case	Potential Reductions (MW)	% Reduction Relative to Reference Case
2017	3.5	0.6%	0.0	0.0%	0.0	0.0%
2020	41.1	7.4%	0.8	0.1%	0.2	0.0%
2023	41.8	7.3%	1.7	0.3%	0.4	0.1%
2026	41.8	7.1%	2.9	0.5%	0.7	0.1%
2029	41.7	6.9%	4.2	0.7%	1.2	0.2%

[5] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

Exhibit ES 8 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Commercial Sector (MW)



Base Year Demand

In the Base Year of 2014, NL's Commercial sector demand was approximately 522 MW, averaged over the 36-hour peak period. This may be compared against the overall average commercial demand for the year, which is:

*2,360 GWh / 8760 hours * 1000 MW/GW = 269 MW*

Exhibit ES 9 shows that space heating accounts for nearly 40% of total commercial sector demand. General lighting accounts for the second largest percentage, at 14%. These are followed by HVAC Fans and Pumps and domestic hot water each at 8%, food service equipment and miscellaneous equipment each at 7% and refrigeration and secondary lighting at 4% each. Other end uses account for 3% or less of the total. The same exhibit also presents the Reference Case demand by end use in 2029, at the end of the study period, for comparison. Overall, NL's Commercial sector is forecast to rise to about 602 MW by 2029 in the absence of new utility CDM initiatives, an increase of approximately 13%.

Exhibit ES 10 shows the distribution of Base Year electric peak demand by sub sector. As illustrated, large offices account for the largest share (12%) of Commercial sector Base Year electricity use. The same exhibit also presents the Reference Case consumption by sub sector type in 2029, at the end of the study period, for comparison.

Reference Case – Electric Peak Demand

Exhibit ES 9 Electric Peak Demand by End Use, Commercial Sector, 2014 and 2029

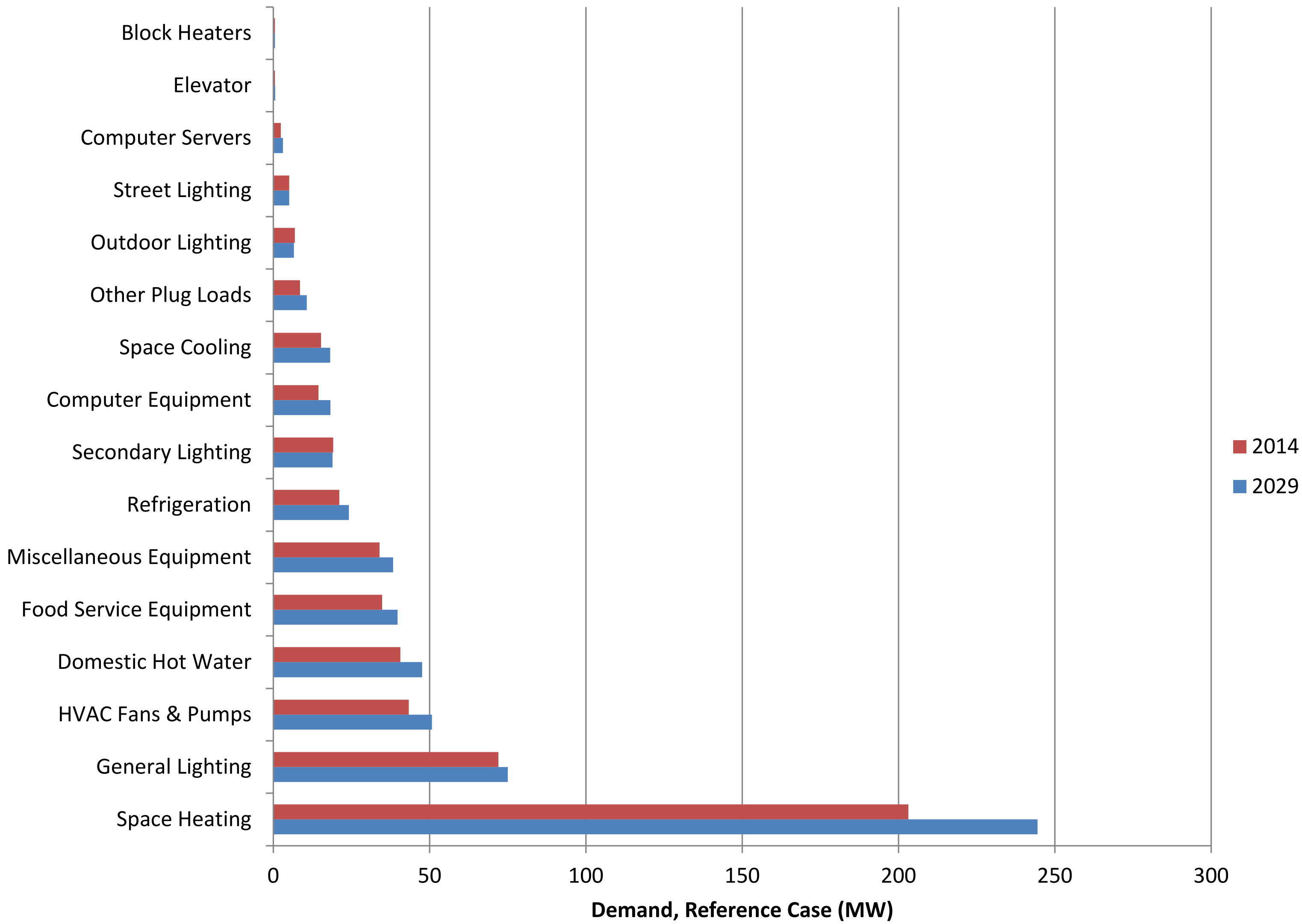
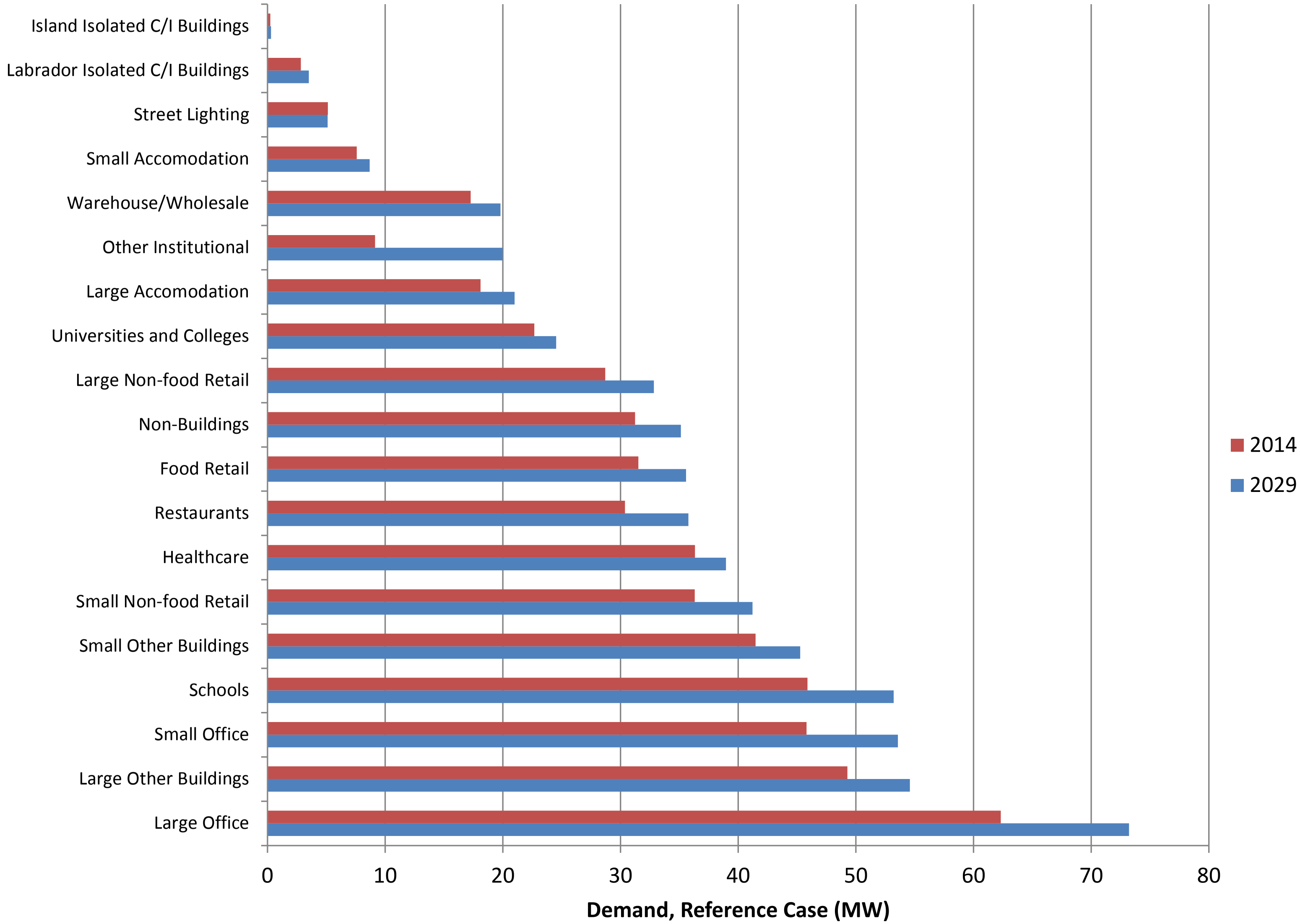


Exhibit ES 10 Electric Peak Demand by Sub Sector, Commercial Sector, 2014 and 2029



Economic Potential Forecast – Electric Peak Demand

Under the conditions of the Economic Potential scenario,[6] the study estimated that electric peak demand in the commercial sector would decrease to approximately 449 MW by 2029. Reductions relative to the Reference case would be approximately 153 MW or about 25%. The Economic Potential reductions in the intermediate milestone years are 134 MW in 2017, 137 MW in 2020, 142 MW in 2023, and 148 MW in 2026. In each case, the reductions amount to approximately 25% of the Reference case peak demand. The Economic Potential reductions are dominated by measures that are cost-effective relative to the Utilities' cost of new capacity based on their full cost (versus the "do-nothing" option), and therefore within the definitions of the scenario they would be adopted immediately and provide reductions starting in the first milestone period.

Achievable Potential – Electric Peak Demand

The Achievable Potential is the portion of the Economic Potential reductions that could realistically be achieved within the study period. In the commercial sector, electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 32 to 118 MW by 2029, a decrease of between 5% and 20% relative to the reference case. Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 1.2 to 4.2 MW by 2029, a decrease of up to a further 1%.Thus, demand reduction potential is dominated by the reductions associated with energy efficiency measures in both of the achievable potential scenarios. The savings in the intervening milestone years show a more realistic ramp-up pattern than that observed in the Economic Potential scenario.

Among the demand reduction measures the most significant Achievable Potential savings opportunities were in actions that addressed HVAC measures. In fact, HVAC reductions account for 64-74% of the opportunities in 2029. Of this, the HVAC demand controls measure offers the largest demand reduction potential in the commercial sector, aside from the demand reduction associated with energy efficiency measures. Besides the HVAC savings, there are also potential demand savings from demand measures related to DHW, lighting, and refrigeration.

[6] The Economic Potential Electric Peak Load Forecast is the expected electric peak load that would occur in the defined peak period if demand is reduced by the reductions associated with the energy efficiency measures in the Economic Potential Electricity Efficiency Forecast, and all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were also fully implemented.

Table of Contents

List of Exhibits

1 Introduction

Newfoundland Power Inc. and Newfoundland and Labrador Hydro have been successfully delivering electricity conservation programs to their customers since 2009 under the joint brand, takeCHARGE.

Since the initial launch of takeCHARGE, NL's CDM market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and demand management potential in province. Similar to the 2008 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

1.1 Study Scope

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).

- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.

- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.

- **Technologies:** This study addresses a range of conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

1.1.1 Data Caveat

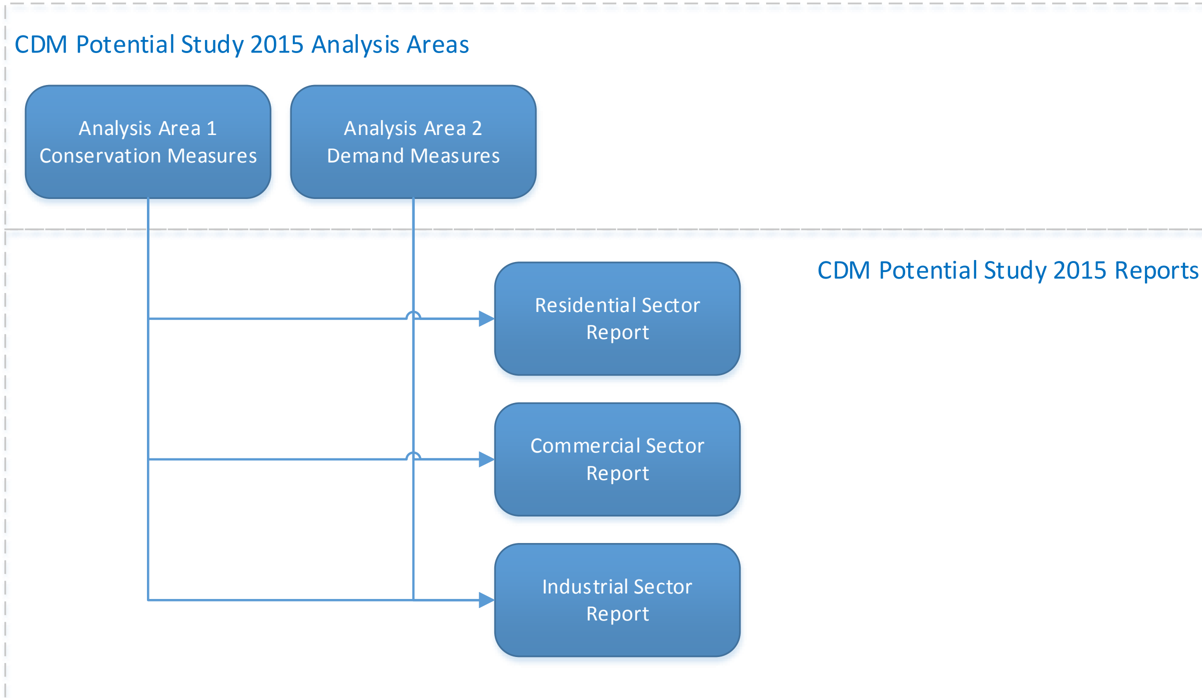
As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the stock of commercial buildings and customer willingness to implement new energy-efficiency measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and the Government of Newfoundland and are based on best available information, which in many cases includes the professional judgment of the consultant team, client personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.2 Study Organization

Exhibit 1 presents an overview of the study's organization; as illustrated, the study has been organized into two analysis areas and four individual reports.

A brief description of each analysis area and its report content is provided below.

Exhibit 1 Overview of *CDM Potential Study 2015* Organization – Analysis Areas and Reports



1.2.1 Analysis Area 1 – Conservation Measures

This area of the *CDM Potential Study 2015* assesses electric energy[7] reduction opportunities that could be provided by electrical efficiency technologies that are expected to be commercially viable by the year 2029; residential customer behaviour measures and commercial and industrial operation and maintenance (O&M) practices are also addressed. The results of Analysis Area 1 are presented in three individual sector reports.

1.2.2 Analysis Area 2 – Demand Measures

This area of the *CDM Potential Study 2015* assesses peak load reduction opportunities that could be provided by peak load reduction technologies that are expected to be commercially viable by the year 2029. The results of Analysis Area 2 are presented in three individual sector reports.

1.3 Report Organization

This report presents the Commercial sector results. It is organized and presented as follows:

- Section 2 presents an overview of the study methodology, including a definition of key terms and an outline of the major analytic steps involved.
- Section 3 presents a profile of Commercial sector Base Year electricity use in NL.
- Section 4 presents a profile of Commercial sector Base Year electric peak load, including the definition of peak periods that are included in this study.

[7] The term "electric energy" is used in this report to distinguish electricity consumption (in units of kWh or MWh) from electricity demand during a specific period (in units of MW).

- Section 5 presents the Reference Case, which provides a detailed estimate of electricity use in NL's Commercial sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 6 presents the Reference Case electric peak loads, which provide a detailed estimate of peak load requirements in NL's Commercial sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 7 identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Commercial sector.
- Section 8 presents the Commercial sector Economic Potential Electricity Forecast for the study period 2014 to 2029, including the potential for both energy efficiency measures and capacity-only peak load reduction measures.
- Section 9 presents the estimated upper and lower Achievable Potential for electric energy savings for the study period 2014 to 2029, including the potential for both energy efficiency measures and capacity-only peak load reduction measures.
- Section 10 lists sources and references.
- Section 11 is the Glossary.

1.4 Results Presentation

The preparation of CDM Potential Studies involves the compilation and analysis of an enormous amount of market and technology data and a nearly infinite number of ways of organizing and presenting the results. It is recognized that readers will have differing levels of needs with respect to the level of detail provided. Consequently, the results of this CDM Potential Studies are presented at three levels of detail.

- **Main report body:** The main body of the report provides a relatively high-level reporting of the main steps involved in undertaking each stage of the study together with a concise summary of results, including comments and interpretation of key findings. It is assumed that the content and level of detail in the main report body is suitable for the majority of readers who wish to gain an understanding of the potential contribution of CDM options to NL's long-term electricity requirements.
- **Appendices:** A separate appendix accompanies each major section of the main report. Each appendix provides more detailed information on the methodology employed, including major assumptions or sample calculations as applicable, together with additional levels of results. It is assumed that this presentation is better suited to CDM analysts and managers wishing a more thorough understanding of the study results.
- **Software:** All of the data generated by the study is provided in two custom-designed Excel models: Data Manager and the measure TRM (technical resource manual) Workbook.
  - **Data Manager** is a custom-designed Excel workbook with query protocols that enable the user to search and report the study results in a virtually infinite number of combinations. Data Manager is intended to support the most detailed level of CDM activity such as program design, preparation of regulatory submissions, etc.

- **The Measure TRM Workbook** is a custom-designed model that provides comprehensive profiles of the CDM measures assessed within the study. Because the information is provided in software form, any changes to economic, financial or performance data inputs can be easily accommodated and revised results generated automatically.

2 Study Methodology

This section provides an overview of the methodology employed for this study. More specifically, it addresses:

- Definition of terms
- Major analytic steps
- Analytic models

2.1 Definition of Terms

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

A brief description of some of the most important terms and their application within this study is included below.

Base Year Electricity Use	The Base Year is the starting point for the analysis. It provides a detailed description of where and how electrical energy is currently used in the existing building stock. Building electricity use simulations were undertaken for the major sub sector types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2014.
Base Year Electric Peak Load Profile	Electric peak load profiles refer to one specific time period throughout the year when NL's generation, transmission and distribution system experiences particularly high levels of electricity demand. This period is of particular interest to system planners; improved management of electricity demand during this peak period may enable deferral of costly system expansion. This study addresses one specific peak periods, as outlined in the main text.
Reference Case Electricity Use (includes "natural" conservation)	The Reference Case electricity use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2014) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable electricity savings potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the sub sectors, estimation of the expected growth in building stock, and finally an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case is calibrated to the Utilities most recent load forecast, minus the impacts of new, future CDM initiatives.
Reference Case Electric Peak Load Profile	The Reference Case peak load profile estimates the expected electric peak loads in the defined peak period over the study period in the absence of new utility CDM program initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable Potentials for peak load reduction.

Conservation and Demand Management (CDM) Measures	CDM measures can include energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and customer-side generation (displace load off of grid). Customer –side generation and fuel switching are not included in this study.
The Cost of Conserved Energy (CCE)	The CCE is calculated for each energy-efficiency technology measure. The CCE is the annualized incremental capital and O&M cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.
The Cost of Electric Peak Reduction (CEPR)	The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.
Electric Capacity-Only Peak Load Reduction Measures	Capacity-only measures are technologies or activities that result in the shifting of certain electrical loads from periods of peak system demand to periods of lower system demand.
Economic Potential Electricity Forecast	The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value[8], which has been set at different prices per kWh for the different supply system types. All the energy-efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the economic threshold value for a given supply system were incorporated into the Economic Potential Forecast.
Economic Potential Electric Peak Load Forecast	The Economic Potential Electric Peak Load Forecast is the expected electric peak loads that would occur in each of the three defined peak periods if all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were fully implemented.
Achievable Potential	The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecasts that could realistically be achieved within the study period. The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.

[8] The economic threshold value is related to the cost of new avoided electrical supply. The values for each supply system are generally selected to provide the CDM Potential Study with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost effective over time. Further discussion is provided in Section 7 of this report.

2.2 Major Analytic Steps

The study was conducted within an iterative process that involved a number of well-defined steps, as illustrated in Exhibit 2.

Exhibit 2 Major Analytic Steps

A summary of the steps is presented below.

Step 1: Develop Base Year Electric Energy and Peak Load Calibration Using Actual Utility Billing Data

Build a model of electric energy and demand for the sector, disaggregated to all the building types and end uses, calibrated to sales of electricity in NL. This includes the following sub-steps:

- Compile and analyze available data on NL's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period.

- Calibrate the weather-sensitive load shape ratios for all three sectors to produce regional demand results that agree with the actual utility peak demand.

Step 2: Develop Reference Case Electric Energy Use and Peak Load Profile

Extend the base year model to the end of the study period, based on forecast building stock growth and expected natural changes in construction practices, equipment efficiency levels and/or practices. This includes the following sub-steps:

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with load forecasting data provided by the Utilities for the study period.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period over the study period.

Step 3: Identify and Assess Energy-efficiency and Peak Load Reduction Measures

Compile information on upgrade measures that can save electric energy and/or reduce peak demand, and assess them for technical applicability and economic feasibility. This includes the following sub-steps:

- Develop list of energy-efficiency upgrade and peak load reduction measures.
- Compile detailed cost and performance data for each measure.
- For energy-efficiency measures, identify the baseline technologies employed in the Reference Case, develop energy-efficiency upgrade options and associated electricity savings for each option, and determine the CCE for each upgrade option.
- For each peak load reduction measure, identify the affected end use, the potential load reduction or off-peak shifting and determine the CEPR.
- Based on the above results, prepare summary tables that show the amount of potential peak load reduction provided by each measure and at what cost ($/kW/yr.).
- Apply each peak load reduction measure to the affected end use, regardless of cost, and determine total peak reduction.
- Summarize the peak load reduction impacts in a supply curve.

Step 4: Estimate Economic Electric Energy Savings Potential

Develop an estimate of the electric energy savings potential that would result from implementing all of the economically feasible measures in all the buildings where they are applicable. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new electricity generation and set an economic threshold value; different economic threshold values were selected for each region and milestone year.
- Identify the combinations of energy-efficiency upgrade options and building types where the cost of saving one kilowatt of electricity is equal to, or less than, the cost of new electricity generation.
- Apply the economically attractive electrical efficiency measures from Step 3 within the energy-use simulation model developed previously for the Reference Case.

- Determine annual electricity consumption in each building type and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: Estimate Achievable Potential Electricity Savings

Develop an estimate for the peak load impacts associated with the measures that save electric energy. This includes the following sub-steps:

- Convert the electricity (electric energy) savings (MWh) calculated in the preceding steps to peak load (electric demand) savings (kW).[9]
- Convert electricity savings to hourly demand, drawing on a library of specific sub sector and end-use electricity load shapes. Using the load shape data, apply the following steps:
  - Disaggregate annual electricity savings for each combination of sub sector and end use by month
  - Further disaggregate monthly electricity savings by day type (weekday, weekend day and peak day)
  - Finally, disaggregate each day type by hour.
- Produce a post-efficiency case for peak demand, by region, building type, end use, and milestone year, to serve as a base case for estimating the impacts of peak load measures.

Step 6: Estimate Peak Load Impacts of Electricity Savings

Develop an estimate for the peak load impacts associated with the measures that save electric energy. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new capacity and set an economic threshold value; different economic threshold values were selected for each region and milestone year.
- Identify the combinations of energy efficiency upgrade options and building types where the cost of reducing one kilowatt of demand is equal to, or less than, the cost of new electric capacity.
- Apply the economically attractive electrical efficiency measures from Step 3 within the demand simulation model developed previously for the Reference Case, using the post-efficiency case as the starting point for the demand measures.
- Determine annual electric demand in each building type and end use when the economic demand reduction measures are employed.
- Compare the electric demand levels when all economic demand reduction measures are used with the post-efficiency demand levels and calculate the total demand reduction.

Step 7: Estimate Achievable Potential Electricity Savings and Demand Reduction

Develop an estimated range for the portion of economic potential savings and demand reductions that would likely be achievable within realistic CDM programs. This includes the following sub-steps:

- Bundle the electric energy and peak load reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a high-level implementation framework, including measure description, cost and savings profile, target sub sectors, potential delivery allies, barriers and possible synergies.

[9] Peak load savings were modelled using the Cross-Sector Load Shape Library Model (LOADLIB).

- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a full day workshop involving the client, the consultant team, trade allies and technical experts to reach general agreement on the upper and lower range of Achievable Potential for both efficiency and demand reduction.
- Total potential for demand reduction includes both the demand reductions associated with the energy efficiency measures and the demand reductions from demand management measures.

2.3 Analytical Models

The analysis of the Commercial sector employed two linked modelling platforms:

- CEEAM (Commercial Electricity and Emissions Analysis Model), an in-house, simulation model developed in conjunction with Natural Resources Canada (NRCan) for modelling electricity use in commercial/institutional building stock.

- CSEEM (Commercial Sector Electricity End-use Model), an in-house spreadsheet-based macro model.

CEEAM was used to develop commercial electricity end-use intensities (EUIs) for each of the commercial and institutional building archetypes. CEEAM has been successfully employed in numerous domestic and international conservation and demand management projects.

Domestically, this includes assignments for BC Hydro, FortisBC, SaskPower, Manitoba Hydro, the Independent Electricity System Operator (IESO)[10], Enbridge Gas, Union Gas, NB Power, Newfoundland Power, Newfoundland Labrador Hydro and Natural Resources Canada. CEEAM is a robust modelling platform whose results have been verified against actual end-use metered data for commercial buildings in the cities of Ottawa and Toronto and against results from DOE-2, the widely used building simulation software tool developed by the US Department of Energy (DOE).

CEEAM was developed specifically for applications such as this study. One of its particular strengths is the capability to simulate electricity performance not only in a given building but also in an entire stock of similar buildings (e.g., all Large Offices). In particular, it is capable of tracking the penetration of multiple technologies in combinations that are not possible with other simulation software tools, such as DOE-2.

CEEAM simulates the electricity consumption and peak load for all electricity end uses present in a given commercial building segment. CEEAM calculates energy use and emissions by end use and reports them in $kWh/ft^2/yr.$ and $kg\ eCO_2/ft^2$. Because CEEAM is a full modelling program, it calculates both building heating and cooling loads (internal and transmission). It therefore accounts for interactive effects such as the increase in heating energy use and decrease in cooling energy use resulting from lighting retrofits. CEEAM also uses equipment part load performance curves to accurately model the seasonal efficiency of heating and cooling plants.

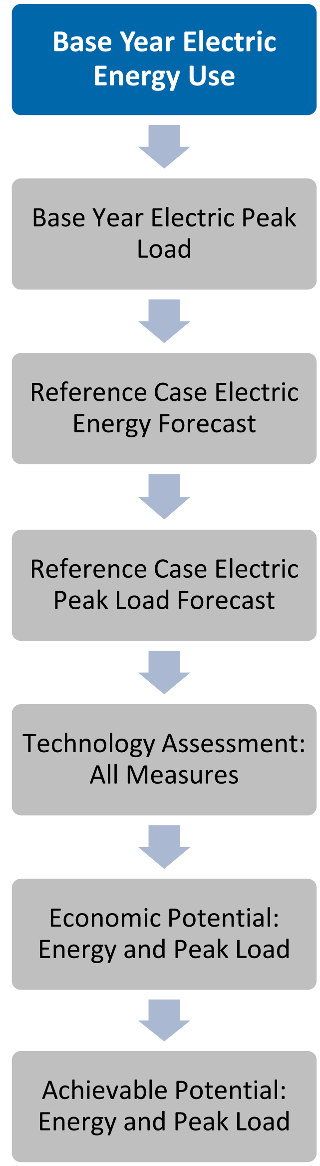
The commercial EUIs derived by CEEAM provide inputs into CSEEM. CSEEM consists of two modules:

- A general parameters module that contains general sector data (e.g., floor space, growth rates, etc.)
- A building profile module that contains the EUI data for each of the selected building sub sectors

[10] Formerly the Ontario Power Authority (OPA). The OPA merged with the IESO on January 1, 2015.

CSEEM combines data from each of these modules and provides total electricity use by service region, building sub sector and end use. CSEEM also enables the analyst to estimate the impacts of the electrical efficiency measures on a utility's on-peak system demand.

3 Base Year (2014) Electric Energy Use



3.1 Introduction

This section provides a profile of Base Year (2014) electricity use in NL's commercial sector. Development of the Commercial sector Base Year electricity profile required the following major steps:

- NL's commercial buildings were segmented into sub sectors containing buildings with similar energy use patterns
- The major energy end uses within commercial buildings were selected
- Data on end-use fuel shares and space cooling saturation were compiled for each sub sector
- Detailed building and equipment specifications were compiled and used to create building energy-use models for each sub sector
- Utility sales data were compiled for each sub sector
- Utility sales data were combined with the model results showing typical sub sector electricity use to generate an estimate of floor area for each sub sector
- CSEEM was used to combine the above data and provide the detailed Base Year profile.

A brief description of each of the above steps is provided below, together with a summary of the results. Additional information is provided in Appendix A.

3.2 Commercial Sector Segmentation

The first major task in developing the Base Year calibration involved the segmentation of the commercial building stock into specific sub sectors. The choice of building sub sectors is driven by both data availability and the need to facilitate the subsequent analysis and modelling of potential electrical efficiency improvements.

For modelling and analysis of energy-efficiency opportunities, the selected building sub sectors must be reasonably similar in terms of major design and operating considerations, such as building size, typical mechanical and electrical systems, and annual operating hours. In order to facilitate energy modelling, this report deals primarily with buildings in which energy use is dominated by space conditioning and the provision of services to occupants (e.g., lighting and water heating). As discussed below, buildings where energy use is primarily process-driven are segregated into a separate category and treated at a less detailed level.

Based on discussions with the Utilities personnel, it was agreed that NL's existing commercial stock would be segmented into the following sub sectors:

- Large Office
- Small Office
- Large Non-food Retail
- Small Non-food Retail

- Food Retail
- Large Accommodations
- Small Accommodations
- Health Care (Hospitals & Nursing Homes)
- Schools (Elementary and Secondary)
- Universities and Colleges
- Warehouse/Wholesale
- Restaurants
- Isolated C/I Buildings
- Large Other Buildings
- Small Other Buildings
- Other Institutional Buildings
- Non-Buildings
- Street Lighting

A brief description of each Commercial sub sector is included in Appendix A. Additional explanation is provided for selected sub sectors:

- **Isolated C/I Buildings:** This sub sector includes buildings such as restaurants, schools, variety stores, medical clinics and multi-purpose garages and sheds that are located in isolated communities served by local diesel-powered systems.

- **Other Buildings:** This sub sector represents buildings that do not fit into the other sub sectors, including churches, theatres, community centres, transportation buildings and recreation complexes.

- **Other Institutional Buildings:** This sub sector includes buildings such as barracks, mess halls, hangers and warehouses located at Canadian Forces Base Goose Bay.

- **Non-Buildings:** This sub sector includes facilities such as microwave repeater stations and telephone exchanges. Although these facilities are housed within a “building,” the majority of their electricity use is consumed by the unique equipment that it houses. This sub sector will be tracked throughout the study but will not be subjected to detailed analysis.

3.3 End Uses

Electricity use within each of the sub sectors noted above is defined on the basis of specific end uses. In this study, an end use is defined as "the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy."

A summary of the major commercial sector end uses used in this study is provided in Exhibit 3, together with a brief description of each.

Exhibit 3 Commercial Electric End Uses

End Use	Description
General Lighting	Lighting in main areas of a building (e.g., classrooms in a school)
Secondary Lighting	Lighting in secondary areas of a building (e.g., corridors/lobbies in a school)
Outdoor Lighting	Lighting used for parking lots and exterior building illumination
Computer Equipment	Computers, monitors, printers, fax machines, and copiers
Computer Servers	Computer servers
Other Plug Loads	Other plug loads, excluding computer equipment
Food Service Equipment	Food preparation equipment, including ranges, broilers, ovens, etc.
Refrigeration	Fridges, freezers, coolers, and display cases
Elevator	Passenger and freight elevators
Miscellaneous Equipment	Air compressors, sump pumps, clothes washers, etc.
Space Heating	Electric boilers, unit heaters, baseboard heaters
Space Cooling	Air-conditioning compressors
HVAC Fans & Pumps	Fans, pumps, cooling tower fans, etc.
Domestic Hot Water	Electric water heaters
Street Lighting	Roadway lighting
Block Heaters	Block heaters and other car warming equipment plugged into outlets in commercial building parking lots

3.4 End-use Saturation and Fuel Share Data

The next step in the analysis involved an estimation of the electric fuel share for space heating, domestic hot water (DHW) and food service equipment,[11] and an estimation of saturation for space cooling.[12] Various information sources were used to derive these estimates, including analysis of NL's sales data, the Commercial End Use Survey (CEUS) from NL, previous project team

[11] Space heating fuel share refers to the percentage of the total floor space that is electrically heated; similarly, DHW fuel share refers to the percentage of the total floor space that is served by electrically heated domestic hot water. Food service equipment fuel share refers the electric portion of end-use energy.
[12] Space cooling saturation refers to the percentage of the total floor space that is air conditioned.

experience, comparable data from other Canadian jurisdictions contained in the ICF database, and consultations with local technical advisors.

Exhibit 4 and Exhibit 5 present the estimated fuel shares and space cooling saturations for each sub sector and service region. It should be noted that the electric fuel share and space cooling saturation was not estimated for all sub sectors. Rather, the end use EUIs for the other sub sectors was derived based on a weighted average of the EUIs for specific sub sectors. Section 5.3 includes more details on how this approach was implemented.

Exhibit 4 Electric Fuel Share by Sub sector & Service Region (%)

Sub Sector	Island Interconnected			Labrador Interconnected			Isolated		
	Space Heating	DHW	Food Service	Space Heating	DHW	Food Service	Space Heating	DHW	Food Service
Large Office	85%	90%	100%	100%	100%	100%	-	-	-
Small Office	90%	95%	100%	100%	100%	100%	-	-	-
Large Non-Food Retail	85%	90%	100%	100%	100%	100%	-	-	-
Small Non-Food Retail	85%	95%	100%	100%	100%	100%	-	-	-
Food Retail	85%	90%	100%	100%	100%	100%	-	-	-
Large Accomodation	90%	90%	98%	100%	100%	100%	-	-	-
Small Accomodation	90%	90%	100%	100%	100%	100%	-	-	-
Healthcare	50%	60%	100%	100%	100%	100%	-	-	-
Schools	75%	80%	100%	100%	100%	100%	-	-	-
Universities and Colleges	20%	25%	100%	90%	100%	100%	-	-	-
Warehouse / Wholesale	75%	80%	100%	80%	100%	100%	-	-	-
Restaurant	90%	95%	98%	100%	100%	100%	-	-	-
Labrador Isolated C/I Buildings	-	-	-	-	-	-	15%	15%	50%
Island Isolated C/I Buildings	-	-	-	-	-	-	15%	15%	50%

Exhibit 5 Space Cooling Saturation by Sub sector and Service Region (%)

Sub Sector	Island Interconnected	Labrador Interconnected	Isolated
Large Office	85%	50%	
Small Office	75%	25%	
Large Non-Food Retail	75%	50%	
Small Non-Food Retail	70%	50%	
Food Retail	65%	25%	
Large Accomodation	75%	25%	
Small Accomodation	50%	25%	
Healthcare	60%	50%	
Schools	2%	50%	
Universities and Colleges	15%	35%	
Warehouse / Wholesale	5%	2%	
Restaurant	70%	25%	
Labrador Isolated C/I Buildings	-	-	10%
Island Isolated C/I Buildings	-	-	0%

3.5 Detailed Building and Equipment Specifications

The next major task involved the development of detailed technical data on building specifications, mechanical and electrical equipment, operating practices and electricity use for each sub sector and end use identified above.

To facilitate the subsequent analysis of the potential impacts of energy-efficiency measures, the detailed data on building, equipment and operating practices were compiled within ICF's Commercial/Institutional Building Energy-use Simulation Model (CEEAM). Detailed building profiles were created that represent the stock of buildings within each sub sector. The detailed technical profiles constitute a bottom-up profile of energy use in the targeted sub sectors.

The building profiles developed for the 2008 CDM Potential Study were used as a starting point for several of the building profiles that were developed for this study. Development and refinement of the detailed building profiles relied on an analysis of data sources, primarily:

- The Commercial End Use Survey (CEUS) provided by the Utilities
- Professional experience of the study team personnel, including building site visits in Newfoundland and other jurisdictions

Separate building profiles were developed for both the Island Interconnected and the Labrador Interconnected service regions. Exhibit 6 presents a sample building profile summary. Detailed profiles for each existing building sub sector are provided in Appendix A.

Exhibit 6 Sample Building Profile Summary – Existing Large Office

Building Type:	Large Office	**Location:**	Island Interconnected

Description:

The building characterisitics used to define the Large Office archetype are as follows:
- Average gross floor area of 40,000 ft^2
- Average footprint of 13,333 ft^2 (approx. 115 ft x 115 ft)
- Average height of 3 stories

Building Envelope						
roof construction:	0.48 W/m².°C					
wall construction:	0.71 W/m².°C					
windows:	3.97 W/m².°C					
shading coefficient	0.58					
window to wall ratio	0.4					
General Lighting & LPD	550 Lux		14.8 W/m²			
System Types	INC	CFL	T12	T8	HID	T5HO
	0%	0%	20%	80%	0%	0%
Architectural Lighting & LPD	350 Lux		31.0 W/m²			
System Types	INC	CFL			HID	T5HO
	45%	45%			5%	0%
Overall LPD	16.4 W/m²					
Plug Loads	1.2 W/m²					
Computer Equipment	4.6 W/m²					
Ventilation:						
System Type	CAV	VAV	DD	IU	100%OA	Other
	75%	25%	0%	0%	0%	
System air Flow	3.6 L/s.m²		0.70 CFM/ft²			
Fan Power	6.0 W/m²		0.56 W/ft²			
Cooling Plant:						
System Type	Centrifugal	Centri HE	Recip Open	DX	LiBr.	Other
	20%	0%	0%	80%	0%	
Calculated Capacity	84 W/m²		450 ft²/Ton			
Cooling Plant Auxiliaries						
Circulating Pumps	0.5 W/m²		0.1 W/ft²			
Condenser Pumps	0.8 W/m²		0.1 W/ft²			
Condenser Fan Size	1.7 W/m²		0.2 W/ft²			

End-Use Summary	**Electricity**		**Fuel Oil / Propane**	
	MJ/m².yr	**kWh/ft².yr**	**MJ/m².yr**	**kWh/ft².yr**
GENERAL LIGHTING	202	5.2		
ARCHITECTURAL LIGHTING	60	1.5		
SPECIAL PURPOSE LIGHTING	0	0.0		
OUTDOOR LIGHTING	17	0.4		
SPACE HEATING	355	9.2	89.5	2.3
SPACE COOLING	38	1.0	0.0	0.0
HVAC FANS & PUMPS	173	4.5		
DOMESTIC HOT WATER	23	0.6	3.0	0.1
COMPUTER EQUIPMENT	91	2.4		
COMPUTER SERVERS	16	0.4		
OTHER PLUG LOADS	28	0.7		
FOOD SERVICE EQUIPMENT	4	0.1	0.0	0.0
REFRIGERATION	4	0.1		
ELEVATORS	3.9	0.1		
MISCELLANEOUS	10	0.3		
BLOCK HEATERS	0	0.0		
Total	**1,025**	**26.5**	**92.5**	**2.4**

3.6 Floor Area Calculations

The addition of floor area is used to drive changes in NL's commercial building stock over the study period, including changes to equipment and electricity use. For the purposes of this study, floor space was derived by dividing the actual sales data for each building sub sector by the applicable fuel share and saturation-weighted whole-building electricity use intensity (EUI). The EUIs used in this calculation were based on the detailed building models for each of the sub sectors and the estimates for fuel share and saturation, as discussed in Sections 3.4 and 0. Exhibit 7 shows the resulting estimates of floor area within each building sub sector and service region.

Exhibit 7 Base Year Floor Area (ft^2) by Sub sector and Service Region

Sub Sector	Island Interconnected	Isolated	Labrador Interconnected	Grand Total
Large Office	10,328,000	-	-	10,328,000
Small Office	8,407,000	-	168,000	8,575,000
Large Non-food Retail	3,817,000	-	273,000	4,090,000
Small Non-food Retail	5,531,000	-	525,000	6,056,000
Food Retail	2,823,000	-	159,000	2,982,000
Large Accomodation	2,442,000	-	234,000	2,677,000
Small Accomodation	1,162,000	-	31,000	1,193,000
Healthcare	4,034,000	-	573,000	4,608,000
Schools	13,600,000	-	741,000	14,341,000
Universities and Colleges	7,391,000	-	118,000	7,509,000
Warehouse/Wholesale	5,075,000	-	370,000	5,444,000
Restaurants	994,000	-	89,000	1,083,000
Labrador Isolated C/I Buildings	-	2,179,000	-	2,179,000
Island Isolated C/I Buildings	-	205,000	-	205,000
Large Other Buildings	6,373,000	-	2,228,000	8,601,000
Small Other Buildings	6,214,000	-	1,500,000	7,715,000
Other Institutional	-	-	2,960,000	2,960,000
Non-Buildings	-	-	-	-
Street Lighting	-	-	-	-
Grand Total	**78,193,000**	**2,383,000**	**9,969,000**	**90,545,000**

Note: Any differences in totals are due to rounding.

For the Island service region, the total floor area of the modelled sub sectors is approximately 78 million square feet. The largest sub sector is Schools, which accounts for 17.4% of the total floor area, followed by Large Office at 13.2%, Small Office at 10.8% and Universities and Colleges at 9.5%.

For the Labrador Interconnected service region, the total floor area of the modelled sub sectors is approximately 10 million square feet. The largest sub sector is Other Institutional, which accounts for 29.7% of the total floor area, followed by Large Other Buildings at 22.3%, Small Other Buildings at 15.1% and Schools at 7.4%.

3.7 Summary of Commercial Base Year Electricity Use

This section presents the results of the analysis of electricity consumption for the Base Year 2014. The results are measured at the customer's point-of-use and do not include line losses; they are presented in five separate exhibits:

- Exhibit 8 presents base year electricity consumption in tabular form by sub sector type and end use
- Exhibit 11 through Exhibit 10 present the results by sub sector, by region and by end use respectively.
- Exhibit 12 presents the model results as a series of stacked bars, showing the percentage consumed by end use for each sub sector.

Additional highlights are provided below.

By Sub Sector
Large Office Buildings account for the largest share of electricity use within the sub sectors (11.6%), followed by Large Other Buildings (9.2%), Non-Buildings (8.7%), and Small Office at 8.2%.

By Region
The Island Interconnected region accounts for 88% of commercial electricity consumption, while the Labrador Interconnected region accounts for 11% of commercial electricity consumption. Commercial accounts connected to isolated diesel grids consume the remaining 1% of commercial electricity.

By End Use
Space heating is the largest end use, accounting for about 27% of Commercial sector electricity use followed by general lighting (17%), HVAC fans & pumps (12%), and Miscellaneous Equipment (9%).

By Sub Sector and End Use
The last exhibit in this section highlights the differences among sub sectors. Offices and schools show a higher percentage of consumption for HVAC and lighting than food retail where the electricity use is dominated by refrigeration. Sub sectors such as large and small accommodation and restaurants have a higher amount of electricity consumption in the domestic hot water end use.

Data Manager

As part of this report, an Excel application called Data Manager is provided. This Excel workbook has the ability to produce charts and tables looking at the data filtered and segmented in many ways. For example:

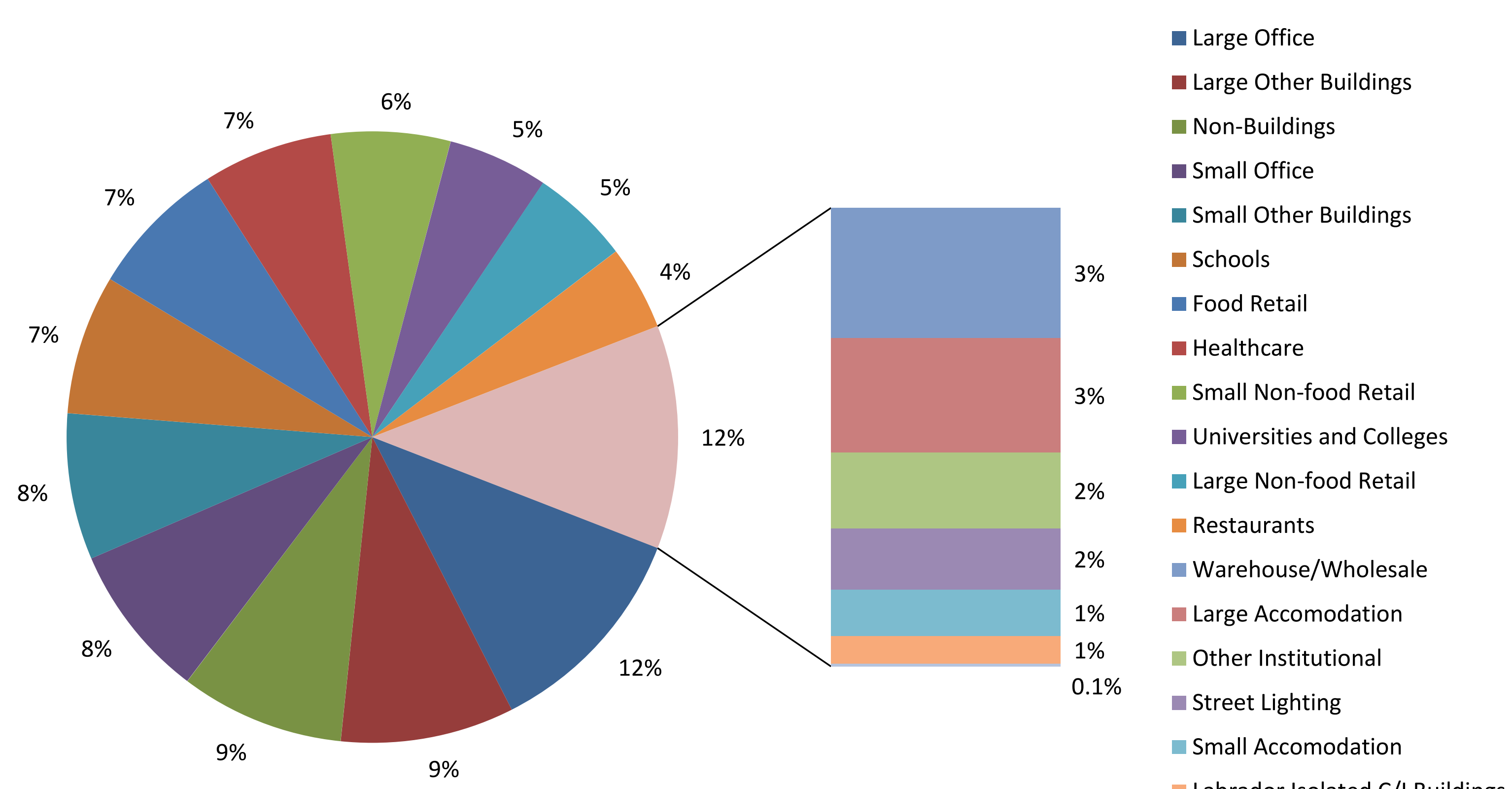
- The user can produce a pie chart of electricity consumption by end use for an individual sub sector of interest, such as large offices.
- The user can produce a column chart showing the electricity consumption for space heating and lighting in each of several sub sector types, with each sub sector type as a separate column and the different end use consumption values shown stacked on top of each other.
- The user can produce a line chart showing consumption for a particular sub sector type by year.

Data Manager has a user interface designed for someone with basic knowledge of Excel.

Exhibit 8 Base Year Annual Electricity Consumption by Sub sector and End Use, All of NL (MWh/yr.)

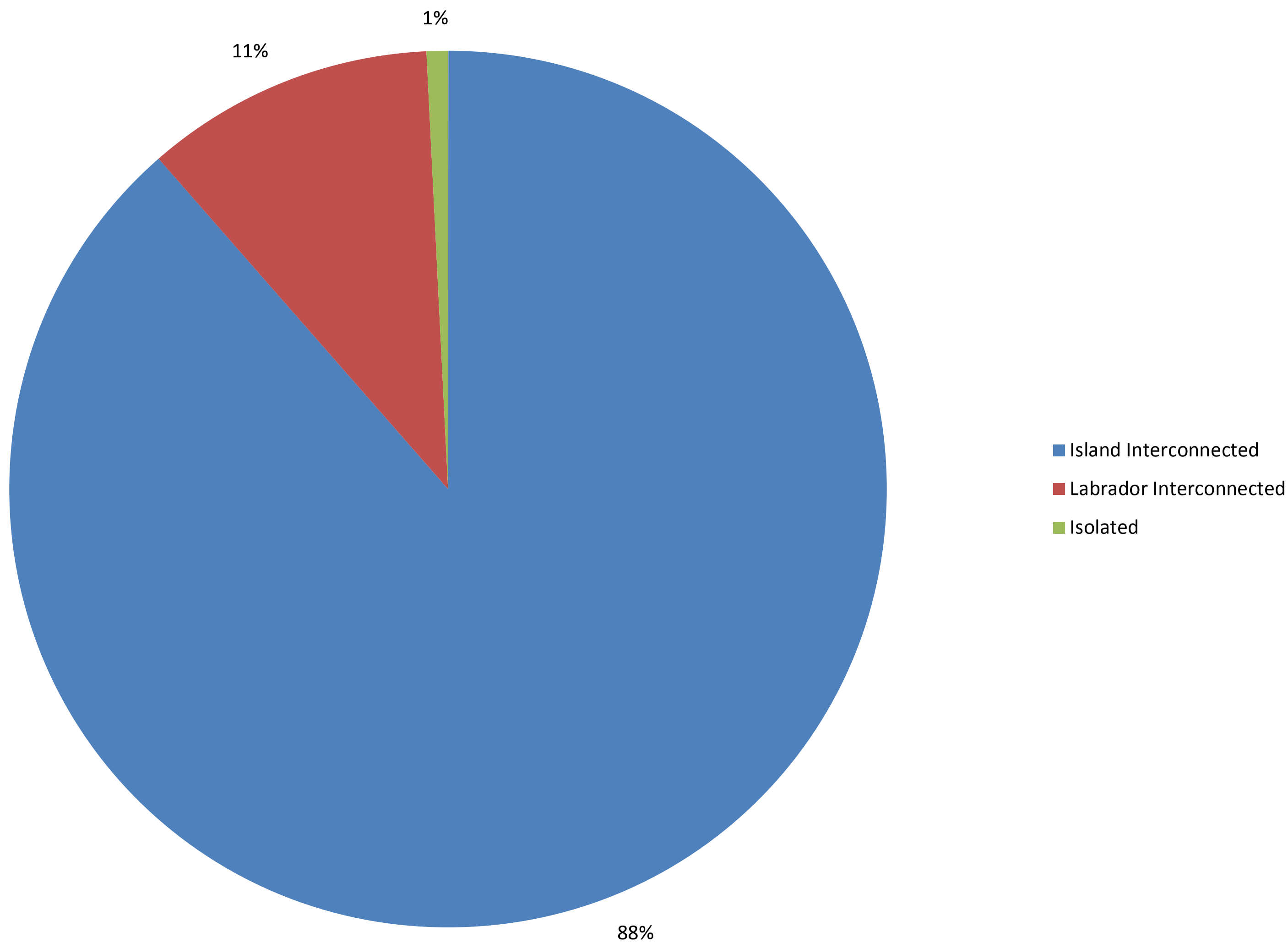
Sub Sector	Space Heating	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Refrigeration	Secondary Lighting	Domestic Hot Water	Computer Equipment	Food Service Equipment	Other Plug Loads	Outdoor Lighting	Space Cooling	Street Lighting	Computer Servers	Elevator	Block Heaters	Grand Total
Large Office	94,614	53,893	46,186	2,666	1,067	15,973	5,999	24,326	1,067	7,386	4,524	10,209	-	4,319	1,033	-	273,262
Small Office	76,520	40,527	20,053	2,192	868	6,020	5,263	20,197	-	6,132	3,756	7,928	-	3,586	-	22	193,065
Large Non-food Retail	30,090	36,209	28,344	1,021	6,135	3,845	1,819	2,021	4,090	2,632	3,583	3,224	-	467	-	35	123,515
Small Non-food Retail	45,979	45,510	29,767	1,496	-	5,322	2,835	2,993	-	3,896	5,305	4,984	-	691	-	68	148,847
Food Retail	23,490	20,697	11,522	749	91,544	3,236	3,484	2,323	9,237	2,502	2,612	1,610	-	327	-	21	173,352
Large Accomodation	20,548	7,426	5,946	661	2,073	7,856	16,327	1,194	3,392	1,321	1,172	1,210	-	254	244	30	69,655
Small Accomodation	9,922	3,788	1,435	304	462	2,102	7,230	537	770	589	523	411	-	113	-	4	28,191
Healthcare	57,863	5,258	30,746	1,116	1,784	24,911	10,048	4,163	9,516	8,004	4,036	2,446	-	963	864	222	161,941
Schools	83,105	45,131	9,356	1,082	1,074	10,063	5,700	7,777	1,481	1,567	6,281	279	-	1,363	-	29	174,289
Universities and Colleges	12,738	40,181	35,767	1,923	3,877	5,076	1,269	10,028	2,908	4,881	3,289	1,341	-	714	739	15	124,745
Warehouse/Wholesale	28,325	20,567	4,753	1,358	8,433	4,089	2,136	1,869	-	4,518	2,385	114	-	621	-	48	79,216
Restaurants	13,061	2,564	3,573	268	18,173	8,146	20,519	447	36,502	598	474	1,007	-	124	-	12	105,467
Labrador Isolated C/I Buildings	580	6,909	1,132	-	3,416	1,608	149	1,051	496	677	739	-	-	-	-	305	17,062
Island Isolated C/I Buildings	-	649	106	-	321	151	-	99	47	64	69	-	-	-	-	-	1,505
Large Other Buildings	65,447	36,027	27,825	1,564	22,200	14,680	13,133	8,017	12,662	5,660	4,741	2,936	-	1,388	406	358	217,045
Small Other Buildings	56,786	33,165	21,646	1,450	18,691	10,949	9,525	7,223	9,684	5,022	4,365	2,711	-	1,240	227	238	182,923
Other Institutional	10,017	12,713	8,247	412	1,763	4,559	2,407	1,212	537	2,075	1,406	219	-	-	-	412	45,979
Non-Buildings	-	-	-	204,856	-	-	-	-	-	-	-	-	-	-	-	-	204,856
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	-	37,127	-	-	-	37,127
Grand Total	629,085	411,214	286,405	223,118	181,881	128,587	107,844	95,476	92,387	57,527	49,260	40,630	37,127	16,170	3,514	1,817	2,362,042

Exhibit 9 Distribution of Electricity Consumption by Sub sector in the Base Year (2014)



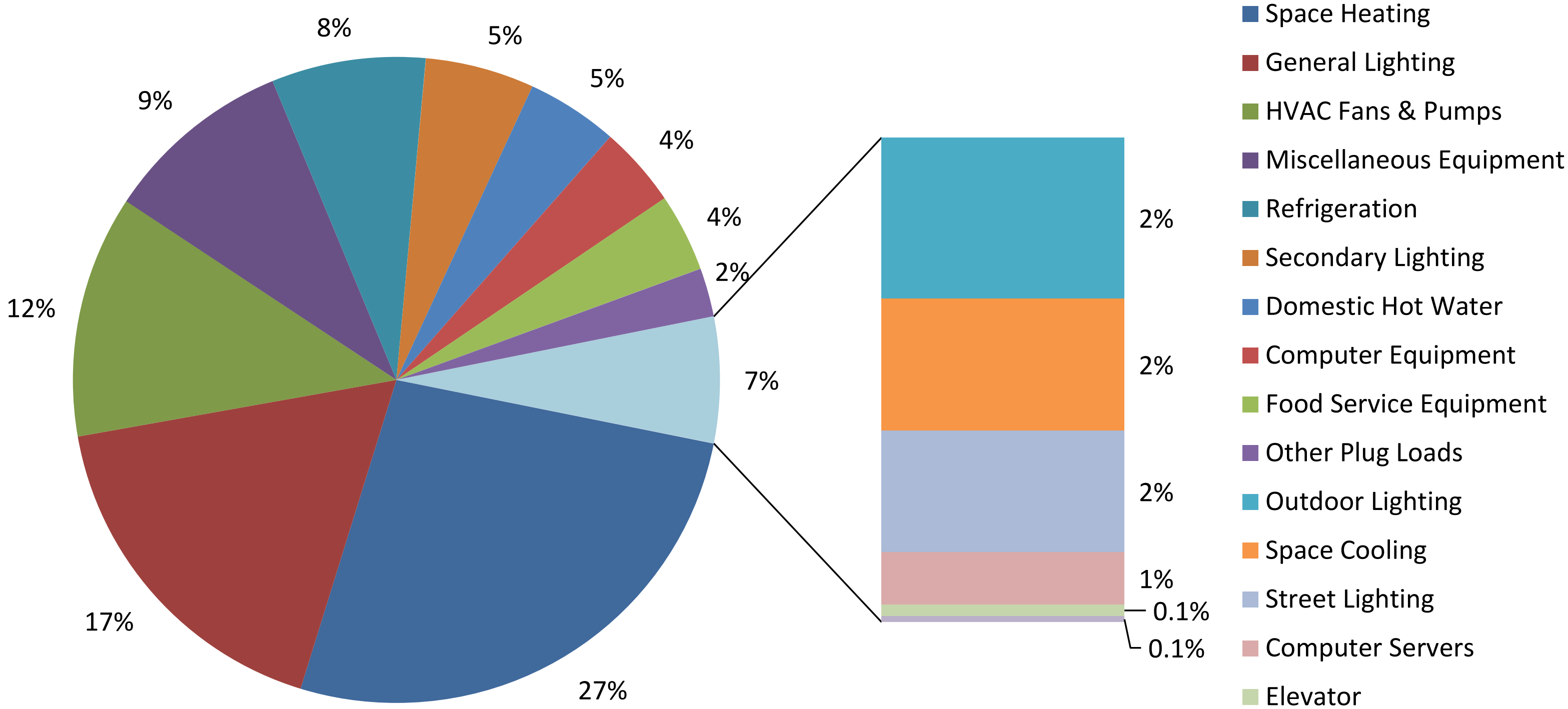
Totals may not add to 100% due to rounding.

Exhibit 10 Distribution of Electricity Consumption, by Region in the Base Year (2014)



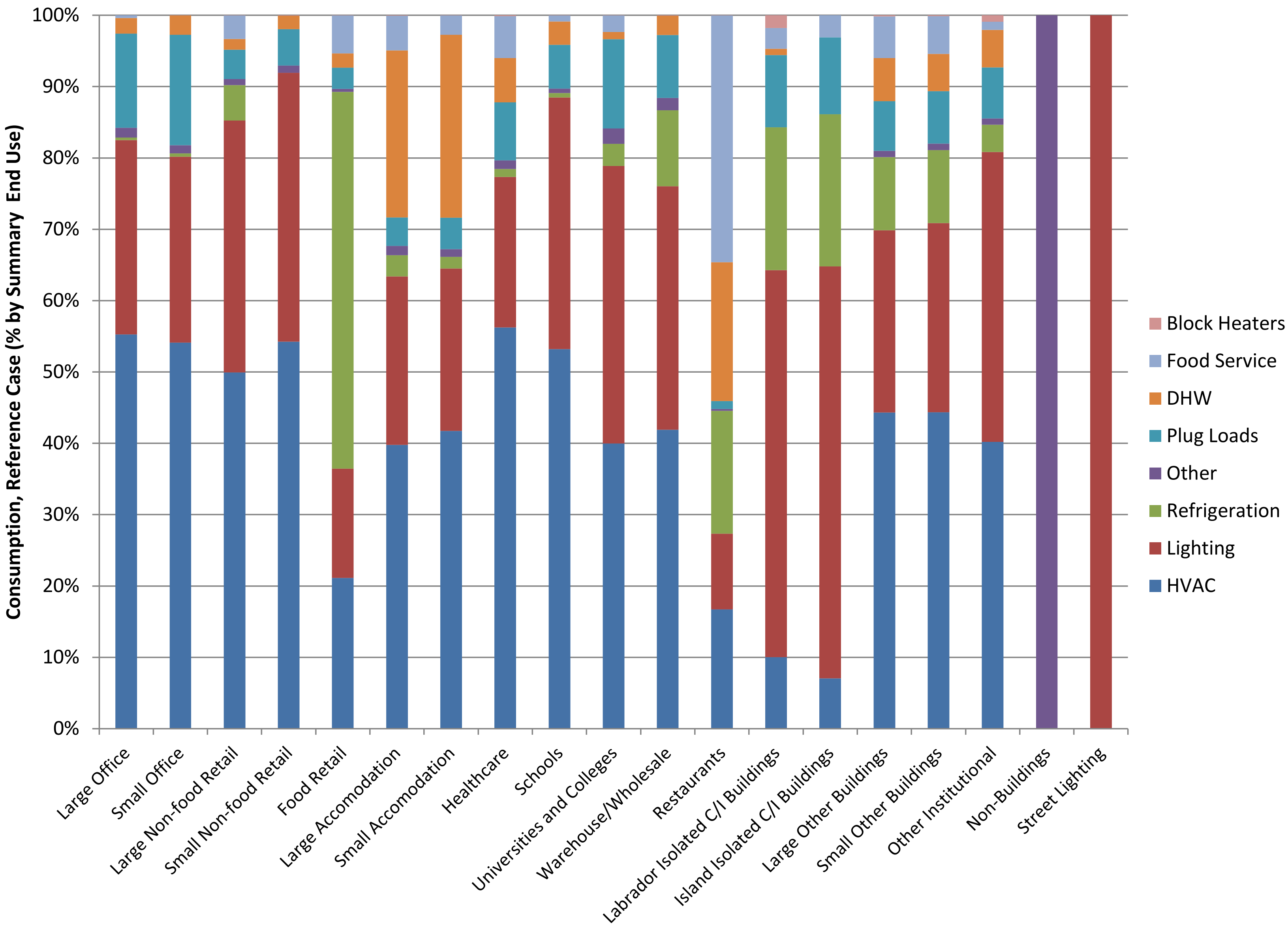
Totals may not add to 100% due to rounding.

Exhibit 11 Distribution of Electricity Consumption, by End Use in the Base Year (2014)

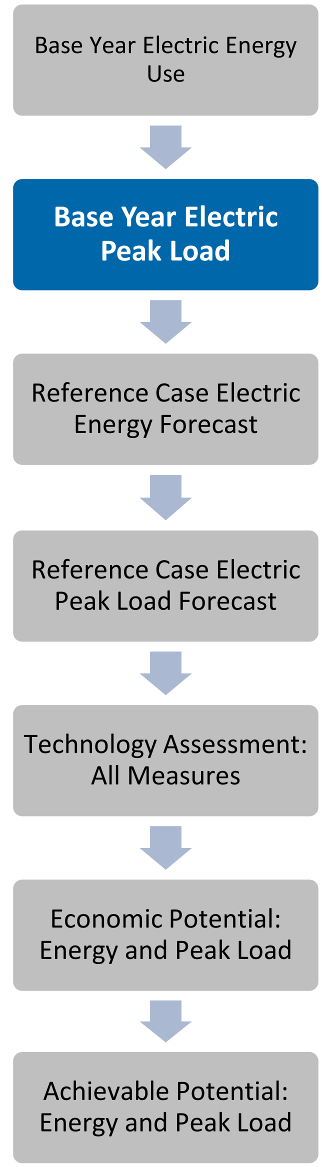


Totals may not add to 100% due to rounding.

Exhibit 12 Distribution of Electricity Consumption, by Sub Sector and End Use in the Base Year (2014)



4 Base Year (2014) Electric Peak Load



4.1 Introduction

This section provides a profile of the Base Year electric peak load for NL's Commercial sector. The discussion is organized into the following sub-sections:

- Peak period definitions
- Methodology
- Summary of results

Additional details are provided in Appendix B.

4.2 Peak Period Definitions

Based on discussions with utility personnel, the peak period of interest was the same as in the 2007-2008 study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[13]

The system capacity constraints are very dependent on cold weather. The NL utilities are do not currently experience capacity constraints in the summer. In future, there may be financial advantages to reducing system demand in summer in order to market more power to summer-peaking utilities in the U.S. That possibility was not explored in this study.

4.3 Methodology

The electric peak load profile converts the annual electric energy use (MWh) presented in Section 3 to hourly demand (MW). Development of the electric peak load estimates employs four specific factors, which are described below and shown graphically in **Error! Not a valid bookmark self-reference.**.

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. In decreasing order of priority, this allocation factor can be obtained from either:
  - Monthly consumption statistics from end-use load studies
  - Monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months, or
  - Heating or cooling degree days applied to an appropriate base.

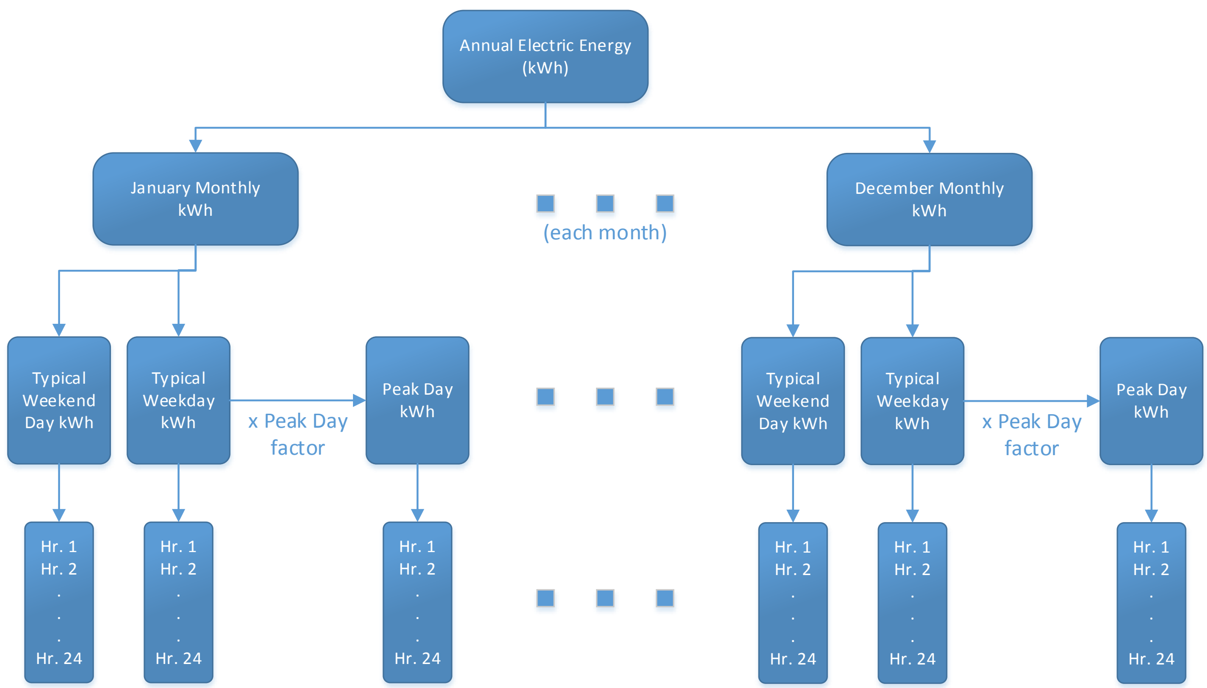
- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end

[13] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.

- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.
- **Per Unit Hourly Factor:** This factor reflects the operating hours of the commercial electric equipment or end uses among different hours of the day for each day type (weekday, weekend day, peak day) and for each month. For example, for lighting, this would be affected by time of day and season (affected by daylight).

Exhibit 13 Overview of Peak Load Profile Methodology



4.4 Summary of Results

The factors defined above provided the basis for converting the annual commercial electricity use presented in Section 3 to aggregate peak loads in the peak period.

Exhibit 14 presents the results for the Commercial sector Base Year. The results are presented for each of the three regions in NL, by sub sector type. In each case, the results show the contribution of Commercial sector demand that is coincident with the total demand in the peak period.

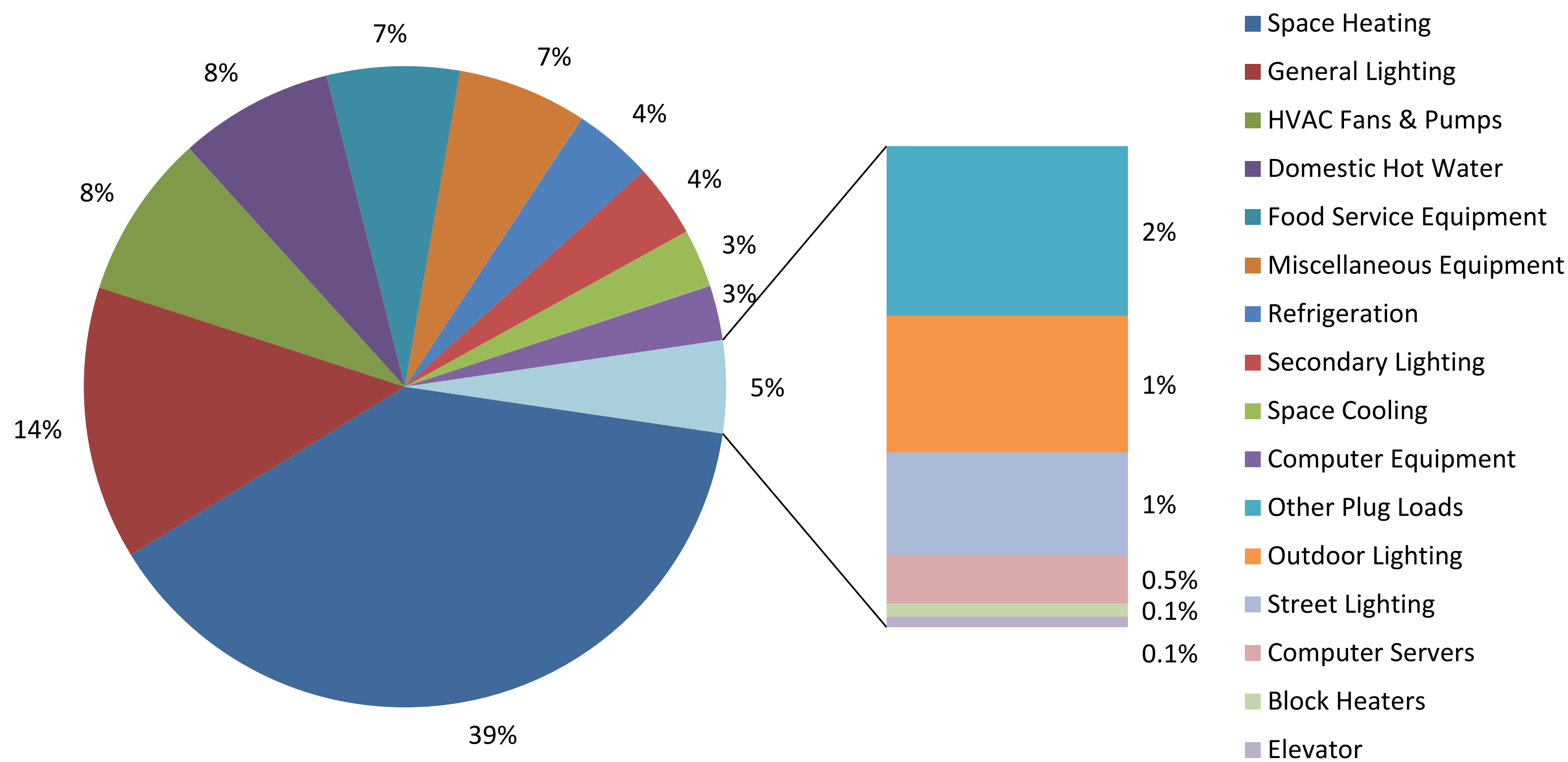
Exhibit 14 Commercial Sector Base Year (2014) Aggregate Peak Demand by Region (MW)

Sub-Sector Type	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Large Office	62	-	-	62
Small Office	45	1	-	46
Large Non-food Retail	27	2	-	29
Small Non-food Retail	33	4	-	36
Food Retail	29	3	-	32
Large Accomodation	16	2	-	18
Small Accomodation	7	0	-	8
Healthcare	33	3	-	36
Schools	43	3	-	46
Universities and Colleges	22	1	-	23
Warehouse/Wholesale	16	2	-	17
Restaurants	28	2	-	30
Labrador Isolated C/I Buildings	-	-	3	3
Island Isolated C/I Buildings	-	-	0	0
Large Other Buildings	35	15	-	49
Small Other Buildings	32	10	-	41
Other Institutional	-	9	-	9
Non-Buildings	30	1	-	31
Street Lighting	5	0	0	5
Grand Total	**463**	**56**	**3**	**522**

Exhibit 15 shows the contribution, by end use, to the commercial component of the peak demand. Some key observations may be made:

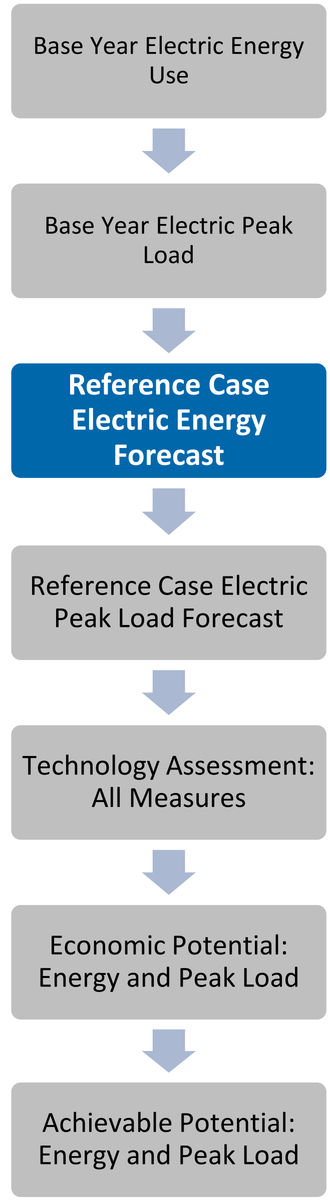
- Space heating is the largest commercial component of peak demand. As shown in the previous section, space heating is the largest end use in terms of annual electrical consumption. It also tends to be concentrated in the winter when the NL system peaks.
- General lighting is the second largest commercial component of peak demand. As shown in the previous section, lighting is a relatively large end use in terms of annual electrical consumption.
- HVAC Fans & Pumps are the third largest commercial contributor to peak demand. As shown in the previous section, HVAC Fans & Pumps are a relatively large end use in terms of annual electrical consumption.
- Domestic Hot Water is the fourth largest commercial contributor to peak demand. As shown in the previous section, domestic hot water is a relatively large end use in terms of electrical consumption.

Exhibit 15 Contribution by End Use to Commercial Aggregate Peak Demand (%)



Additional detail is provided in Appendix B.

5 Reference Case Electric Energy Forecast



5.1 Introduction

This section presents the Commercial sector Reference Case for the study period (2014 to 2029). The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new utility-based CDM initiatives. As such, the Reference Case provides the point of comparison for the calculation of electricity saving opportunities associated with each of the scenarios that are assessed within this study.

The Reference Case discussion is presented within the following sub-sections:

- Methodology
- New Commercial Buildings
- “Natural Changes” to Electricity Use Intensity
- Commercial Floor Space
- Summary of Model Results
- Selected Highlights

5.2 Methodology

Development of the Reference Case involved the following three steps:

Step 1: Detailed building archetypes were developed for “New” buildings in each of the Commercial sub sectors. For the purposes of this study, any facility built after the Base Year is considered to be a “New” building. Each profile defines building specifications, mechanical equipment, lighting equipment and other electricity-using equipment.

Step 2: Expected “natural” changes in electricity consumption patterns over the study period were estimated. Special consideration was given to three factors:

- Naturally-occurring improvements in equipment efficiency through time.
- Expected stock penetration by more efficient equipment as older, inefficient equipment reaches the end of its service life.
- Changes in equipment density (e.g., computers and plug loads) or loads (e.g., required ventilation rates).

Step 3: The growth in floor space within each building sub sector over the study period was estimated. The growth rates were derived from the load forecast data provided by the Utilities.

5.3 New Commercial Buildings

The first task in building the Reference Case involved the development of detailed technical profiles that define building specifications, mechanical equipment, lighting equipment and electricity use for the new buildings in each of the commercial building sub sectors. In each case, the new building profiles were developed using CEEAM and the same approach as described previously in Section 3.5. Detailed profiles for each building sub sector are provided in Appendix C. Exhibit 16 highlights the resulting whole building electric EUIs for each new commercial building sub sector. For the purposes of comparison, it also shows whole-building electric EUIs for each of the existing building sub sectors.

Other trends include:

- Higher efficiency building envelopes, including improved window U-values and higher levels of wall and roof insulation.
- Improved lighting system efficiency, including higher efficacy lighting sources and lower light levels where appropriate.
- Increased saturation of space cooling in some sub sectors.
- 100% penetration of electric space heating and domestic hot water heating in new construction.

Certain sub sectors were not modelled with CEEAM. The methodology for determining the end use EUIs for these sub sectors is described in more detail below:

- **Large Other Buildings:** These buildings are assumed to be a composite of the Large Office, Large Non-Food Retail, Food Retail, Large Accommodation, Healthcare, Schools, Universities and Colleges, Warehouse/Wholesale, and Restaurants sub sectors. Their EUIs for each end use are estimated by taking a weighted average of the end use EUIs of each of the aforementioned building types.
- **Small Other Buildings:** These buildings are assumed to be a composite of the Small Office, Small Non-Food Retail, Food Retail, Small Accommodation, Healthcare, Schools, Universities and Colleges, Warehouse/Wholesale, and Restaurants sub sectors. Their EUIs for each end use are estimated by taking a weighted average of the end use EUIs of each of the aforementioned building types.
- **Other Institutional:** The military base at Goose Bay is assumed to be a composite of the Small Office, Food Retail, Small Non-Food Retail, Small Accommodation, Healthcare, Warehouse/Wholesale, and Restaurant sub sectors.
- **Isolated C/I Buildings:** The end use EUIs for these sub sectors, Island and Labrador, are based on energy audit data for buildings in these regions. The buildings in the isolated regions are not further broken down into sub sectors because of a lack of detailed information about specific sub sectors and because building types do not differ as much in the isolated regions as they do in larger urban areas.

Exhibit 16 Comparison of Whole Building Electric EUIs by Sub Sector, (kWh/ft^2/yr.)

Sub Sector	Island Interconnected		Labrador Interconnected		Comments
	Existing Buildings	New Buildings	Existing Buildings	New Buildings	
Large Office	28.3	25.7	28.6	35.7	New Office buildings have higher efficiency lighting and envelope systems. This is offset by a higher space cooling saturation and electric space heating share.
Small Office	23.8	22.2	22.8	26.9	
Large Non-food Retail	31.9	24.1	29.4	29.5	New Non-food retail buildings have higher efficiency lighting and envelope systems. This is offset by a higher space cooling saturation and electric space heating share.
Small Non-food Retail	26.0	23.6	27.9	25.6	
Food Retail	59.0	53.2	72.2	53.2	New Food Retail buildings are typically equipped w ith higher efficiency lighting, HVAC and envelope systems. This is offset by higher a space cooling saturation and electric space heating share.
Large Accommodation	27.3	23.4	30.3	28.6	New Hotels and Motels have higher efficiency lighting and envelope systems. This is offset by a higher electric space heating share and higher space cooling saturations due primarily to increased instance of in-room heating/cooling units.
Small Accommodation	25.4	22.2	30.3	30.1	
Healthcare	51.4	35.0	29.6	31.0	New healthcare buildings have higher efficiency lighting and envelope systems, and higher space cooling saturation. This is offset somew hat by higher ventilation rates, particularly in larger buildings and a higher electric space heating share.
School	14.9	13.3	18.5	15.3	New Schools have higher efficiency lighting and envelope systems. This is offset by a higher electric space heating share.
Universities and Colleges	24.1	19.6	26.3	24.8	New Universities and Colleges have higher efficiency lighting and envelope systems. This is offset by a higher electric space heating share.
Warehouse / Wholesale	16.2	14.0	21.1	16.8	New Warehouse/Wholesale buildings have higher efficiency lighting and envelope systems. This is offset by a higher electric space heating share.
Restaurant	100.9	102.9	97.0	92.9	New Restaurants have higher efficiency lighting, and envelope systems. This is offset by a higher electric space heating share.
Large Other	24.0	23.4	28.8	26.9	Changes to this sub sector are a consequence of changes to its constituent building types (see below).
Small Other	22.7	22.7	28.0	26.3	Changes to this sub sector are a consequence of changes to its constituent building types (see below).
Other Institutional	N/A	N/A	15.5	14.6	No major changes to construction practices are anticipated.
Island Isolated C/I	7.4	7.1	N/A	N/A	Natural changes to equipment efficiency are expected to drive EUI reduction.
Labrador Isolated C/I	N/A	N/A	7.8	7.5	Natural changes to equipment efficiency are expected to drive EUI reduction.

5.4 "Natural Changes" to Electricity Use Intensity

The next task involved estimating changes in electricity consumption patterns that would occur within the existing building stock over the study period in the absence of any CDM programming or influence. This included consideration of three major factors:

- Naturally-occurring improvements in equipment efficiency
- Expected stock penetration by more efficient equipment
- Changes in the saturation/intensity of end-use services (e.g., cooling, plug loads etc.)

These factors strongly influence future electric energy use within the Commercial sector. While the first two factors will have the effect of reducing electricity consumption, the last factor will result in increased electricity demand. Other considerations, such as operating hours and fuel share, may also affect future electricity demand. However, the values assumed in existing and new stock were assumed to remain constant over the study period.

Based on the assessment of current trends, the most significant natural changes are expected to involve the following end uses:

- Reduced lighting EUIs in existing buildings due to efficiency improvements at the time of natural stock turnover

- A trend toward more efficient space cooling equipment in existing buildings

- Increased computer equipment and plug load EUIs due to higher equipment densities

Detailed assumptions regarding natural change are presented in Appendix C.

5.5 Commercial Floor Space

The final task in the construction of the Reference Case involved calibration with NLH and NLP's load forecasts through time. This was accomplished using the following steps:

- Estimate and apply the expected impact of natural changes (see Section 5.4 above) within the existing building stock for each sub sector (i.e., an adjusted EUI that includes the effects of natural conservation at each milestone year)

- Add new buildings to the stock in order to match forecasted consumption in each combination of sub sector and milestone year.

A summary of the resulting floor space estimates in the Island Interconnected, Labrador Interconnected, and Isolated grids by sub sector and milestone year are provided in the following exhibits.

Exhibit 17 Commercial Sector Floor Space (ft^2), by Sub Sector and Milestone Year – Island Interconnected

Sub Sector	2014	2017	2020	2023	2026	2029
Large Office	10,328,000	10,615,000	11,014,000	11,559,000	11,950,000	12,399,000
Small Office	8,407,000	8,588,000	9,043,000	9,439,000	9,722,000	10,047,000
Large Non-food Retail	3,817,000	3,930,000	4,169,000	4,377,000	4,532,000	4,708,000
Small Non-food Retail	5,531,000	5,606,000	5,841,000	6,082,000	6,266,000	6,474,000
Food Retail	2,823,000	2,864,000	2,990,000	3,111,000	3,198,000	3,297,000
Large Accomodation	2,442,000	2,490,000	2,620,000	2,742,000	2,831,000	2,933,000
Small Accomodation	1,162,000	1,174,000	1,221,000	1,271,000	1,308,000	1,349,000
Healthcare	4,034,000	4,059,000	4,176,000	4,303,000	4,397,000	4,502,000
Schools	13,600,000	13,817,000	14,448,000	15,083,000	15,562,000	16,102,000
Universities and Colleges	7,391,000	7,475,000	7,617,000	7,744,000	7,847,000	7,961,000
Warehouse/Wholesale	5,075,000	5,187,000	5,435,000	5,654,000	5,816,000	6,001,000
Restaurants	994,000	1,011,000	1,061,000	1,106,000	1,138,000	1,174,000
Large Other Buildings	6,373,000	6,492,000	6,778,000	7,040,000	7,232,000	7,451,000
Small Other Buildings	6,214,000	6,184,000	6,328,000	6,543,000	6,705,000	6,885,000
Grand Total	78,193,000	79,492,000	82,741,000	86,053,000	88,504,000	91,284,000

Note: Any differences in totals are due to rounding.

Exhibit 18 Commercial Sector Floor Space (ft^2), by Sub Sector and Milestone Year – Labrador Interconnected

Sub Sector	2014	2017	2020	2023	2026	2029
Large Office	-	-	-	-	-	-
Small Office	168,000	168,000	172,000	176,000	180,000	184,000
Large Non-food Retail	273,000	275,000	277,000	279,000	281,000	283,000
Small Non-food Retail	525,000	528,000	545,000	560,000	575,000	590,000
Food Retail	159,000	159,000	160,000	161,000	162,000	163,000
Large Accomodation	234,000	235,000	236,000	237,000	238,000	239,000
Small Accomodation	31,000	31,000	32,000	33,000	33,000	34,000
Healthcare	573,000	442,000	444,000	446,000	449,000	451,000
Schools	741,000	744,000	752,000	760,000	768,000	776,000
Universities and Colleges	118,000	118,000	119,000	119,000	120,000	120,000
Warehouse/Wholesale	370,000	371,000	377,000	382,000	388,000	393,000
Restaurants	89,000	90,000	91,000	92,000	93,000	94,000
Large Other Buildings	2,228,000	2,236,000	2,245,000	2,254,000	2,263,000	2,271,000
Small Other Buildings	1,500,000	1,503,000	1,547,000	1,585,000	1,622,000	1,658,000
Other Institutional	2,960,000	2,983,000	3,005,000	3,028,000	3,051,000	3,075,000
Grand Total	9,969,000	9,882,000	10,003,000	10,113,000	10,222,000	10,331,000

Note: Any differences in totals are due to rounding.

Exhibit 19 Commercial Sector Floor Space (ft^2), by Sub Sector and Milestone Year – Isolated

Sub Sector	2014	2017	2020	2023	2026	2029
Labrador Isolated C/I Buildings	2,179,000	2,153,000	2,506,000	2,620,000	2,727,000	2,836,000
Island Isolated C/I Buildings	205,000	201,000	240,000	251,000	262,000	273,000
Grand Total	2,383,000	2,354,000	2,746,000	2,870,000	2,989,000	3,109,000

Note: Any differences in totals are due to rounding.

5.6 Summary of Results

This section presents the results of the model runs for the entire study period. The results are measured at the customer's point-of-use and do not include line losses. They are presented in four exhibits:

- Exhibit 20 presents the model results in tabular form, by sub sector type, end use and milestone year
- Exhibit 21 presents the model results for 2029 by subsector type
- Exhibit 22 presents the model results for 2029 by by region

Exhibit 23 presents the model results for 2029 by end use

- Exhibit 24 shows the evolving relative contribution of different summary end uses towards the total consumption in different sub sector types.

As illustrated, the combined Reference Case for all regions indicates that, in the absence of new utility-based CDM initiatives, total Commercial sector electricity consumption is expected to increase from approximately 2.36 million MWh/yr. in the Base Year to approximately 2.70 million MWh/yr. in 2029. This is an increase of approximately 14.1% over the study period.

Selected highlights are provided below.

By Sub Sector

Large and small office buildings contribute the largest portion of electricity consumption increases to the overall growth rate, about 25% of total load growth. The retail sector, including food retail and large and small non-food retail, also accounts for a significant portion of load growth (18%).

By Region

The division of electricity consumption by region is expected to remain stable over the study period, with the Island Interconnected region continuing to account for 88% of commercial electricity consumption, the Labrador Interconnected region accounting for 11%, and accounts connected to isolated diesel grids consuming the remaining 1%.

By End Use

Overall, electricity use grows a total of about 14% over the study period. This growth is driven in large part by increases in space heating electricity consumption, which grows by 21% between 2014 and 2029, due to a large number of new electrically heated buildings being introduced in to the building stock. A knock-on effect of the move toward electric space heating in new buildings is that electricity consumption for water heating also increases dramatically (17% growth), as electrically heated buildings rarely invest in fossil fuel infrastructure for water heating only.

Three additional end uses also experience significant growth from 2014 to 2029: space cooling (19%), HVAC fans and pumps (17%), and computer equipment (26%), servers (27%), and plug loads (24%).

Between 2014 and 2029 space cooling (19%) and HVAC fans and pumps (17%) increase as a consequence of a trend towards higher space cooling saturations. Computer equipment (26%), servers (27%), and plug loads (24%) increase between 2014 and 2029, reflecting increased densities of computer equipment and plug loads which offset efficiency gains in equipment over the period.

End uses which grow at a significantly slower rate than average include general lighting (4%) and secondary lighting, which decreases by 1.2%. Lighting end uses show a slight decline in importance as more efficient new buildings are introduced into the building stock through time, and as a result of naturally occurring lighting retrofits in existing buildings.

In terms of absolute contribution, space heating accounts for the largest portion of overall load growth (133,000 MWh or about 40% of total load growth). This is followed by HVAC fans & pumps (15%), miscellaneous equipment (9%), refrigeration (8%) and computer equipment (8%).

By Sub sector and End Use

The last exhibit in this section shows the trends in consumption by sub sector and end-use groupings. The following key observations can be made:

- Consumption in the HVAC end uses is expected to modestly increase in most commercial sub sectors between now and 2029
- Lighting is expected to account for a slightly diminishing share of commercial electricity consumption between now and 2029, even without new CDM intervention, largely as a result of naturally occurring lighting retrofits in existing buildings.
- The exhibit also permits comparisons of end-use consumption proportions from one sub sector type to another. These patterns are expected to remain relatively consistent through the study period.

Exhibit 20 Reference Case Electricity Consumption, Modelled by End Use, Sub sector and Milestone Year (MWh/yr.)

Sub-Sector	Year	Space Heating	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Refrigeration	Secondary Lighting	Domestic Hot Water	Computer Equipment	Food Service Equipment	Other Plug Loads	Outdoor Lighting	Space Cooling	Street Lighting	Computer Servers	Elevator	Block Heaters	Grand Total
Large Office	2014	94,614	53,893	46,186	2,666	1,067	15,973	5,999	24,326	1,067	7,386	4,524	10,209	0	4,319	1,033	0	273,262
	2017	96,854	54,127	47,938	2,740	1,096	15,870	6,179	25,489	1,096	7,739	4,469	10,463	0	4,526	1,062	0	279,648
	2020	99,960	54,868	50,370	2,843	1,137	15,850	6,427	26,914	1,137	8,172	4,462	10,855	0	4,779	1,101	0	288,877
	2023	104,216	56,281	53,700	2,984	1,194	15,942	6,768	28,686	1,194	8,710	4,520	11,430	0	5,093	1,156	0	301,873
	2026	107,265	56,989	56,085	3,085	1,234	15,916	7,013	30,093	1,234	9,137	4,510	11,813	0	5,343	1,195	0	310,912
	2029	110,768	57,962	58,826	3,201	1,280	15,935	7,293	31,637	1,280	9,606	4,526	12,268	0	5,617	1,240	0	321,441
Small Office	2014	76,520	40,527	20,053	2,192	868	6,020	5,263	20,197	0	6,132	3,756	7,928	0	3,586	0	22	193,065
	2017	77,805	40,464	20,877	2,239	868	5,953	5,376	21,027	0	6,384	3,685	8,062	0	3,733	0	22	196,495
	2020	81,110	41,554	22,953	2,357	868	5,967	5,663	22,513	0	6,836	3,736	8,520	0	3,997	0	22	206,097
	2023	83,988	42,399	24,762	2,460	868	5,964	5,913	23,860	0	7,244	3,761	8,910	0	4,236	0	23	214,387
	2026	86,061	42,775	26,056	2,533	868	5,927	6,092	24,940	0	7,572	3,736	9,166	0	4,428	0	23	220,180
	2029	88,432	43,325	27,540	2,618	868	5,903	6,298	26,118	0	7,930	3,730	9,472	0	4,637	0	24	226,895
Large Non-food Retail	2014	30,090	36,209	28,344	1,021	6,135	3,845	1,819	2,021	4,090	2,632	3,583	3,224	0	467	0	35	123,515
	2017	30,629	36,278	29,006	1,050	6,308	3,823	1,875	2,118	4,205	2,758	3,540	3,293	0	489	0	36	125,409
	2020	31,748	37,212	30,389	1,112	6,669	3,862	1,993	2,278	4,446	2,966	3,608	3,472	0	526	0	36	130,316
	2023	32,725	37,934	31,596	1,166	6,983	3,886	2,096	2,422	4,656	3,153	3,648	3,624	0	559	0	36	134,485
	2026	33,458	38,292	32,499	1,206	7,219	3,884	2,173	2,540	4,813	3,307	3,642	3,730	0	586	0	36	137,386
	2029	34,291	38,800	33,526	1,252	7,487	3,893	2,261	2,668	4,991	3,474	3,656	3,854	0	616	0	37	140,806
Small Non-food Retail	2014	45,979	45,510	29,767	1,496	0	5,322	2,835	2,993	0	3,896	5,305	4,984	0	691	0	68	148,847
	2017	46,550	45,134	30,163	1,515	0	5,252	2,873	3,091	0	4,025	5,161	5,012	0	713	0	68	149,557
	2020	48,422	45,949	31,431	1,578	0	5,262	2,997	3,275	0	4,265	5,170	5,208	0	756	0	70	154,382
	2023	50,318	46,793	32,723	1,642	0	5,274	3,122	3,461	0	4,507	5,182	5,409	0	799	0	72	159,301
	2026	51,805	47,249	33,725	1,692	0	5,259	3,220	3,620	0	4,713	5,144	5,553	0	836	0	74	162,891
	2029	53,457	47,862	34,845	1,747	0	5,255	3,329	3,790	0	4,934	5,127	5,720	0	875	0	76	167,017
Food Retail	2014	23,490	20,697	11,522	749	91,544	3,236	3,484	2,323	9,237	2,502	2,612	1,610	0	327	0	21	173,352
	2017	23,684	20,545	11,683	760	92,742	3,205	3,538	2,401	9,364	2,587	2,561	1,619	0	338	0	21	175,048
	2020	24,284	20,942	12,182	793	96,442	3,244	3,702	2,544	9,759	2,744	2,622	1,683	0	359	0	21	181,322
	2023	24,858	21,302	12,659	824	99,978	3,279	3,859	2,684	10,137	2,896	2,676	1,743	0	380	0	21	187,295
	2026	25,273	21,447	13,003	847	102,532	3,286	3,973	2,798	10,410	3,020	2,686	1,781	0	396	0	21	191,473
	2029	25,745	21,671	13,396	872	105,442	3,304	4,103	2,921	10,720	3,154	2,712	1,828	0	414	0	21	196,304
Large Accomodation	2014	20,548	7,426	5,946	661	2,073	7,856	16,327	1,194	3,392	1,321	1,172	1,210	0	254	244	30	69,655
	2017	20,894	7,362	6,051	673	2,092	7,807	16,653	1,238	3,423	1,371	1,147	1,226	0	264	249	30	70,481
	2020	21,816	7,440	6,330	707	2,143	7,938	17,530	1,316	3,506	1,462	1,157	1,291	0	282	262	30	73,210
	2023	22,685	7,505	6,593	738	2,190	8,053	18,355	1,391	3,585	1,549	1,164	1,350	0	298	274	31	75,762
	2026	23,322	7,512	6,786	762	2,225	8,095	18,959	1,452	3,642	1,620	1,157	1,391	0	312	283	31	77,550
	2029	24,046	7,542	7,006	788	2,265	8,165	19,647	1,519	3,708	1,697	1,155	1,439	0	327	293	31	79,627
Small Accomodation	2014	9,922	3,788	1,435	304	462	2,102	7,230	537	770	589	523	411	0	113	0	4	28,191
	2017	10,008	3,730	1,450	307	466	2,076	7,305	553	777	606	507	413	0	117	0	4	28,319
	2020	10,385	3,728	1,514	319	485	2,107	7,630	584	809	642	507	437	0	124	0	4	29,276
	2023	10,777	3,731	1,581	332	505	2,141	7,971	615	841	679	508	462	0	131	0	4	30,280
	2026	11,069	3,713	1,631	342	519	2,156	8,222	642	866	709	504	480	0	137	0	4	30,992
	2029	11,397	3,702	1,687	353	536	2,177	8,506	670	893	742	501	500	0	143	0	4	31,812

Exhibit 20 Reference Case Electricity Consumption, Modelled by End Use, Sub sector and Milestone Year (MWh/yr.) (cont'd…)

Sub-Sector	Year	Space Heating	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Refrigeration	Secondary Lighting	Domestic Hot Water	Computer Equipment	Food Service Equipment	Other Plug Loads	Outdoor Lighting	Space Cooling	Street Lighting	Computer Servers	Elevator	Block Heaters	Grand Total
Healthcare	2014	57,863	5,258	30,746	1,116	1,784	24,911	10,048	4,163	9,516	8,004	4,036	2,446	0	963	864	222	161,941
	2017	57,443	5,038	30,085	1,105	1,743	23,821	9,690	4,148	9,296	7,975	3,787	2,414	0	960	856	171	158,532
	2020	58,774	5,092	30,958	1,135	1,789	23,841	10,089	4,336	9,542	8,337	3,737	2,472	0	1,003	880	171	162,156
	2023	60,227	5,160	31,908	1,169	1,839	23,905	10,524	4,534	9,809	8,717	3,697	2,537	0	1,049	905	172	166,153
	2026	61,299	5,184	32,612	1,193	1,876	23,828	10,846	4,702	10,007	9,039	3,626	2,579	0	1,088	924	172	168,975
	2029	62,507	5,224	33,404	1,221	1,918	23,801	11,208	4,880	10,230	9,382	3,566	2,629	0	1,129	946	172	172,217
Schools	2014	83,105	45,131	9,356	1,082	1,074	10,063	5,700	7,777	1,481	1,567	6,281	279	0	1,363	0	29	174,289
	2017	84,471	44,837	9,534	1,099	1,091	9,983	5,808	8,052	1,504	1,623	6,126	300	0	1,411	0	29	175,868
	2020	88,451	45,707	10,053	1,148	1,141	10,136	6,122	8,555	1,570	1,724	6,155	365	0	1,499	0	29	182,656
	2023	92,446	46,585	10,575	1,198	1,191	10,290	6,437	9,059	1,636	1,826	6,186	430	0	1,588	0	29	189,475
	2026	95,470	47,029	10,970	1,235	1,228	10,358	6,676	9,478	1,686	1,910	6,148	479	0	1,661	0	30	194,358
	2029	98,878	47,644	11,415	1,277	1,271	10,460	6,945	9,931	1,743	2,001	6,136	535	0	1,740	0	30	200,006
Universities and Colleges	2014	12,738	40,181	35,767	1,923	3,877	5,076	1,269	10,028	2,908	4,881	3,289	1,341	0	714	739	15	124,745
	2017	13,160	39,760	36,075	1,945	3,921	5,017	1,323	10,341	2,940	5,033	3,194	1,419	0	736	748	15	125,627
	2020	13,867	39,599	36,592	1,982	3,994	4,987	1,415	10,731	2,995	5,223	3,125	1,557	0	764	762	15	127,609
	2023	14,504	39,375	37,058	2,015	4,060	4,950	1,497	11,102	3,045	5,404	3,049	1,681	0	790	774	15	129,321
	2026	15,022	39,042	37,437	2,041	4,114	4,901	1,564	11,442	3,085	5,569	2,963	1,779	0	814	785	15	130,574
	2029	15,589	38,754	37,852	2,071	4,172	4,857	1,638	11,794	3,129	5,741	2,882	1,887	0	839	796	16	132,017
Warehouse/Wholesale	2014	28,325	20,567	4,753	1,358	8,433	4,089	2,136	1,869	0	4,518	2,385	114	0	621	0	48	79,216
	2017	28,899	20,571	4,825	1,387	8,608	4,028	2,195	1,945	0	4,703	2,339	118	0	646	0	48	80,312
	2020	30,202	21,092	4,988	1,452	9,003	3,992	2,326	2,070	0	5,004	2,355	128	0	688	0	49	83,349
	2023	31,347	21,500	5,131	1,509	9,349	3,951	2,442	2,184	0	5,280	2,358	137	0	726	0	49	85,963
	2026	32,210	21,703	5,239	1,551	9,609	3,899	2,528	2,279	0	5,510	2,336	144	0	757	0	50	87,817
	2029	33,185	21,988	5,361	1,600	9,903	3,852	2,626	2,382	0	5,758	2,323	152	0	791	0	51	89,972
Restaurants	2014	13,061	2,564	3,573	268	18,173	8,146	20,519	447	36,502	598	474	1,007	0	124	0	12	105,467
	2017	13,396	2,552	3,624	273	18,467	8,065	20,868	463	37,092	620	463	1,016	0	128	0	12	107,038
	2020	14,360	2,617	3,769	286	19,321	8,140	21,878	493	38,804	660	466	1,061	0	136	0	12	112,003
	2023	15,233	2,671	3,900	297	20,093	8,192	22,793	521	40,355	697	468	1,101	0	144	0	12	116,476
	2026	15,856	2,694	3,994	306	20,646	8,183	23,447	544	41,465	727	463	1,126	0	150	0	12	119,614
	2029	16,569	2,729	4,101	315	21,278	8,196	24,195	568	42,733	760	461	1,157	0	157	0	12	123,231
Labrador Isolated C/I Buildings	2014	580	6,909	1,132	0	3,416	1,608	149	1,051	496	677	739	0	0	0	0	305	17,062
	2017	573	6,689	1,118	0	3,375	1,557	148	1,059	490	682	701	0	0	0	0	301	16,693
	2020	650	7,498	1,409	0	3,931	1,724	172	1,258	573	810	813	0	0	0	0	351	19,187
	2023	674	7,663	1,501	0	4,109	1,756	180	1,335	599	860	830	0	0	0	0	367	19,874
	2026	698	7,815	1,590	0	4,279	1,785	187	1,410	624	908	844	0	0	0	0	382	20,521
	2029	721	7,968	1,679	0	4,449	1,814	194	1,486	650	956	858	0	0	0	0	397	21,173
Island Isolated C/I Buildings	2014	0	649	106	0	321	151	0	99	47	64	69	0	0	0	0	0	1,505
	2017	0	626	105	0	316	146	0	99	46	64	66	0	0	0	0	0	1,466
	2020	0	716	136	0	377	164	0	120	55	78	78	0	0	0	0	0	1,725
	2023	0	732	145	0	393	168	0	128	57	82	80	0	0	0	0	0	1,786
	2026	0	748	154	0	411	171	0	135	60	87	82	0	0	0	0	0	1,847
	2029	0	765	163	0	428	174	0	143	62	92	83	0	0	0	0	0	1,910

Exhibit 20 Reference Case Electricity Consumption, Modelled by End Use, Sub sector and Milestone Year (MWh/yr.) (cont'd…)

Sub-Sector	Year	Space Heating	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Refrigeration	Secondary Lighting	Domestic Hot Water	Computer Equipment	Food Service Equipment	Other Plug Loads	Outdoor Lighting	Space Cooling	Street Lighting	Computer Servers	Elevator	Block Heaters	Grand Total
Large Other Buildings	2014	65,447	36,027	27,825	1,564	22,200	14,680	13,133	8,017	12,662	5,660	4,741	2,936	0	1,388	406	358	217,045
	2017	66,313	35,786	28,269	1,590	22,506	14,521	13,332	8,306	12,823	5,854	4,623	2,986	0	1,437	413	359	219,118
	2020	68,311	36,189	29,295	1,651	23,216	14,534	13,783	8,769	13,190	6,152	4,598	3,146	0	1,516	429	360	225,139
	2023	70,141	36,495	30,234	1,707	23,865	14,520	14,196	9,206	13,525	6,435	4,560	3,290	0	1,591	444	361	230,570
	2026	71,504	36,537	30,933	1,748	24,348	14,437	14,505	9,572	13,777	6,675	4,482	3,389	0	1,653	455	362	234,377
	2029	73,045	36,680	31,724	1,795	24,895	14,380	14,855	9,964	14,061	6,931	4,420	3,504	0	1,720	467	363	238,804
Small Other Buildings	2014	56,786	33,165	21,646	1,450	18,691	10,949	9,525	7,223	9,684	5,022	4,365	2,711	0	1,240	227	238	182,923
	2017	56,611	32,383	21,570	1,444	18,624	10,696	9,497	7,339	9,654	5,106	4,176	2,673	0	1,260	226	238	181,497
	2020	57,970	32,437	22,175	1,479	19,060	10,671	9,774	7,656	9,895	5,329	4,114	2,754	0	1,315	232	242	185,103
	2023	59,756	32,744	22,979	1,527	19,645	10,698	10,135	8,039	10,204	5,592	4,089	2,879	0	1,381	239	246	190,153
	2026	61,179	32,844	23,617	1,565	20,107	10,679	10,424	8,369	10,453	5,821	4,033	2,969	0	1,438	245	250	193,994
	2029	62,724	33,015	24,311	1,606	20,611	10,675	10,738	8,717	10,722	6,062	3,987	3,071	0	1,498	251	254	198,243
Other Institutional	2014	10,017	12,713	8,247	412	1,763	4,559	2,407	1,212	537	2,075	1,406	219	0	0	0	412	45,979
	2017	33,698	12,550	8,319	415	1,775	4,494	2,423	1,246	542	2,133	1,362	218	0	0	0	415	69,591
	2020	50,460	12,387	8,392	418	1,788	4,428	2,438	1,280	547	2,191	1,318	218	0	0	0	418	86,285
	2023	50,522	12,225	8,466	421	1,801	4,362	2,454	1,314	552	2,250	1,274	218	0	0	0	421	86,281
	2026	50,585	12,063	8,540	425	1,814	4,297	2,470	1,348	558	2,308	1,231	217	0	0	0	425	86,280
	2029	50,648	11,902	8,615	428	1,827	4,232	2,486	1,382	563	2,366	1,187	217	0	0	0	428	86,282
Non-Buildings	2014	0	0	0	204,856	0	0	0	0	0	0	0	0	0	0	0	0	204,856
	2017	0	0	0	207,490	0	0	0	0	0	0	0	0	0	0	0	0	207,490
	2020	0	0	0	214,805	0	0	0	0	0	0	0	0	0	0	0	0	214,805
	2023	0	0	0	221,041	0	0	0	0	0	0	0	0	0	0	0	0	221,041
	2026	0	0	0	225,350	0	0	0	0	0	0	0	0	0	0	0	0	225,350
	2029	0	0	0	230,330	0	0	0	0	0	0	0	0	0	0	0	0	230,330
Street Lighting	2014	0	0	0	0	0	0	0	0	0	0	0	0	37,127	0	0	0	37,127
	2017	0	0	0	0	0	0	0	0	0	0	0	0	36,851	0	0	0	36,851
	2020	0	0	0	0	0	0	0	0	0	0	0	0	36,931	0	0	0	36,931
	2023	0	0	0	0	0	0	0	0	0	0	0	0	36,999	0	0	0	36,999
	2026	0	0	0	0	0	0	0	0	0	0	0	0	37,043	0	0	0	37,043
	2029	0	0	0	0	0	0	0	0	0	0	0	0	37,086	0	0	0	37,086
Grand Total	2014	629,085	411,214	286,405	223,118	181,881	128,587	107,844	95,476	92,387	57,527	49,260	40,630	37,127	16,170	3,514	1,817	2,362,042
	2017	660,988	408,432	290,691	226,032	183,999	126,314	109,081	98,914	93,254	59,263	47,906	41,233	36,851	16,760	3,553	1,768	2,405,038
	2020	700,771	415,029	302,937	234,065	191,362	126,848	113,939	104,692	96,828	62,594	48,023	43,168	36,931	17,744	3,665	1,831	2,500,428
	2023	724,416	421,095	315,512	241,030	198,063	127,332	118,743	110,542	100,196	65,882	48,049	45,201	36,999	18,765	3,793	1,860	2,577,476
	2026	742,075	423,639	324,872	245,880	203,029	127,062	122,301	115,362	102,679	68,634	47,587	46,596	37,043	19,600	3,887	1,887	2,632,135
	2029	762,002	427,532	335,451	251,473	208,630	127,074	126,322	120,570	105,485	71,588	47,311	48,233	37,086	20,505	3,994	1,915	2,695,172

Exhibit 21 Distribution of Electricity Consumption in 2029 by Sub Sector

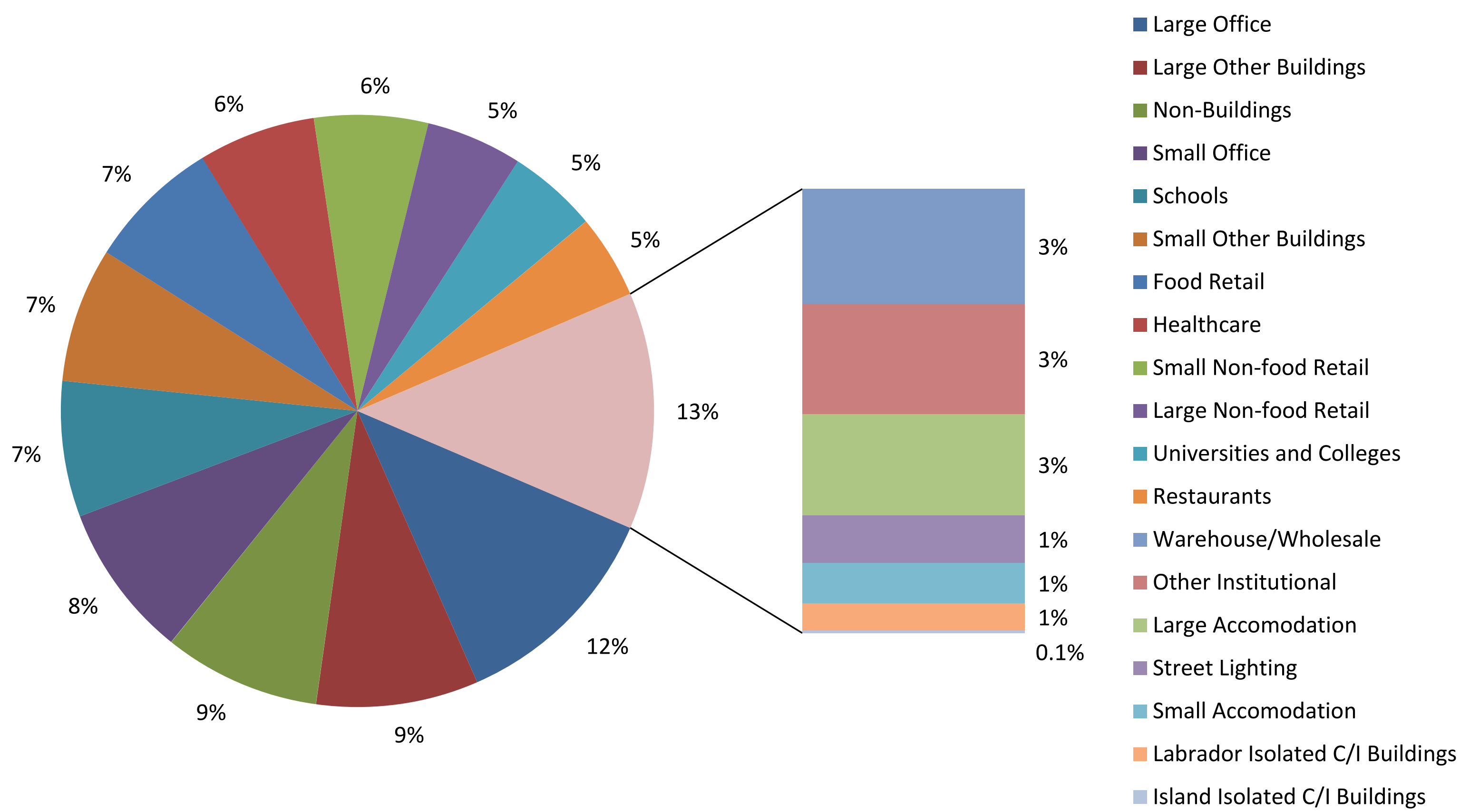


Exhibit 22 Distribution of Electricity Consumption in 2029 by Region

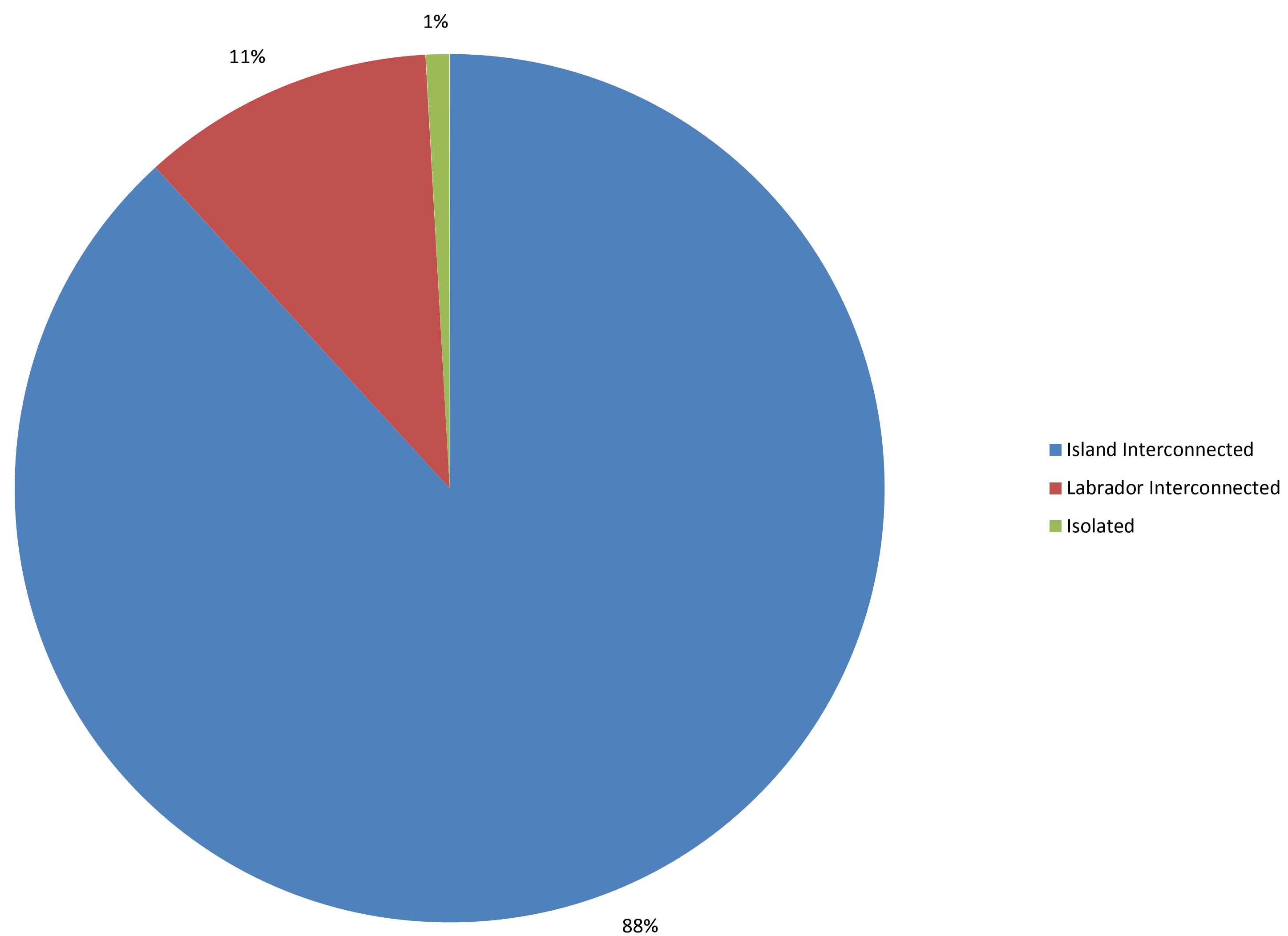


Exhibit 23 Distribution of Electricity Consumption in 2029 by End Use

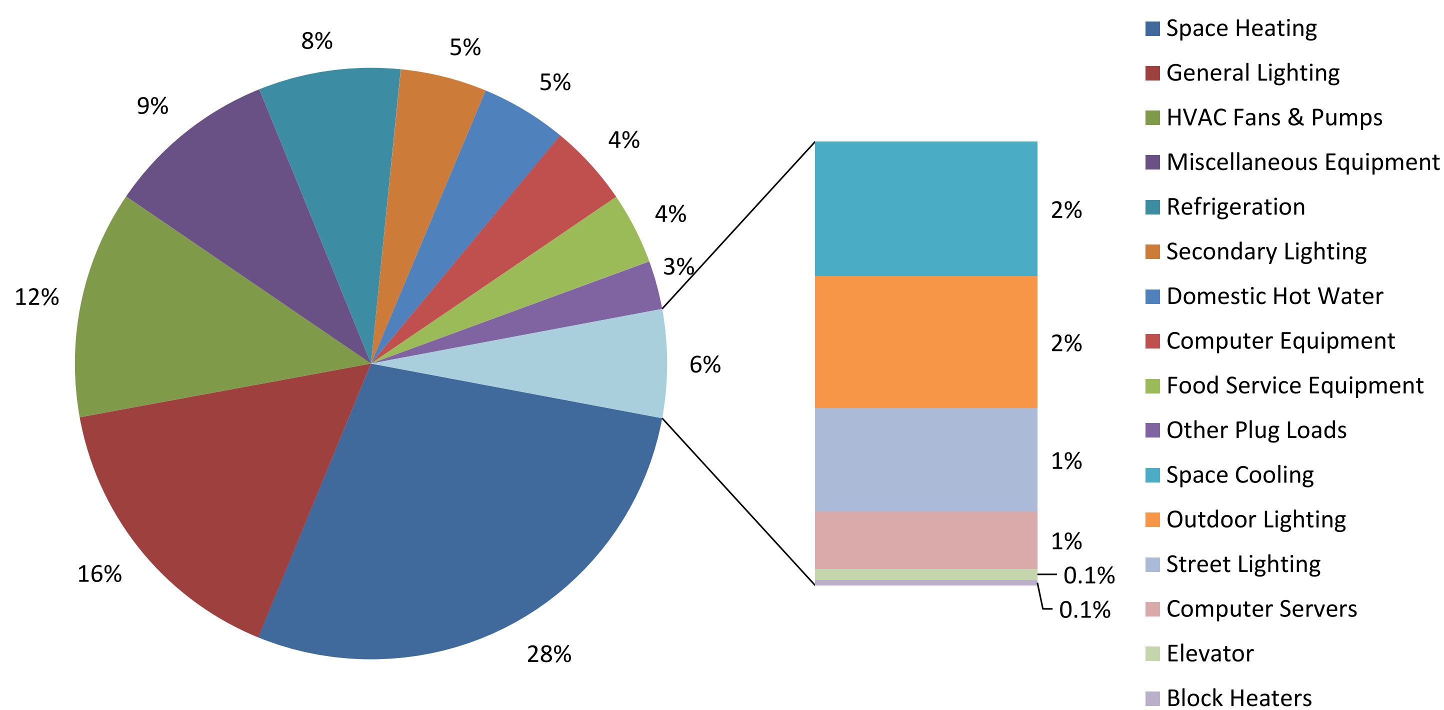


Exhibit 24 Distribution of Electricity Consumption, by Sub sector and End Use, Trends to 2029

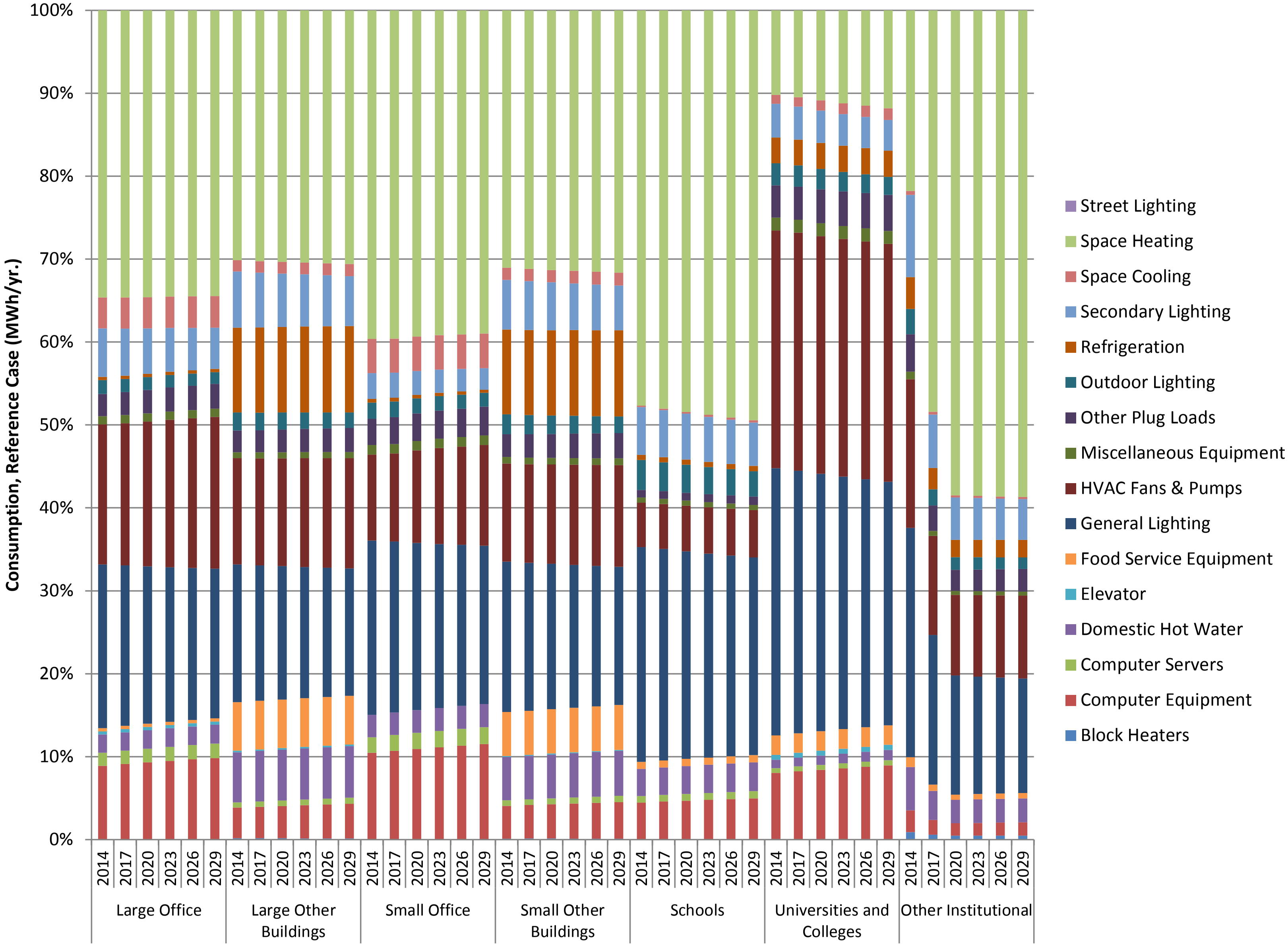


Exhibit 24 Distribution of Electricity Consumption, by Sub sector and End Use, Trends to 2029 (cont'd…)

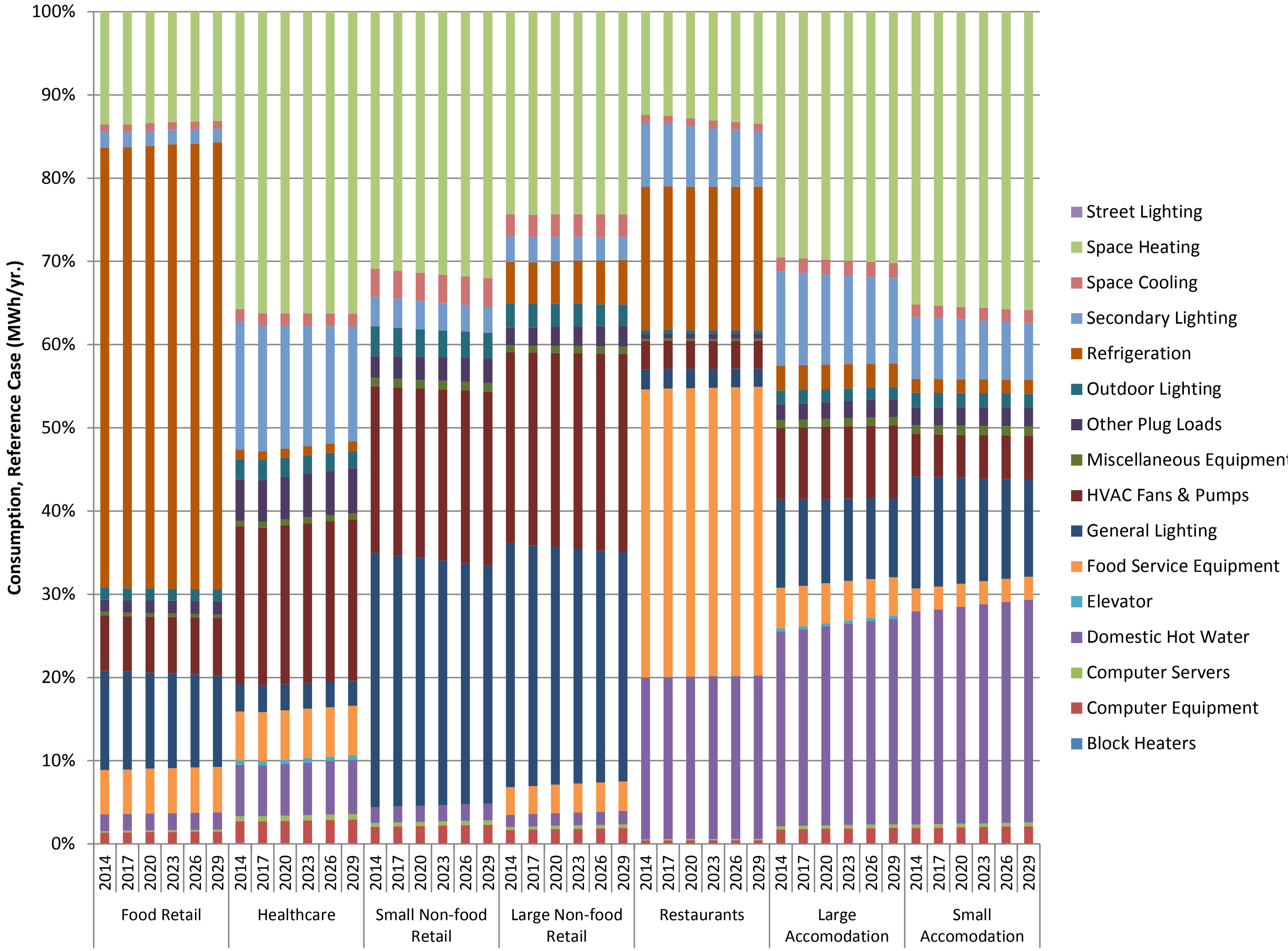
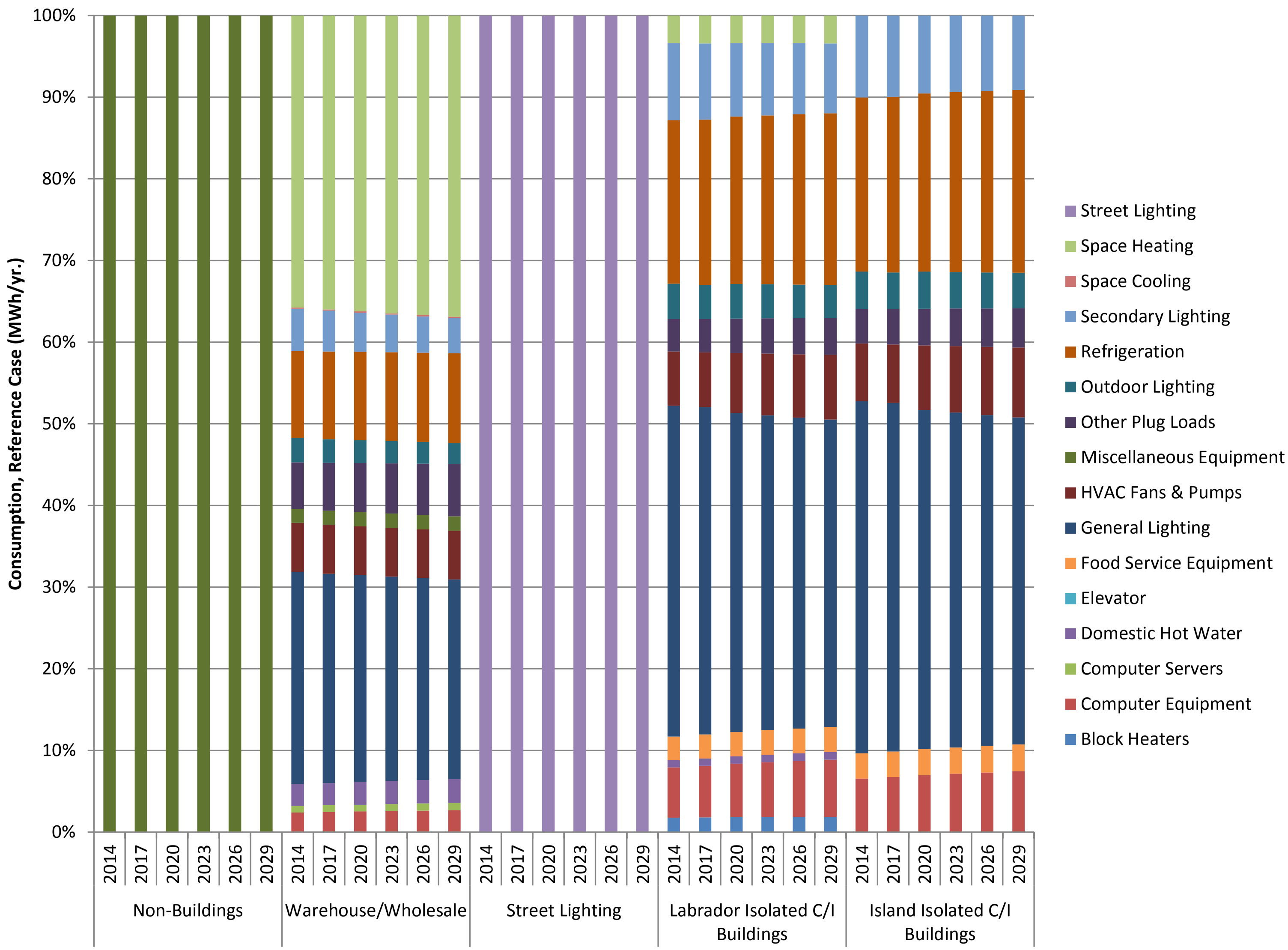
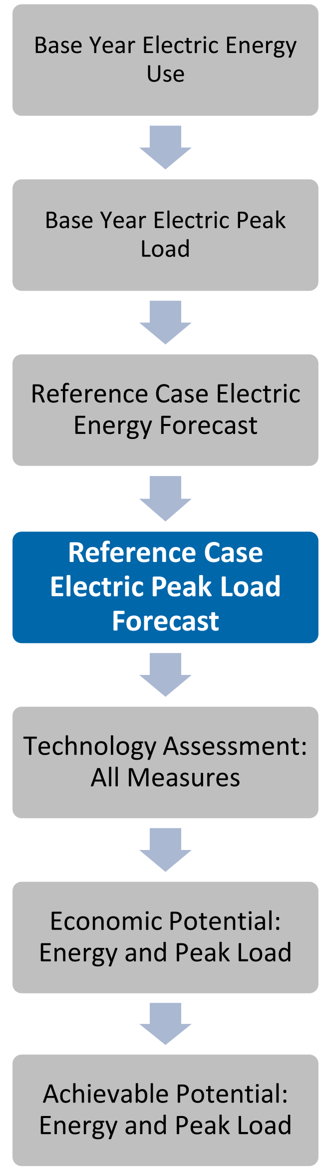


Exhibit 24 Distribution of Electricity Consumption, by Sub sector and End Use, Trends to 2029 (cont'd…)



6 Reference Case Electric Peak Load Forecast



6.1 Introduction

This section provides a profile of the electric peak load for Newfoundland and Labrador's Commercial sector over the Reference Case period of 2014 to 2029. The Reference Case peak load profile estimates the expected level of demand in the peak period that would occur over the study period in the absence of new CDM initiatives or rate changes. As such, the Reference Case provides the point of comparison for the calculation of peak load savings associated with each of the subsequent scenarios that are assessed within this study.

The discussion is organized into the following sub-sections:

- Methodology
- Summary of results

6.2 Methodology

The electric peak loads for each combination of end use, sub sector and milestone year were calculated in exactly the same manner as shown in Section 4, which presented the Base Year peak load profiles.

For this Reference Case, the electric energy consumption (from Section 5) is converted to a demand value for the peak period definition by dividing the applicable electric energy value for each sub sector and end use by the corresponding Commercial sector load shape hours-use factors, as presented in Appendix B.

6.3 Summary of Results

A summary of the Reference Case peak load profiles is presented in Exhibit 25.

Exhibit 25 Electric Peak Loads, by Milestone Year, Sub sector & Region (MW)

Sub-Sector	Year	Island Interconnected	Isolated	Labrador Interconnected	Grand Total
Large Office	2014	62	-	-	62
	2017	64	-	-	64
	2020	66	-	-	66
	2023	69	-	-	69
	2026	71	-	-	71
	2029	73	-	-	73
Small Office	2014	45	-	1	46
	2017	46	-	1	47
	2020	48	-	1	49
	2023	50	-	1	51
	2026	51	-	1	52
	2029	53	-	1	54
Large Non-food Retail	2014	27	-	2	29
	2017	27	-	2	29
	2020	28	-	2	30
	2023	29	-	2	31
	2026	30	-	2	32
	2029	31	-	2	33
Small Non-food Retail	2014	33	-	4	36
	2017	33	-	4	37
	2020	34	-	4	38
	2023	35	-	4	39
	2026	36	-	4	40
	2029	37	-	4	41
Food Retail	2014	29	-	3	32
	2017	29	-	3	32
	2020	30	-	3	33
	2023	31	-	3	34
	2026	32	-	3	35
	2029	33	-	3	36
Large Accomodation	2014	16	-	2	18
	2017	17	-	2	18
	2020	17	-	2	19
	2023	18	-	2	20
	2026	19	-	2	20
	2029	19	-	2	21
Small Accomodation	2014	7	-	0	8
	2017	7	-	0	8
	2020	8	-	0	8
	2023	8	-	0	8
	2026	8	-	0	8
	2029	8	-	0	9
Healthcare	2014	33	-	3	36
	2017	33	-	3	36
	2020	34	-	3	37
	2023	35	-	3	37
	2026	36	-	3	38
	2029	36	-	3	39

Exhibit 25 Electric Peak Loads, by Milestone Year, Sub sector & Region (MW) (cont'd…)

Sub-Sector	Year	Island Interconnected	Isolated	Labrador Interconnected	Grand Total
Schools	2014	43	-	3	46
	2017	44	-	3	46
	2020	45	-	3	48
	2023	47	-	3	50
	2026	49	-	3	52
	2029	50	-	3	53
Universities and Colleges	2014	22	-	1	23
	2017	22	-	1	23
	2020	23	-	1	23
	2023	23	-	1	24
	2026	23	-	1	24
	2029	24	-	1	25
Warehouse/Wholesale	2014	16	-	2	17
	2017	16	-	2	18
	2020	17	-	2	18
	2023	17	-	2	19
	2026	18	-	2	19
	2029	18	-	2	20
Restaurants	2014	28	-	2	30
	2017	28	-	2	31
	2020	30	-	3	32
	2023	31	-	3	34
	2026	32	-	3	35
	2029	33	-	3	36
Labrador Isolated C/I Buildings	2014	-	3	-	3
	2017	-	3	-	3
	2020	-	3	-	3
	2023	-	3	-	3
	2026	-	4	-	4
	2029	-	4	-	4
Island Isolated C/I Buildings	2014	-	0	-	0
	2017	-	0	-	0
	2020	-	0	-	0
	2023	-	0	-	0
	2026	-	0	-	0
	2029	-	0	-	0
Large Other Buildings	2014	35	-	15	49
	2017	35	-	15	50
	2020	36	-	15	51
	2023	38	-	15	53
	2026	39	-	15	54
	2029	40	-	15	55
Small Other Buildings	2014	32	-	10	41
	2017	32	-	10	41
	2020	32	-	10	42
	2023	33	-	10	43
	2026	34	-	10	44
	2029	35	-	10	45

Exhibit 25 Electric Peak Loads, by Milestone Year, Sub sector & Region (MW) (cont'd…)

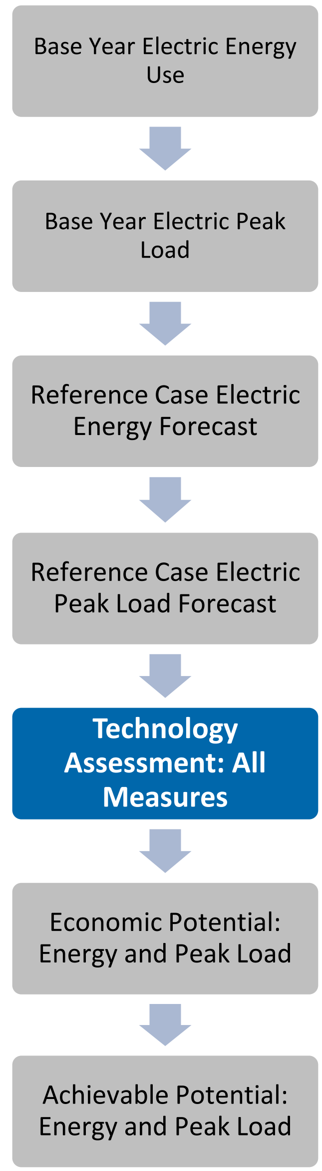
Sub-Sector	Year	Island Interconnected	Isolated	Labrador Interconnected	Grand Total
Other Institutional	2014	-	-	9	9
	2017	-	-	15	15
	2020	-	-	20	20
	2023	-	-	20	20
	2026	-	-	20	20
	2029	-	-	20	20
Non-Buildings	2014	30	-	1	31
	2017	31	-	1	32
	2020	32	-	1	33
	2023	33	-	1	34
	2026	34	-	1	34
	2029	34	-	1	35
Street Lighting	2014	5	0	0	5
	2017	5	0	0	5
	2020	5	0	0	5
	2023	5	0	0	5
	2026	5	0	0	5
	2029	5	0	0	5
Grand Total	2014	463	3	56	522
	2017	469	3	62	534
	2020	486	4	67	557
	2023	503	4	67	575
	2026	516	4	68	588
	2029	530	4	68	603

Selected highlights include:

- Since the hours-use factors applied are not assumed to change during the study period, trends in peak demand contributions for specific sub sectors are expected to follow the electricity consumption trends for those sub sectors. Large and small offices, for example, will continue to make the largest commercial contribution to the peak demand throughout the study period.

- Similarly, peak demand contributions for specific end uses are expected to follow the electricity consumption trends for those end uses. Space heating becomes an increasingly important contributor to peak demand through time, while indoor lighting, because of natural gains in efficiency, will make a gradually declining contribution towards the peak demand.

7 Technology Assessment: All Measures



7.1 Introduction

This section identifies and assesses the economic attractiveness of the selected energy efficiency measures for the Commercial sector. It also identifies and assesses the economic attractiveness of selected Commercial sector electric capacity-only peak load reduction measures, which in this study are defined as those measures that affect electric peak but have minimal or no impact on electric energy use. The discussion is organized and presented as follows:

- Methodology
- Energy efficiency technologies
- Electric peak load reduction measures
- Summary of unbundled results
- Energy efficiency supply curves
- Demand reduction supply curves.

7.2 Methodology

The following steps were employed to assess the measures:

- Select candidate measures
- Establish technical performance for each option
- Establish the capital, installation and operating costs for each option
- Calculate the cost of conserved energy (CCE) for each energy efficiency technology and O&M measure
- Calculate the cost of electric peak load reduction (CEPR) for each option.

A brief description of each step is provided below.

Step 1 Select Candidate Measures

The candidate measures were selected in close collaboration with client personnel based on a combination of a literature review and previous study team experience. The selected measures are all considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs, which will be addressed in this section, were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources, including the experience and on-going research work of study team members. In the case of some of the peak load reduction measures, comfort may be affected and the trade-off between benefits (e.g., cost savings) and costs (including reduction in comfort) were judged based on past experience with similar technologies and customer acceptance.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources, including the experience and on-going research work of study team members.

In the case of energy efficiency measures, the incremental cost is applicable when a measure is installed in a new facility, or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy efficiency measure relative to the baseline technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.[14]

Unlike energy efficiency measures, in which major equipment, such as heating and water heating systems are typically replaced, or thermal envelope measures such as insulation upgrades affect systems directly, capacity-only measures are typically implemented via add-on control equipment, although some built-in control equipment exists. The incremental cost is thus defined as the control equipment itself or incremental cost for a controllable appliance or device relative to the baseline appliance cost (e.g., remote accessible thermostat vs. standard thermostat), plus any required infrastructure (e.g., automatic meter reading or communications gateways). In cases where a more efficient appliance with peak control functions replaces a standard appliance, both electric energy and electric peak reduction are achieved, with some splitting of incremental costs attributable to each function. Where a new or replacement end use is installed that operates off peak, thus achieving electric peak reduction without significant energy impacts, incremental costs for the electric peak reduction device will be compared with standard equipment without assuming any early replacement and, thus, salvage value.

In all cases the costs and savings are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs. All costs are expressed in constant 2014 dollars.

Step 4 Calculate CCE for Each Energy Efficiency Measure

One of the important sets of information provided in this section is the CCE associated with each energy efficiency measure. The CCE for an energy efficiency measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the accompanying TRM Workbook is expressed in constant 2014 dollars.

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CCE is calculated according to the following formula:

$$\frac{C_A + M}{S}$$

[14] With some exceptions, many measures could conceivably be applied as either a full-cost measure (applicable immediately) or as an incremental cost measure (upon end of service life), depending on how financially attractive it is. Therefore, for all but a few measures, the TRM Workbook is configured to evaluate the measure at full cost and include it on that basis if it passes the screen, then roll to evaluating it on an incremental basis, and only fail it completely if it fails both tests. Where a measure is always full cost (such as the block heater timer, where the baseline technology is the "do nothing" option), the incremental cost option is excluded. Where a measure is always incremental cost (such as high-performance homes, where the baseline technology has to be a standard construction home, not no home at all), the full cost option is excluded.

It is recognized that some measures can be implemented prior to the end of their useful life, that is, early retirement. This intermediate option between full and incremental cost could increase the rate of adoption for some of the incremental measures, raising the Economic Potential savings modestly. However, in this study early retirement is treated as a program option.

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O&M)
S is the annual kWh electricity savings

And *A* is the annualization factor

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:

i is the discount rate
n is the life of the measure

The detailed CCE tables (see TRM Workbook) show both incremental and full installed costs for the energy efficiency measures, as applicable. If the measure or technology is installed in a new facility or at the point of natural replacement in an existing facility, then the incremental cost of the measure versus the cost of the baseline technology is used. If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the full cost of the efficient measure is used.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations that accompany this document, a discount rate of 7% (real) is used.

Step 5 Calculate CEPR for Each Peak Load Measure

The CEPR for a peak load reduction measure is defined as the annualized incremental cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the TRM Workbook is in constant (2014) dollars.

The CEPR provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CEPR is calculated according to the following formula:

$$\frac{C_A + M}{S_p}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O & M)
S_p is the annual kW load reduction associated with peak definition p.

And A is the annualization factor.

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:

i is the discount rate;
n is the life of the measure.

Note that the annual O&M cost will include, in some cases, amortized costs associated with infrastructure considered a prerequisite for implementation of the measure. This could include automated metering infrastructure (AMI), such as advanced metering, communications gateways and other related system investments. These costs would typically support multiple applications (e.g., communications gateways could enable control of heating, air conditioning, water heating, and HVAC fans and pumps), as well as facilitate time-differentiated rates that would be required for a feasible and cost-effective program implementation (e.g., thermal energy storage). It should also be noted that the measure lifetime is for the control device, function or feature, rather than that of the unit it is controlling. The study does not presume any specific technology or infrastructure, but does assume that a marketplace will develop for such systems, whether or not NL utilities adopt them, or develops access directly or indirectly to customer control equipment.

The CEPR can be compared to benefits, which include the value of reduced peak for the utility (avoided capacity and transmission and distribution (T&D) investment or purchase costs), the customer (e.g., bill savings) and society (e.g., value of environmental benefits) to determine its cost effectiveness from various perspectives (societal, utility, participant and non-participant).

As with the CCE for energy savings, the CEPR calculation is sensitive to the chosen discount rate, which, as for the CCE, used a 7% (real) discount rate. Higher discount rates will tend to reduce savings and decrease cost effectiveness where costs are incurred upfront and benefits accrue over many years.

Step 6 Estimate Approximate Unbundled Electric Energy Savings Potential for Each Energy Efficiency Measure and Demand Reduction for Each Peak Load Measure

The next step in the assessment was to prepare an approximate estimate of the potential unbundled electric energy savings that could theoretically be provided by each energy efficiency measure over the study period, and similarly to prepare an estimate of demand reductions that could be provided by each peak load measure. The term "unbundled" means that the savings for each measure are calculated in isolation from other important factors that ultimately determine the potential for real life savings.

The strength of this approach is that it provides insight into the relative size of the potential electric energy savings or demand reductions associated with individual measures; this perspective is often of particular value to utility CDM program design personnel who may need to consider combinations of measures that differ from those selected for the CDM potential assessment.

However, it should be noted that the savings from individual measures cannot be used directly to calculate total savings potential or demand reduction. This is due primarily to two factors:

- **More than one upgrade may affect a given end use:** For example, improved insulation reduces space heating electricity use, as does the installation of a heat pump. On its own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of bundles of measures that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a heat pump heating system). Similarly, more than one peak load measure may affect a given end use, or peak load measures may be applied to the same end use that one or more energy efficiency measures may also affect.
- **There are interactive effects among end uses:** For example, the electricity savings from more efficient lighting result in reduced waste heat. During the space heating season, lighting waste heat contributes to a facility's internal heat gains, which lower the amount of heat that must be

provided by the space heating system. The magnitude of the interactive effects can be significant, both on energy consumption and peak demand. However, it is important to note that assessing the impact of interactive effects in commercial facilities is more complex since heat may be generated in spaces that heat the conditioned space much less effectively (e.g. high bay fixtures or equipment in mechanical rooms). Interactive effects were captured on a measure by measure basis for measures that were more likely to have an impact on space heating requirements and a 30% heating penalty was assumed for this subset of measures. For example, it was assumed that about 30% of the savings from the LED lamps measure would be lost due to increased space heating requirements. Rather than reducing the savings from these measures directly, interactive effects have been taken into consideration with the measure "HVAC Impact from Other Savings".

The above factors are incorporated in later stages of the analysis.

Step 7 Prepare Energy Efficiency and Demand Reduction Supply Curves

The final step in the assessment of the selected energy efficiency measures was the generation of an energy efficiency supply curve and a demand reduction supply curve. Energy efficiency supply curves are built up based on the conserved electricity and the CCE for each measure. Similarly, demand reduction supply curves are built up based on the demand reduction and the CEPR for each measure. The CSEEM model was used to model the application of all technically feasible measures, accumulating the electricity savings or demand reduction and associated implementation costs for each sub sector type.

Measures were applied sequentially to account, at least approximately, for interaction between measures. The impact of building shell measures was modelled using ICF's Commercial/Institutional Building Energy-use Simulation Model (CEEAM), but only individually. The full package of measures was not modelled together, nor was the impact of internal gains on space heating and cooling included. These effects are modelled more thoroughly for the Economic Potential calculation, when all the measures that pass the economic screen are modelled together. Similarly, the demand measures were also applied sequentially, but began with the demand reference case, not the demand that would remain after all the efficiency measures were applied. Thus the interaction between energy efficiency and demand reduction is neglected for this supply curve.

The accumulated savings and costs for each measure were added together to present the overall energy efficiency supply curve for the province. They were sorted in order from lowest cost per kWh saved to highest cost, and presented on a graph showing CCE versus electricity savings.

The accumulated demand reduction and costs for each measure were added together to present the overall demand reduction supply curve for the province. They were sorted in order from lowest cost per kW reduction to highest cost, and presented on a graph showing CEPR versus demand reduction.

7.3 Energy Efficiency Technology Assessment

Exhibit 26 shows the energy efficiency technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 26 Energy Efficiency Technologies Included in this Study

Block Heaters
- Block Heater Controls

Computer Equipment (ENERGY STAR ®)
- ENERGY STAR® Computers
- ENERGY STAR® Office Equipment
- Energy-Efficient Server Technologies
- Activate PC Power Management*

Domestic Hot Water
- On-Demand Water Heaters
- Heat Pump Water Heaters
- Low-Flow Pre-Rinse Spray Valves
- Low-Flow Faucet Aerators
- Low-Flow Showerheads
- Drainwater Heat Recovery
- ENERGY STAR® Dishwashers

Food Service Equipment
- High-Efficiency Cooking Equipment

Lighting
- LED Screw-In Lamps**
- LED High Bay fixtures**
- LED Tubular Lamps**
- LED Troffers**
- LED Outdoor Fixtures
- LED Exit Signs
- LED Refrigerated Display Case Lighting
- High Performance T8 Fixtures**
- T5HO Fixtures**
- Occupancy Sensors (Lighting)
- Dimming Control (Daylighting)
- Lighting Controls (Outdoor)
- Make Use of Daylighting*
- Use Task Light Instead of Ambient*

Building Envelope
- Roof Insulation
- Wall Insulation
- High Performance Glazing Systems
- Air Curtains

Refrigeration
- Cooler Night Covers
- Refrigerated Cases with Doors
- ECM Motors and Evaporator Fan Motor Controllers
- Freezer Defrost Controllers
- High Efficiency Compressors
- Automatic Door Closers (Walk-in Coolers)
- Refrigeration Heat Recovery
- Refrigeration Controls
- CEE-Rated Refrigerators and Freezers

HVAC
- High-Efficiency Air Source Heat Pumps
- Ground Source Heat Pumps
- Ductless Mini-Split Heat Pumps
- HVAC Occupancy Sensors
- Demand Control Ventilation (DCV)
- VFDs on HVAC Motors
- Ventilation Heat Recovery
- Radiant Infrared Heaters
- High Efficiency Chillers
- High Efficiency Rooftop Units (RTUs)
- Premium Efficiency Motors
- Advanced Building Automation Systems
- Building Recommissioning
- Programmable Thermostats
- Demand Control Kitchen Ventilation (DCKV)
- Use Natural Ventilation (Summer)*
- Use Shades/Blinds (Summer)*
- Use Shades/Blinds (Winter)*
- Keep Doors Closed (Summer)*
- Keep Doors Closed (Winter)*

Other Plug Loads
- Refrigerated Vending Machine Controllers
- Reduce Number of Fridges*

New Construction
- New Construction (25% more efficient)
- New Construction (40% more efficient)

Street Lighting
- LED Street Lighting

* Denotes behavioural measure
** Measures assessed separately for primary (e.g. classrooms in a school) and secondary lighting (e.g. hallways in a school), since hours of operation differ for these scenarios. As such, many of the following exhibits include two line items with the same measure name.

7.3.1 Technology Screening Results

A summary of the results is provided in Exhibit 27. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[15] for the CCE that is shown (e.g. full versus incremental)
- The measure's average CCE for each region[16] Average CCE refers to a weighted average of the CCE values for the measure in different sub sectors.[17]

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 27 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some sub sector types and on an incremental cost basis in others is shown as "Full/Incr". The exhibit does not include behavior measures as there are no measure-level costs associated with implementing these measures (i.e. CCE of 0 ¢/kWh).

Exhibit 27 Commercial Sector Energy Efficiency Technology Measures, Screening Results[18]

Measure Name	Basis	Average CCE (¢/kWh)		
		Island	Labrador	Isolated
Activate PC Power Management	Full	0.0	0.0	0.0
Make Use of Daylighting	Full	0.0	0.0	0.0
Use Task Light Instead of Ambient	Full	0.0	0.0	0.0
Reduce Number of Fridges	Full	0.0	0.0	0.0
Use Shades/Blinds (Winter)	Full	0.0	0.0	0.0
Keep Doors Closed (Winter)	Full	0.0	0.0	0.0
Use Shades/Blinds (Summer)	Full	0.0	0.0	0.0
Use Natural Ventilation (Summer)	Full	0.0	0.0	0.0
Keep Doors Closed (Summer)	Full	0.0	0.0	0.0
Low-Flow Showerheads	Full	0.1	0.1	0.1
Low-Flow Showerheads	Full	0.1	0.1	0.1
Low-Flow Faucet Aerators	Full	0.1	0.1	0.1
Lighting Controls (Outdoor)	Full	0.4	0.4	0.7
Cooler Night Covers	Full	0.7	0.7	0.7
Low-Flow Pre-Rinse Spray Valves	Full	0.7	0.9	1.1
Automatic Door Closers (Walk-In Coolers & Freezers)	Full	1.2	1.2	N/A
LED Screw-In Lamps (Secondary)	Full	1.7	1.4	1.6
Programmable Thermostats	Full	1.8	2.0	1.4
LED Screw-In Lamps	Full	2.2	1.8	2.1

[15] See Step 4 in Section 7.2 for a fuller description.
[16] The thresholds that were employed for the economic screening of the measures are summarized in Section 8.2
[17] In the subsequent modeling described in Section 8, measure pass or fail the economic screen on the basis of their CCE in the individual sub sector and region, not on the basis of this weighted average value.
[18] Average CCE does not include program costs.

Exhibit 27 Commercial Sector Energy Efficiency Technology Measures, Screening Results (cont'd…)

Measure Name	Basis	Average CCE (¢/kWh)		
		Island	Labrador	Isolated
Refrigerated Vending Machine Controllers	Full	2.6	2.6	2.6
High Efficiency Compressors (Refrigeration)	Full	2.7	2.7	N/A
High Performance T8 Fixtures (Secondary)	Full	3.7	2.7	3.3
VFDs on HVAC Motors	Full	3.5	3.2	3.1
Building Recommissioning	Full	3.4	3.6	2.9
Hotel Occupancy Sensors	Full	3.8	2.8	N/A
ENERGY STAR Dishwashers	Full	5.0	5.0	0.0
T5HO Fixtures (Secondary)	Full	3.9	2.9	3.6
LED High Bay Fixtures (Secondary)	Full	4.0	3.2	3.8
LED Exit Signs	Full	3.8	3.8	3.8
High Performance T8 Fixtures	Full	4.7	3.5	4.2
Demand Control Kitchen Ventilation (DCKV)	Full	4.2	4.2	N/A
T5HO Fixtures	Full	4.7	3.7	4.5
Refrigeration Controls	Full	4.5	4.5	N/A
LED High Bay Fixtures	Full	5.0	4.0	4.8
Ventilation Heat Recovery	Full	5.2	4.7	4.1
ECM Motors and Evaporator Fan Motor Controllers	Full	4.7	4.7	4.7
Occupancy Sensors (Lighting)	Full	4.7	4.9	5.3
LED Street Lighting	Full	7.8	7.8	0.0
Radiant Infrared Heaters	Full	5.9	6.1	N/A
LED Tubular Lamps (Secondary)	Full	7.1	5.3	6.8
Ductless Mini-Split Heat Pump	Full	9.0	4.4	6.2
Demand Control Ventilation (DCV)	Full	8.1	5.9	N/A
Refrigeration Heat Recovery	Full	8.2	8.2	N/A
Block Heater Controls	Full	N/A	10.0	10.0
Advanced Building Automation Systems	Full	9.9	11.2	N/A
Refrigerated Cases with Doors	Full	10.9	10.9	N/A
Dimming Control (Daylighting)	Full	18.5	14.2	18.6
Air Curtains	Full	18.8	18.8	N/A
Freezer Defrost Controllers	Full	27.9	27.9	27.9
High-Efficiency Air Source Heat Pumps	Full/Incr.	4.6	0.9	9.4
Heat Pump Water Heaters	Full/Incr.	4.8	3.4	12.2
LED Tubular Lamps	Full/Incr.	8.9	5.3	8.7
Ground Source Heat Pumps	Full/Incr.	12.3	10.0	12.5
Energy-Efficient Server Technologies	Incr.	0.0	0.0	0.0
ENERGY STAR Computers	Incr.	0.0	0.0	0.0
ENERGY STAR Office Equipment	Incr.	0.0	0.0	0.0
New Construction (25% More Efficient)	Incr.	3.3	3.1	3.8
Drainwater Heat Recovery	Incr.	4.5	4.5	4.5

Exhibit 27 Commercial Sector Energy Efficiency Technology Measures, Screening Results (cont'd…)

Measure Name	Basis	Average CCE (¢/kWh)		
		Island	Labrador	Isolated
Premium Efficiency Motors	Incr.	4.9	4.5	4.3
High Performance Glazing Systems	Incr.	5.6	6.1	3.2
LED Outdoor Fixtures	Incr.	3.0	3.0	11.3
New Construction (40% More Efficient)	Incr.	6.1	5.8	7.2
CEE-Rated Refrigerators and Freezers	Incr.	8.4	8.4	8.4
Wall Insulation	Incr.	14.1	13.8	5.8
Roof Insulation	Incr.	15.8	16.4	5.0
LED Refrigerated Display Case Lighting	Incr.	11.5	11.5	16.0
On-Demand Water Heaters	Incr.	13.2	13.2	N/A
LED Troffers (Secondary)	Incr.	15.9	12.7	26.2
High Efficiency Chillers	Incr.	14.9	21.7	N/A
LED Troffers	Incr.	20.1	16.3	19.3
High Efficiency RTUs	Incr.	24.6	34.7	32.1

7.4 Demand Reduction Technology Assessment

Exhibit 28 shows the demand reduction technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 28 Demand Reduction Technologies Included in this Study[19]

Space Heating ▪ Thermal Storage ▪ Heating Controls HVAC Fans and Pumps ▪ HVAC Demand Controls Lighting ▪ Lighting Demand Controls	Domestic Hot Water ▪ DHW Controls Refrigeration ▪ Refrigeration Demand Controls

7.4.1 Technology Screening Results

A summary of the results is provided in Exhibit 29. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[20] for the CEPR that is shown (e.g. full versus incremental)
- The measure's average CEPR for each region[21]

[19] Please note that all demand curtailment is accounted for in the Industrial sector analysis and reporting
[20] See Step 4 in Section 7.2 for a fuller description.
[21] The thresholds that were employed for the economic screening of the measures are summarized in Section 8.2

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 29 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some sub sector types and on an incremental cost basis in others is shown as “Full/Incr.”

Exhibit 29 Commercial Sector Demand Reduction Technology Measures, Screening Results[22]

Measure Name	Basis	Average CEPR ($/kW)		
		Island	Labrador	Isolated
Lighting Demand Controls	Full	37.7	37.7	37.7
Refrigeration Demand Controls	Full	69.2	69.2	N/A
HVAC Demand Controls	Full	72.4	72.4	72.4
Heating Controls	Full	87.1	87.1	87.1
DHW Controls	Full	103.7	92.9	82.7
Thermal Storage	Full	241.0	241.0	241.0

7.5 Energy Efficiency Supply Curve

This sub-section includes energy efficiency supply curves for each of the three regions studied. It is important to present the supply curves for each region separately, because the avoided costs are different. The supply curves presented are for the year 2029, but the Data Manager can be used to generate supply curves for the other years. Each supply curve shows the avoided cost for that region as a horizontal line, with dashed lines showing the upper and lower edge of the range of reasonableness.

The supply curves were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 23. The following approach was used:

- Measures were introduced in sequence
- Where more than one measure affected the same end use, the savings shown for the second measure are incremental to those already shown for the first
- Sequence was determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It included consideration of CCE results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CCE, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in six exhibits:

- Exhibit 30 presents the potential by measure for the Island Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 31 presents the supply curve for the Island Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 30.

[22] Average CEPR does not include program costs.

- Exhibit 32 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 33 presents the supply curve for the Island Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 32.
- Exhibit 34 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 35 presents the supply curve for the Island Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 34.

Exhibit 30 Island Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	ENERGY STAR Computers	26,019	26,019	$0.00
2	Activate PC Power Management	8,476	34,495	$0.00
3	Energy-Efficient Server Technologies	2,510	37,005	$0.00
4	ENERGY STAR Office Equipment	1,834	38,839	$0.00
5	Make Use of Daylighting	1,055	39,894	$0.00
6	Reduce Number of Fridges	587	40,481	$0.00
7	Use Task Light Instead of Ambient	456	40,938	$0.00
8	Use Shades/Blinds (Winter)	239	41,177	$0.00
9	Keep Doors Closed (Winter)	114	41,291	$0.00
10	Use Shades/Blinds (Summer)	41	41,332	$0.00
11	Use Natural Ventilation (Summer)	20	41,351	$0.00
12	Keep Doors Closed (Summer)	11	41,362	$0.00
13	Low-Flow Showerheads	4,628	45,990	$0.00
14	Low-Flow Faucet Aerators	15,350	61,340	$0.00
15	Lighting Controls (Outdoor)	3,873	65,213	$0.00
16	Low-Flow Pre-Rinse Spray Valves	1,004	66,217	$0.00
17	Cooler Night Covers	3,660	69,877	$0.01
18	Automatic Door Closers (Walk-In Coolers & Freezers)	561	70,438	$0.01
19	LED Screw-In Lamps	14,213	84,652	$0.02
20	Programmable Thermostats	31,416	116,068	$0.02
21	High-Efficiency Air Source Heat Pumps	109,737	225,804	$0.02
22	LED Screw-In Lamps	10,497	236,301	$0.02
23	Refrigerated Vending Machine Controllers	6,819	243,121	$0.03
24	High Efficiency Compressors (Refrigeration)	8,537	251,658	$0.03
25	High Performance T8 Fixtures	2,832	254,490	$0.03
26	LED Outdoor Fixtures	21,223	275,714	$0.03
27	New Construction (25% More Efficient)	45,360	321,074	$0.03
28	VFDs on HVAC Motors	22,300	343,374	$0.03
29	Building Recommissioning	96,103	439,477	$0.03
30	Heat Pump Water Heaters	6,015	445,492	$0.03
31	Advanced Building Automation Systems	49,883	495,376	$0.04
32	Hotel Occupancy Sensors	2,434	497,810	$0.04
33	LED Exit Signs	169	497,979	$0.04

Exhibit 30 Island Interconnected Measure Potential and CCE (cont'd…)

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
34	Demand Control Kitchen Ventilation (DCKV)	1,569	499,548	$0.04
35	Premium Efficiency Motors	3,516	503,064	$0.04
36	High Performance Glazing Systems	27,639	530,703	$0.04
37	Occupancy Sensors (Lighting)	33,225	563,928	$0.04
38	T5HO Fixtures	3,345	567,273	$0.04
39	Refrigeration Controls	3,318	570,591	$0.04
40	Drainwater Heat Recovery	4,108	574,699	$0.05
41	ECM Motors and Evaporator Fan Motor Controllers	5,901	580,600	$0.05
42	LED High Bay Fixtures	4,486	585,086	$0.05
43	High Performance T8 Fixtures	19,273	604,359	$0.05
44	T5HO Fixtures	804	605,162	$0.05
45	ENERGY STAR Dishwashers	2,856	608,018	$0.05
46	Ventilation Heat Recovery	19,399	627,417	$0.05
47	LED High Bay Fixtures	1,095	628,512	$0.05
48	New Construction (40% More Efficient)	26,877	655,388	$0.06
49	Radiant Infrared Heaters	3,270	658,658	$0.06
50	LED Tubular Lamps	4,989	663,648	$0.06
51	High-Efficiency Cooking Equipment	3,658	667,306	$0.06
52	LED Tubular Lamps	33,184	700,490	$0.07
53	LED Street Lighting	14,638	715,127	$0.08
54	Refrigeration Heat Recovery	896	716,023	$0.08
55	CEE-Rated Refrigerators and Freezers	5,714	721,738	$0.08
56	Ductless Mini-Split Heat Pump	62,016	783,754	$0.09
57	Demand Control Ventilation (DCV)	23,996	807,750	$0.09
58	Ground Source Heat Pumps	24,316	832,067	$0.11
59	Refrigerated Cases with Doors	13,416	845,482	$0.11
60	LED Refrigerated Display Case Lighting	3,310	848,793	$0.11
61	Wall Insulation	29,480	878,272	$0.13
62	On-Demand Water Heaters	843	879,115	$0.13
63	LED Troffers	915	880,030	$0.14
64	Roof Insulation	20,435	900,466	$0.14
65	High Efficiency Chillers	1,193	901,659	$0.15
66	Air Curtains	299	901,957	$0.19
67	Dimming Control (Daylighting)	9,011	910,968	$0.19
68	LED Troffers	5,826	916,794	$0.19
69	High Efficiency RTUs	5,442	922,236	$0.26
70	Freezer Defrost Controllers	291	922,527	$0.28

Exhibit 31 Island Interconnected Energy Efficiency Supply Curve

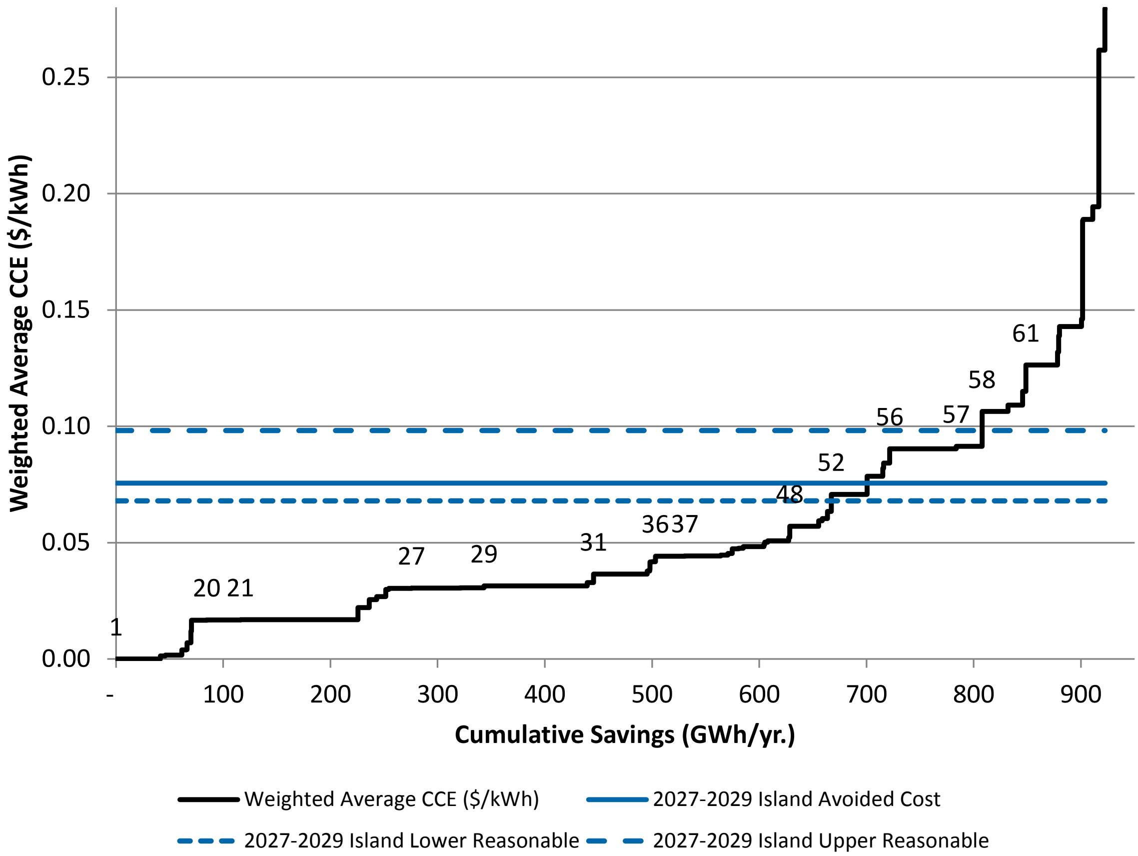


Exhibit 32 Labrador Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	ENERGY STAR Computers	1,784	1,784	$0.00
2	Activate PC Power Management	387	2,171	$0.00
3	ENERGY STAR Office Equipment	99	2,270	$0.00
4	Energy-Efficient Server Technologies	48	2,318	$0.00
5	Make Use of Daylighting	40	2,358	$0.00
6	Keep Doors Closed (Winter)	16	2,374	$0.00
7	Reduce Number of Fridges	5	2,379	$0.00
8	Use Task Light Instead of Ambient	5	2,384	$0.00
9	Use Shades/Blinds (Winter)	3	2,387	$0.00
10	Keep Doors Closed (Summer)	0	2,387	$0.00
11	Use Shades/Blinds (Summer)	0	2,387	$0.00
12	Use Natural Ventilation (Summer)	0	2,387	$0.00
13	Low-Flow Showerheads	605	2,992	$0.00
14	Low-Flow Faucet Aerators	3,117	6,109	$0.00
15	Lighting Controls (Outdoor)	518	6,626	$0.00
16	Low-Flow Pre-Rinse Spray Valves	129	6,755	$0.00
17	Cooler Night Covers	175	6,929	$0.01

Exhibit 32 Labrador Interconnected Measure Potential and CCE (cont'd…)

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
18	High-Efficiency Air Source Heat Pumps	21,261	28,190	$0.01
19	Automatic Door Closers (Walk-In Coolers & Freezers)	68	28,259	$0.01
20	LED Screw-In Lamps	1,458	29,716	$0.02
21	Programmable Thermostats	6,414	36,130	$0.02
22	LED Screw-In Lamps	1,293	37,423	$0.02
23	Refrigerated Vending Machine Controllers	736	38,159	$0.03
24	High Efficiency Compressors (Refrigeration)	415	38,574	$0.03
25	Hotel Occupancy Sensors	262	38,836	$0.03
26	LED Outdoor Fixtures	2,881	41,717	$0.03
27	New Construction (25% More Efficient)	1,753	43,470	$0.03
28	High Performance T8 Fixtures	461	43,931	$0.03
29	VFDs on HVAC Motors	1,886	45,817	$0.03
30	Ductless Mini-Split Heat Pump	14,318	60,135	$0.03
31	LED Exit Signs	39	60,174	$0.04
32	Building Recommissioning	14,030	74,204	$0.04
33	Heat Pump Water Heaters	1,114	75,317	$0.04
34	High-Efficiency Cooking Equipment	314	75,631	$0.04
35	High Performance T8 Fixtures	1,323	76,953	$0.04
36	Demand Control Kitchen Ventilation (DCKV)	160	77,114	$0.04
37	T5HO Fixtures	78	77,192	$0.04
38	LED High Bay Fixtures	345	77,537	$0.04
39	Premium Efficiency Motors	367	77,904	$0.04
40	LED High Bay Fixtures	105	78,009	$0.04
41	Refrigeration Controls	157	78,167	$0.04
42	Ventilation Heat Recovery	4,624	82,791	$0.04
43	T5HO Fixtures	270	83,061	$0.04
44	Drainwater Heat Recovery	324	83,384	$0.05
45	LED Tubular Lamps	830	84,214	$0.05
46	ECM Motors and Evaporator Fan Motor Controllers	411	84,625	$0.05
47	Occupancy Sensors (Lighting)	3,056	87,681	$0.05
48	Advanced Building Automation Systems	7,460	95,141	$0.05
49	ENERGY STAR Dishwashers	277	95,418	$0.05
50	New Construction (40% More Efficient)	1,031	96,449	$0.06
51	Demand Control Ventilation (DCV)	6,440	102,889	$0.06
52	High Performance Glazing Systems	5,351	108,240	$0.06
53	Radiant Infrared Heaters	554	108,794	$0.06
54	LED Tubular Lamps	2,332	111,126	$0.06
55	LED Street Lighting	883	112,010	$0.08
56	Refrigeration Heat Recovery	637	112,647	$0.08
57	CEE-Rated Refrigerators and Freezers	1,169	113,815	$0.08
58	Ground Source Heat Pumps	5,383	119,198	$0.09
59	Block Heater Controls	407	119,605	$0.10
60	Refrigerated Cases with Doors	650	120,255	$0.11

Exhibit 32 Labrador Interconnected Measure Potential and CCE (cont'd…)

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
61	LED Refrigerated Display Case Lighting	167	120,422	$0.11
62	Roof Insulation	6,822	127,244	$0.13
63	On-Demand Water Heaters	68	127,312	$0.13
64	Wall Insulation	7,924	135,236	$0.14
65	LED Troffers	153	135,389	$0.14
66	Dimming Control (Daylighting)	172	135,561	$0.17
67	Air Curtains	54	135,615	$0.19
68	LED Troffers	417	136,032	$0.19
69	High Efficiency Chillers	41	136,073	$0.21
70	Freezer Defrost Controllers	69	136,142	$0.28
71	High Efficiency RTUs	146	136,288	$0.36

Exhibit 33 Labrador Interconnected Energy Efficiency Supply Curve

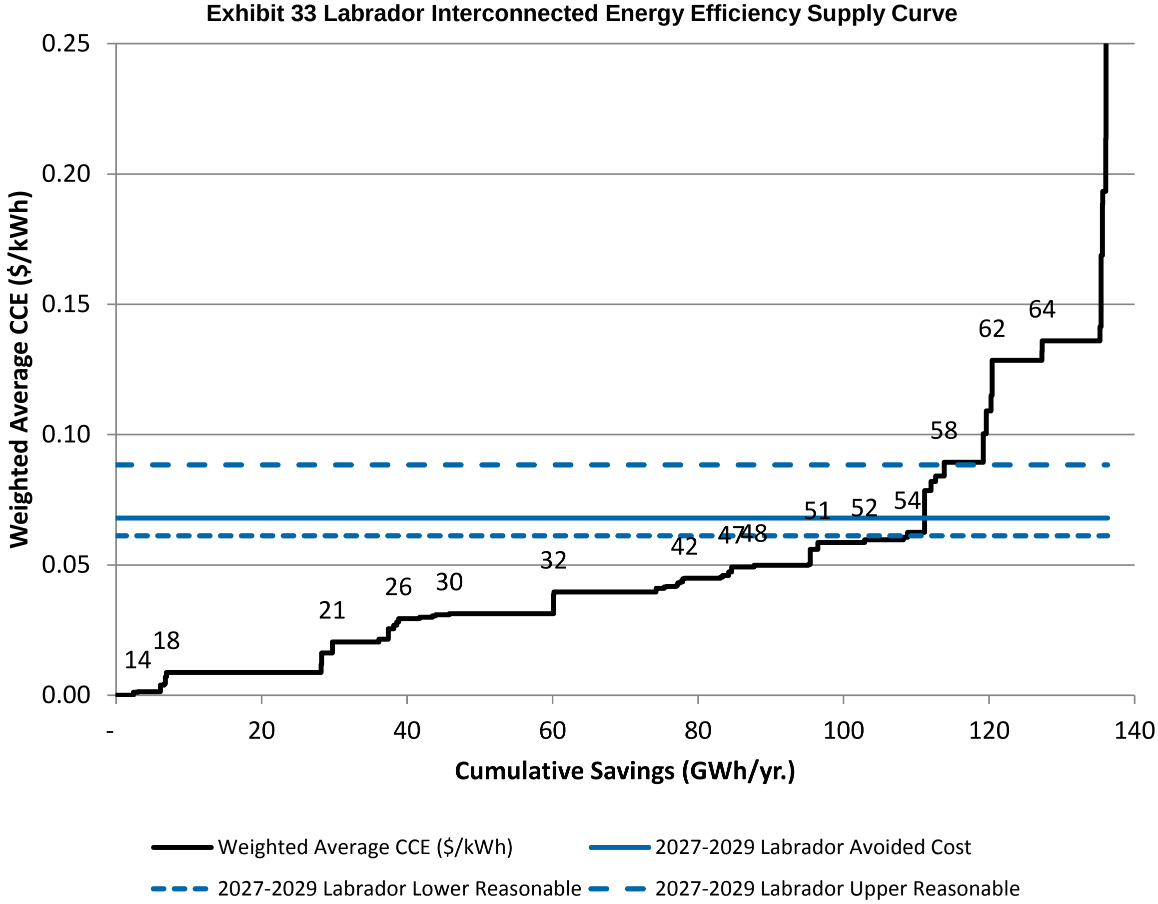


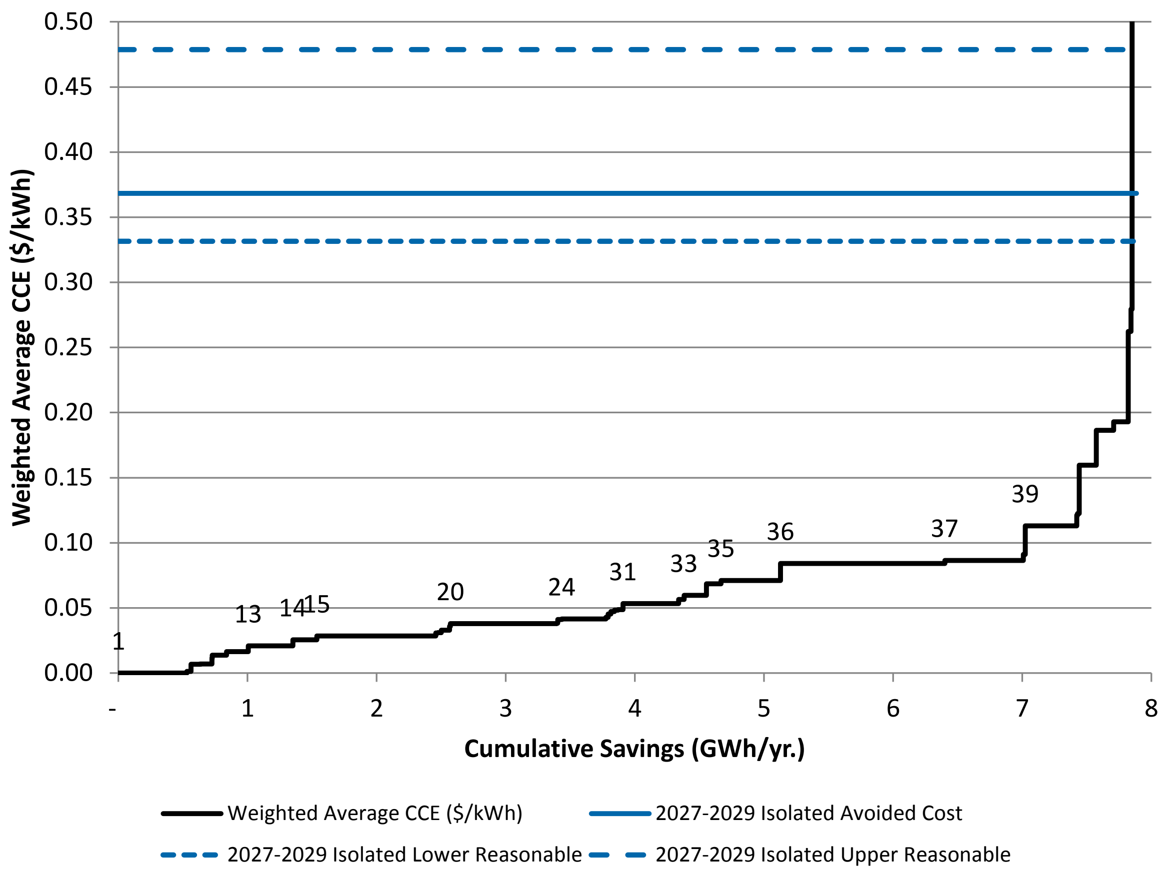
Exhibit 34 Isolated Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	ENERGY STAR Computers	334	334	$0.00
2	Activate PC Power Management	127	462	$0.00
3	Make Use of Daylighting	44	506	$0.00
4	ENERGY STAR Office Equipment	24	529	$0.00
5	Use Shades/Blinds (Winter)	1	530	$0.00
6	Low-Flow Faucet Aerators	30	559	$0.00
7	Low-Flow Showerheads	3	562	$0.00
8	Lighting Controls (Outdoor)	73	635	$0.01
9	Cooler Night Covers	91	725	$0.01
10	Low-Flow Pre-Rinse Spray Valves	2	727	$0.01
11	Programmable Thermostats	110	837	$0.01
12	LED Screw-In Lamps	169	1,006	$0.02
13	LED Screw-In Lamps	345	1,351	$0.02
14	Refrigerated Vending Machine Controllers	186	1,536	$0.03
15	Building Recommissioning	921	2,457	$0.03
16	VFDs on HVAC Motors	18	2,476	$0.03
17	High Performance Glazing Systems	25	2,501	$0.03
18	High Performance T8 Fixtures	64	2,565	$0.03
19	T5HO Fixtures	6	2,571	$0.04
20	New Construction (25% More Efficient)	821	3,392	$0.04
21	LED High Bay Fixtures	9	3,401	$0.04
22	LED Exit Signs	3	3,404	$0.04
23	Ventilation Heat Recovery	30	3,434	$0.04
24	High Performance T8 Fixtures	343	3,777	$0.04
25	Premium Efficiency Motors	17	3,794	$0.04
26	Drainwater Heat Recovery	3	3,796	$0.05
27	T5HO Fixtures	18	3,814	$0.05
28	ECM Motors and Evaporator Fan Motor Controllers	28	3,842	$0.05
29	LED High Bay Fixtures	27	3,869	$0.05
30	Roof Insulation	39	3,908	$0.05
31	Occupancy Sensors (Lighting)	430	4,338	$0.05
32	Wall Insulation	42	4,381	$0.06
33	Ductless Mini-Split Heat Pump	173	4,554	$0.06
34	LED Tubular Lamps	115	4,668	$0.07
35	New Construction (40% More Efficient)	460	5,128	$0.07
36	CEE-Rated Refrigerators and Freezers	1,272	6,400	$0.08
37	LED Tubular Lamps	609	7,008	$0.09
38	High-Efficiency Air Source Heat Pumps	16	7,024	$0.09
39	LED Outdoor Fixtures	397	7,422	$0.11
40	Ground Source Heat Pumps	7	7,428	$0.12
41	Heat Pump Water Heaters	14	7,442	$0.12
42	LED Refrigerated Display Case Lighting	131	7,574	$0.16
43	Dimming Control (Daylighting)	135	7,709	$0.19

Exhibit 34 Isolated Measure Potential and CCE (cont'd…)

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
44	LED Troffers	112	7,820	$0.19
45	LED Troffers	22	7,842	$0.26
46	Freezer Defrost Controllers	9	7,851	$0.28
47	High-Efficiency Cooking Equipment	33	7,884	$1.11

Exhibit 35 Isolated Energy Efficiency Supply Curve



7.6 Demand Reduction Supply Curve

This sub-section includes demand reduction supply curves for each of the three regions studied. It is important to present the supply curves for each region separately, because the avoided costs are different. The supply curves presented are for the year 2029, but the Data Manager can be used to generate supply curves for the other years. Each supply curve shows the avoided cost for that region as a horizontal line, with dashed lines showing the upper and lower edge of the range of reasonableness.

The supply curves were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 28. The following approach was used:

- Measures were introduced in sequence
- Where more than one measure affected the same end use, the reduction shown for the second measure are incremental to those already shown for the first
- Sequence was determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It included consideration of CEPR results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CEPR, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in six exhibits:

- Exhibit 36 presents the potential by measure for the Island Interconnected region. The columns provide the reduction for the measure, cumulative reduction, and CEPR, with measures sorted and numbered in order of increasing CEPR.
- Exhibit 37 presents the supply curve for the Island Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 36.
- Exhibit 38 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 39 presents the supply curve for the Labrador Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 38.
- Exhibit 40 presents the potential by measure for the Isolated region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 41 presents the supply curve for the Isolated region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 40.

Exhibit 36 Island Interconnected Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Lighting Demand Controls	3	3	$37.65
2	Refrigeration Demand Controls	1	4	$69.24
3	HVAC Demand Controls	10	14	$72.41
4	Heating Controls	2	16	$87.13
5	DHW Controls	13	29	$89.31
6	Thermal Storage	75	104	$240.96

Exhibit 37 Island Interconnected Demand Reduction Supply Curve

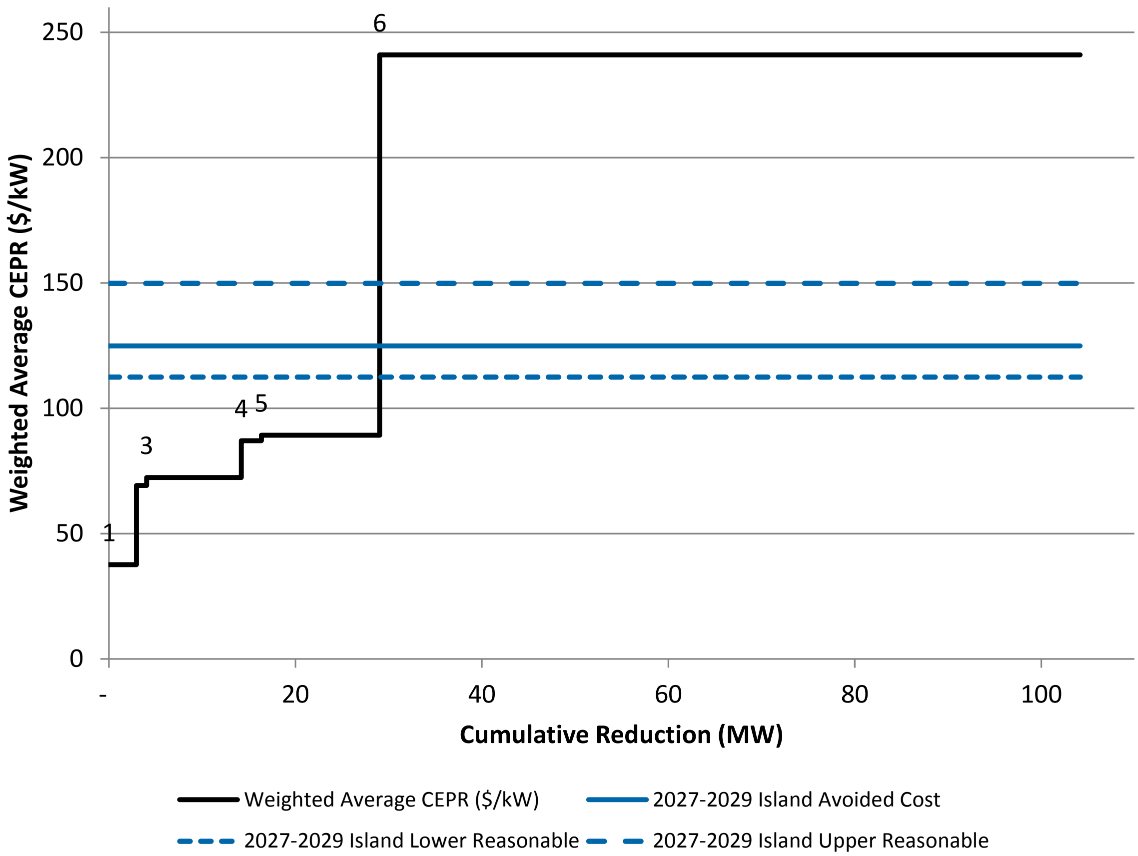


Exhibit 38 Labrador Interconnected Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Lighting Demand Controls	1	1	$37.65
2	Refrigeration Demand Controls	0	1	$69.24
3	HVAC Demand Controls	1	2	$72.41
4	DHW Controls	2	4	$85.31
5	Heating Controls	1	5	$87.13
6	Thermal Storage	8	12	$240.96

Exhibit 39 Labrador Interconnected Demand Reduction Supply Curve

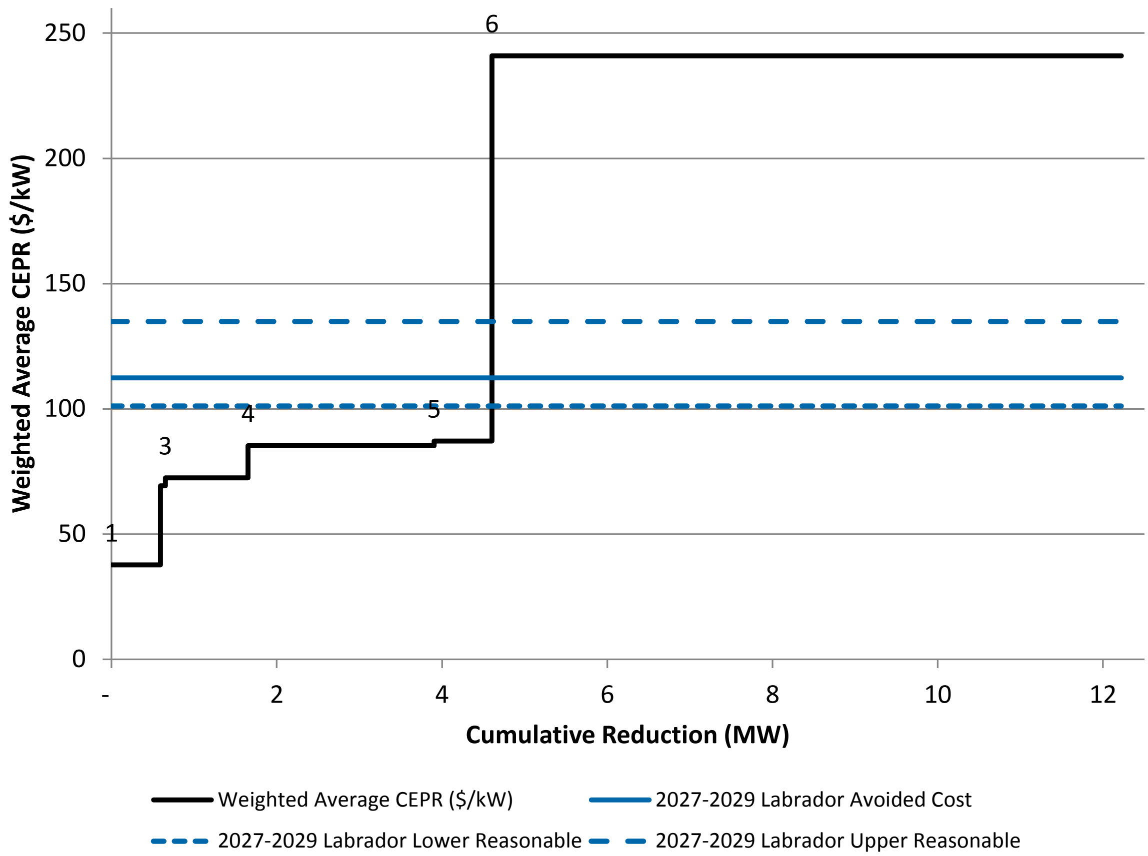
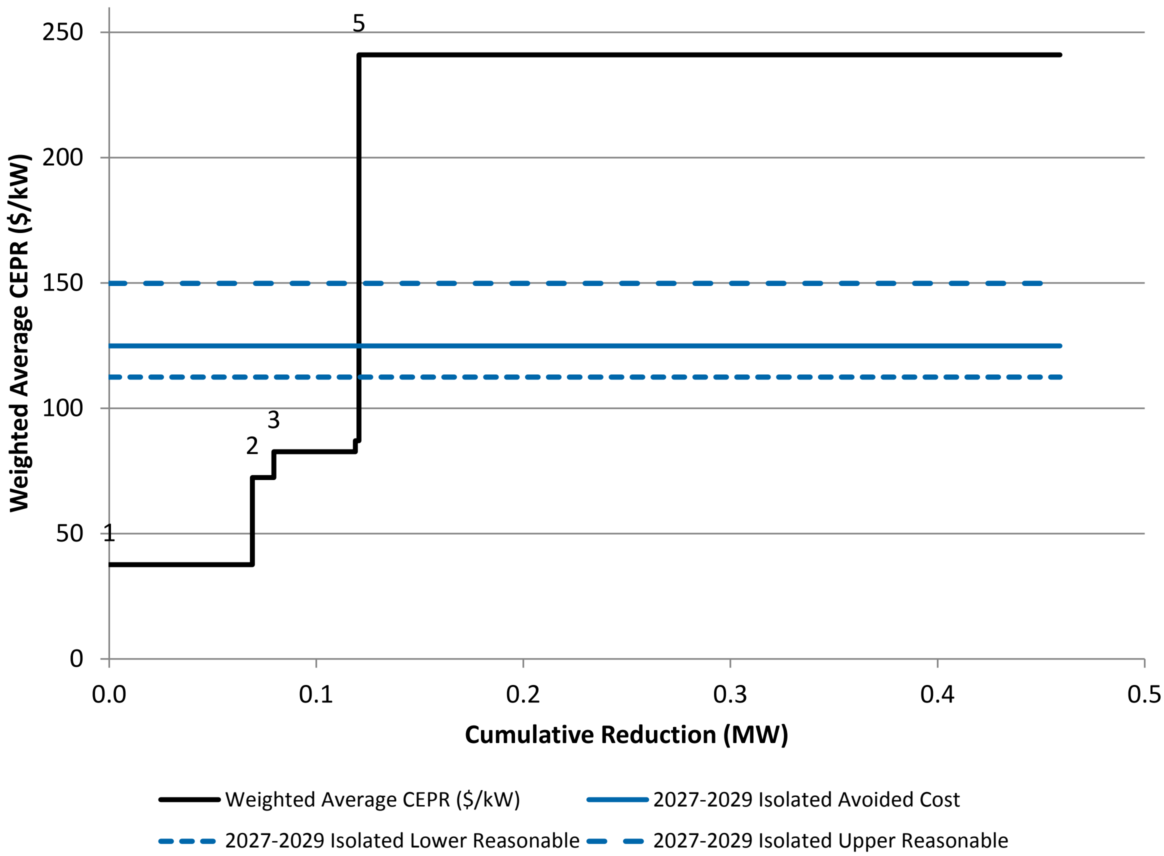


Exhibit 40 Isolated Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Lighting Demand Controls	0.07	0.07	$37.65
2	HVAC Demand Controls	0.01	0.08	$72.41
3	DHW Controls	0.04	0.12	$82.74
4	Heating Controls	0.00	0.12	$87.13
5	Thermal Storage	0.34	0.46	$240.96

Exhibit 41 Isolated Demand Reduction Supply Curve



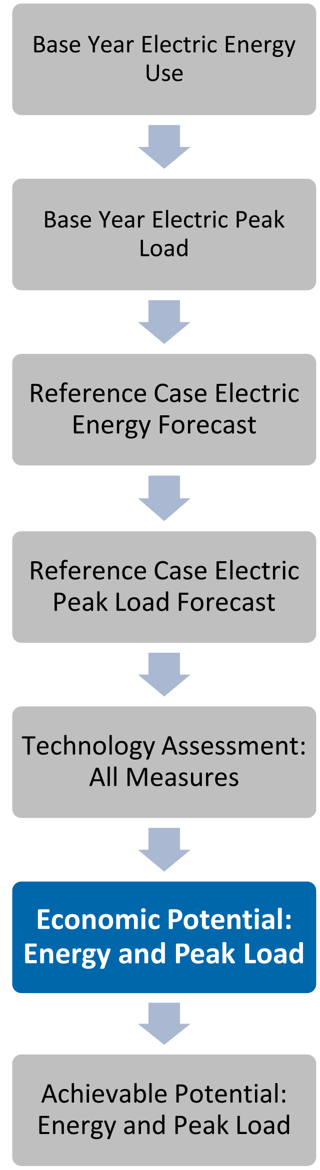
8 Economic Potential: Electric Energy Forecast

8.1 Introduction

This section presents the Commercial sector Economic Potential Forecast for electric energy and demand for the study period 2014 to 2029. The Economic Potential Electric Energy Forecast estimates the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold values for electricity in the three regions in NL. The model also estimates the peak demand implications of applying all the cost-effective efficiency measures. Starting from that point, the Economic Potential Peak Demand Forecast estimates the level of peak demand that would occur if all cost-effective demand reduction measures were also applied. In this study, "cost effective" means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) or the cost of electricity peak reduction (CEPR) in the preceding section, is equal to or less than the economic threshold value for a given region.

The discussion in this section covers the following:

- Avoided costs used for screening
- Major modelling tasks
- Technologies included in Economic Potential Forecast
- Presentation of energy efficiency results
- Interpretation of energy efficiency results
- Summary of peak load reductions from energy efficiency
- Presentation of load reduction results
- Interpretation of load reduction results
- Range of reasonableness.



8.2 Avoided Costs Used For Screening

The Utilities agreed on a set of economic threshold values for electricity supply to be used in this study. The values vary by region and milestone year as shown in Exhibit 42. Each of the values for the years after 2014 represents the average of the three years in the milestone period.

Exhibit 42 Avoided Costs of New Electricity Supply

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.108	$0.037	$0.21
2017	$0.125	$0.039	$0.23
2020	$0.050	$0.045	$0.26
2023	$0.059	$0.053	$0.29
2026	$0.068	$0.061	$0.34
2029	$0.076	$0.068	$0.37

The Economic Potential Electric Energy Forecast then incorporates all the electric energy-efficient upgrades that the technology assessment found to have a CCE equal to or less than these thresholds.

The Utilities also agreed on a set of economic threshold values for new generation capacity to be used in this study. These values also vary by region and milestone year as shown in Exhibit 43. Again, each value for the years after 2014 represents an average of the three years in the milestone period. The cost of new capacity for the Isolated region was not available. For the purposes of the study, the higher of the two values for the other two regions was used in each milestone year.

Exhibit 43 Avoided Costs of New Electric Generation Capacity

Year	Avoided Cost per kW		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$50.911	$72.059	
2017	$65.116	$82.527	
2020	$101.821	$91.601	
2023	$115.126	$103.571	
2026	$124.930	$112.390	
2029	$124.907	$112.370	

The Economic Potential Peak Demand Forecast then incorporates all the demand reduction upgrades that the technology assessment found to have a CEPR equal to or less than these thresholds.

The Utilities also provided a range of reasonableness for all of these avoided costs. The lower range for new electricity supply is considered to be 10% below the costs per kWh shown in Exhibit 42 while the upper range is considered to be 30% above those values. The upper range for new electric generation capacity supply is considered to be 10% below the costs per kW shown in Exhibit 43 while the upper range is considered to be 20% above those values. The purpose for establishing the range of reasonableness is to show the sensitivity of the results to varying avoided cost scenarios and to improve the ability of planners to examine options that may become more cost effective over time.

Emerging end-use technology measures are becoming cheaper over time as these markets become more cost effective. This is apparent by examining a range of measures whose costs have reduced significantly in the last several years (e.g., the cost of LED lamps has reduced by a factor of 5-10x since their introduction). Including these apparently more costly measures in this study allows the review of these measures in the near future, as programs are effective in introducing more competitiveness within these markets. At the same time, new sources of supply are expected to come online during the study period, so it is important to explore the implications of lower avoided costs.

8.3 Major Modelling Tasks

By comparing the results of the Commercial sector Economic Potential Electric Energy and Peak Demand Forecasts with the Reference Case, it is possible to determine the aggregate level of potential electricity savings and demand reductions within the Commercial sector, as well as identify which specific building sub sectors and end uses provide the most significant opportunities for savings.

To develop the Commercial sector Economic Potential Electric Energy Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibit 27 were reviewed, using the 7% (real) discount rate.
- Technology upgrades that had a CCE equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CCE that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Electricity use within each of the building sub sectors was modelled with the same energy models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.
- When more than one upgrade option was applied to a given end use, the first measure selected was the one that reduced the electrical load. For example, measures to reduce the overall space heating load (e.g., roof insulation and more efficient glazing) were applied before a heat pump.

To develop the Commercial sector Economic Potential Peak Demand Forecast, the following tasks were completed:

- The Economic Potential Electric Energy Forecast was used to generate the reductions in peak demand associated with efficiency improvements. These reductions were applied to the demand Reference Case to generate a Post-Efficiency Case to serve as the starting point for the demand reduction model. This was intended to avoid any double counting of demand reductions.
- The CEPR for each of the load reduction upgrades presented in Exhibit 28 were reviewed, using the 7% (real) discount rate.
- Technology upgrades that had a CEPR equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CEPR that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Peak demand within each of the building sub sectors was modelled with the same demand models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.

8.4 Technologies Included in Economic Potential Forecast

Exhibit 44 provides a listing of the efficiency technologies included in this forecast. Exhibit 45 provides a listing of the demand reduction technologies included in this forecast. In each case, the exhibits show the following:

- End use affected
- Upgrade option(s) selected
- Building type to which the upgrade options were applied
- Rate at which the upgrade options were introduced into the stock.

Some of the technologies listed in the exhibits below are the subject of current utility programs in the province of NL. The load forecast provided by the Utilities assumed a modest level of continued program activity and continued savings from efficiency improvements made under past programs, but no new program activity. The reference case for this project was constructed to be consistent with that forecast, in that the penetrations of the energy technologies below were not all assumed to remain static at their current levels. Reference case penetrations were assumed to increase, to account for natural adoption and the modest level of program activity assumed in the reference case.

In most cases, current programs are unlikely to capture all the economic potential for the technologies over the next 15 years. Therefore, none of the technologies have actually been removed from consideration in the study. Nonetheless, there are cases where the reference case penetration “catches up” to the economic penetration, and the economic potential diminishes, as can be seen later in this section in Exhibit 48.

Exhibit 44 Efficiency Technologies Included in Economic Potential Forecast

End Use Category	Upgrade Option	Applicability	Rate of Introduction
Computer Equipment	ENERGY STAR Computers	All existing facilities	At natural rate of replacement
	ENERGY STAR Office Equipment	All existing facilities	At natural rate of replacement
	Energy-Efficient Server Technologies	All existing facilities	At natural rate of replacement
Lighting	LED Screw-In Lamps	All existing facilities	Immediate
	LED Tubular Lamps	All existing facilities	At natural rate of replacement/Immediate in some facility types
	LED Troffers	All existing facilities	At natural rate of replacement
	High Performance T8 Fixtures	All existing facilities	Immediate
	LED Exit Signs	All existing facilities	Immediate
	LED High Bay Fixtures	Facilities with high bay fixtures (e.g. warehouses)	Immediate
	T5HO Fixtures	Facilities with high bay fixtures (e.g. warehouses)	Immediate
	Occupancy Sensors (Lighting)	All existing facilities	Immediate
	Dimming Control (Daylighting)	Facilities with a significant proportion of windows	Immediate
	LED Outdoor Fixtures	All existing facilities	At natural rate of replacement/Immediate in some cases
	Lighting Controls (Outdoor)	All existing facilities	Immediate
	LED Street Lighting	All street lighting	At natural rate of replacement/Immediate in some cases
DHW	Low-Flow Faucet Aerators	All existing facilities	Immediate
	On-Demand Water Heaters	Accommodation facilities	Immediate (at time of major renovation)
	Drainwater Heat Recovery	Accommodation facilities	Immediate (at time of major renovation)
	Heat Pump Water Heaters	Facilities with waste heat in their mechanical rooms (excludes retail and warehouses)	At natural rate of replacement/Immediate in some facility types
	Low-Flow Pre-Rinse Spray Valves	Facilities with larger commercial kitchens (excludes Offices)	Immediate
	ENERGY STAR Dishwashers	Facilities with larger commercial kitchens (excludes Offices)	At natural rate of replacement/Immediate in some facility types
	Low-Flow Showerheads	Facilities with significant shower use	Immediate
	Refrigeration Heat Recovery	Large Other facilities (focus on arenas)	Immediate
Refrigeration	LED Refrigerated Display Case Lighting	Food Retail and Large Non-Food Retail	At natural rate of replacement
	Cooler Night Covers	Food Retail and Large Non-Food Retail	Immediate

Exhibit 44 Efficiency Technologies Included in Economic Potential Forecast (cont'd…)

End Use Category	Upgrade Option	Applicability	Rate of Introduction
Refrigeration	Refrigerated Cases with Doors	Food Retail and Large Non-Food Retail	Immediate
	ECM Motors and Evaporator Fan Motor Controllers	All facilities with significant commercial refrigeration loads	Immediate
	Freezer Defrost Controllers	All facilities with significant commercial refrigeration loads	Immediate
	High Efficiency Compressors (Refrigeration)	Food Retail and Large Non-Food Retail	Immediate
	Automatic Door Closers (Walk-In Coolers & Freezers)	Food Retail and Restaurants	Immediate
	Refrigeration Controls	Food Retail and Large Non-Food Retail	Immediate
	CEE-Rated Refrigerators and Freezers	All facilities with stand-alone refrigerators	At natural rate of replacement
HVAC Equipment and Controls	High-Efficiency Air Source Heat Pumps	All commercial facilities with rooftop units (RTUs)	At natural rate of replacement/Immediate in some facility types
	Ground Source Heat Pumps	All existing facilities	At natural rate of replacement/Immediate in some facility types
	Ductless Mini-Split Heat Pump	All small commercial facilities	Immediate
	Ventilation Heat Recovery	Facilities where exhaust air ducting is located close to supply air ducting	Immediate
	Radiant Infrared Heaters	Warehouses	Immediate
	High Efficiency Chillers	All commercial facilities with chillers	At natural rate of replacement
	High Efficiency RTUs	All commercial facilities with rooftop units (RTUs)	At natural rate of replacement
	Hotel Occupancy Sensors	Accommodation facilities	Immediate
	Demand Control Ventilation (DCV)	Facilities with large variances in occupancy, excluding restaurants	Immediate
	Programmable Thermostats	All existing facilities	Immediate
	Demand Control Kitchen Ventilation (DCKV)	Restaurants	Immediate
	VFDs on HVAC Motors	All facilities with variable air volume (VAV) HVAC systems	Immediate
	Premium Efficiency Motors	All existing facilities	At natural rate of replacement
Building Envelope	Roof Insulation	All existing facilities	Immediate (at time of major renovation)
	Wall Insulation	All existing facilities	Immediate (at time of major renovation)
	High Performance Glazing Systems	All existing facilities	At natural rate of replacement
	Air Curtains	Food Retail and Large Non-Food Retail	Immediate

Exhibit 44 Efficiency Technologies Included in Economic Potential Forecast (cont'd…)

End Use Category	Upgrade Option	Applicability	Rate of Introduction
Whole Building	Advanced Building Automation Systems	Larger commercial facilities	Immediate
	Building Recommissioning	All existing facilities	Immediate
New Construction	New Construction (25% More Efficient)	All new facilities	At time of new construction
	New Construction (40% More Efficient)	All new facilities	At time of new construction
Other	Refrigerated Vending Machine Controllers	All facilities with vending machines	Immediate
	High-Efficiency Cooking Equipment	All facilities with commercial kitchens	At natural rate of replacement
	Block Heater Controls	Labrador and Isolated only	Immediate
Behaviour	Activate PC Power Management	All existing facilities	Immediate
	Make Use of Daylighting	Facilities with a significant proportion of windows	Immediate
	Use Task Light Instead of Ambient	Offices	Immediate
	Reduce Number of Fridges	Offices	Immediate
	Use Shades/Blinds (Winter)	Offices	Immediate
	Use Shades/Blinds (Summer)	Offices	Immediate
	Use Natural Ventilation (Summer)	Offices	Immediate
	Keep Doors Closed (Winter)	Retail facilities and Warehouses	Immediate
	Keep Doors Closed (Summer)	Retail facilities and Warehouses	Immediate

Exhibit 45 Load Reduction Technologies Included in Economic Potential Forecast

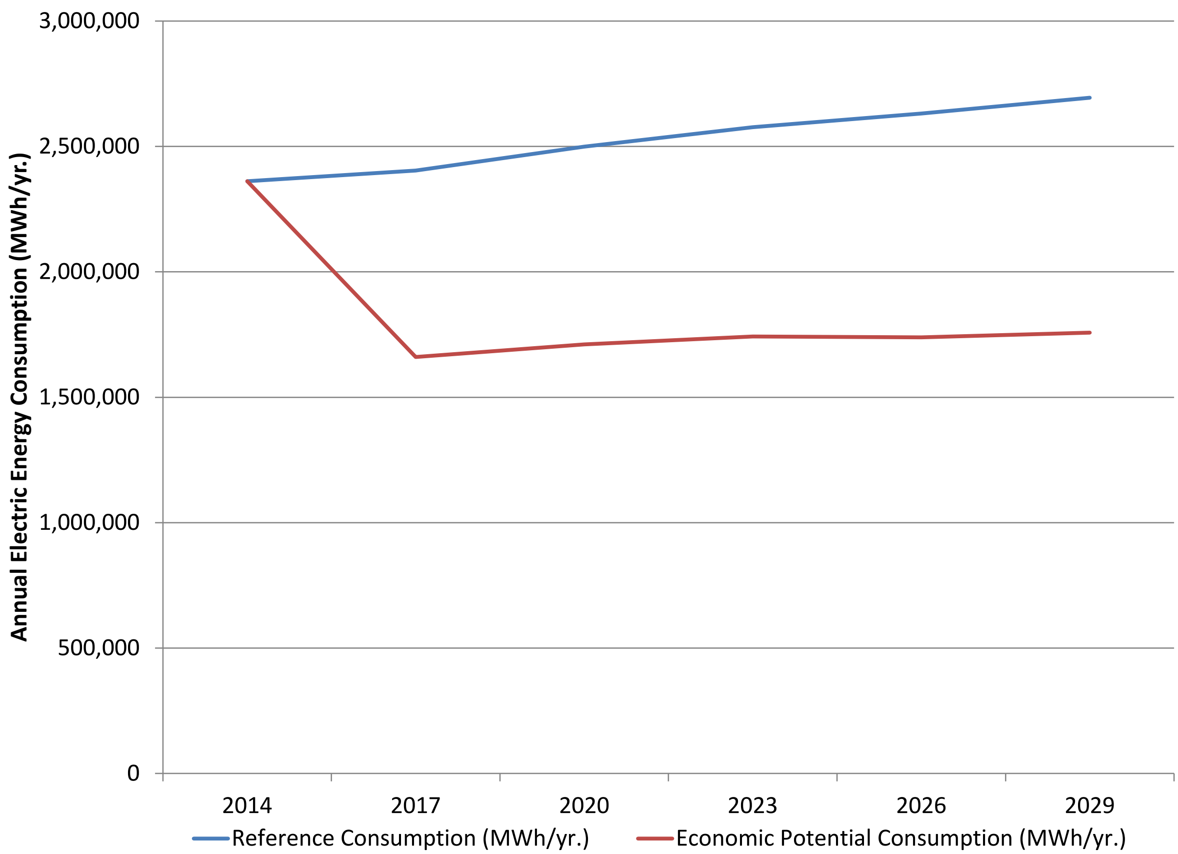
End Use Category	Upgrade Option	Applicability	Rate of Introduction
HVAC	Space Heating Controls	Accommodation facilities	Immediate
	Electric Thermal Storage Systems	All facilities, excluding large retail, Universities and Warehouses	Immediate
	HVAC Fans & Pumps Controls	Larger facilities with central HVAC controls	Immediate
Lighting	Lighting Controls	All facilities	Immediate
DHW	Domestic Hot Water (DHW) Controls	Facilities with DHW loads during peak periods	Immediate
Refrigeration	Refrigeration Controls	All facilities with significant refrigeration loads	Immediate

8.5 Summary of Electric Energy Savings

Exhibit 46 compares the commercial electricity consumption forecasts for the Reference Case and the Economic Potential Electric Energy scenarios.[23] Under the Reference Case, commercial electricity consumption would grow from the Base Year level of about 2,360 GWh/yr. to approximately 2,700 GWh/yr. by 2029. This contrasts with the Economic Potential Forecast in which electricity use would decrease to approximately 1,760 GWh/yr. for the same period. This represents a difference of approximately 940 GWh/yr., or about 35%.

The exhibit shows a large fraction of the economic potential savings occurring in the first milestone period. There are several reasons for this, including a large number of measures that pass on a full-cost basis, and avoided costs in the Island Interconnected region that are forecast to drop sharply after 2018. These factors are discussed in more detail in Section 8.5.2.

Exhibit 46 Reference Case versus Economic Potential Electric Energy Consumption in Commercial Sector (MWh/yr.)



[23] All results are reported at the customer's point-of-use and do not include line losses.

8.5.1 Electric Energy Savings

Further detail on the total potential electric energy savings provided by the Economic Potential Forecast is provided in the following exhibits:[24]

- Exhibit 47 presents the results by end use, sub sector and milestone year
- Exhibit 48 provides a further disaggregation of the savings by measure and milestone year
- Exhibit 49 presents savings by major end use, milestone year and region
- Exhibit 50 presents savings by major end use, milestone year and sub sector
- Exhibit 51 presents savings by major end use, milestone year and vintage

[24] MWh/yr. savings shown in the following exhibits are not incremental. For example, the space heating savings in 2029 are not in addition to the space heating savings from the previous milestone years. Rather, they are the difference between the Reference Case space heating consumption in 2029 and the space heating consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 47 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year (MWh/yr.)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Refrigeration	Domestic Hot Water	Computer Equipment	Secondary Lighting	Outdoor Lighting	Street Lighting	Space Cooling	Other Plug Loads	Food Service Equipment	Computer Servers	TOTAL
Large Office	2017	35,396	21,111	14,702	112	2,009	7,233	4,890	1,856	-	2,385	2,000	-	643	**92,337**
	2020	40,728	20,671	15,130	118	2,047	9,231	4,640	2,251	-	2,430	2,048	-	1,093	**100,389**
	2023	47,060	20,538	15,984	132	2,129	9,532	4,441	2,669	-	2,563	2,101	-	1,114	**108,262**
	2026	51,318	25,502	16,999	148	2,227	9,797	4,260	2,988	-	2,728	2,149	-	1,135	**119,251**
	2029	58,110	25,654	18,382	170	2,363	10,076	4,119	2,902	-	2,967	2,199	-	1,156	**128,099**
Small Office	2017	44,075	15,639	6,969	-	1,515	5,995	1,842	1,540	-	2,384	215	-	534	**80,708**
	2020	44,508	15,394	7,186	-	1,648	7,685	1,745	1,867	-	2,407	231	-	908	**83,577**
	2023	45,850	15,353	7,715	-	1,830	7,923	1,667	2,218	-	2,511	245	-	925	**86,236**
	2026	45,843	18,520	8,269	-	2,012	8,134	1,591	2,479	-	2,621	256	-	943	**90,666**
	2029	48,379	19,236	9,021	-	2,186	8,355	1,526	2,402	-	2,782	268	-	960	**95,116**
Large Non-food Retail	2017	9,704	17,204	9,596	2,257	489	602	1,411	1,471	-	948	829	-	-	**44,511**
	2020	11,305	16,818	9,720	2,300	502	772	1,344	1,786	-	955	846	-	-	**46,347**
	2023	13,142	16,653	10,057	2,405	533	797	1,294	2,126	-	994	862	-	-	**48,864**
	2026	15,226	16,513	10,418	2,492	565	819	1,247	2,382	-	1,037	878	-	-	**51,577**
	2029	17,206	16,521	10,914	2,614	610	843	1,211	2,318	-	1,100	895	-	-	**54,231**
Small Non-food Retail	2017	18,270	16,073	7,408	-	760	887	1,936	2,174	-	1,105	-	-	-	**48,613**
	2020	20,230	15,879	7,578	-	776	1,135	1,842	2,634	-	1,118	-	-	-	**51,191**
	2023	21,848	15,704	7,891	-	805	1,169	1,761	3,112	-	1,159	-	-	-	**53,449**
	2026	23,084	18,549	8,283	-	842	1,200	1,688	3,473	-	1,215	-	-	-	**58,333**
	2029	26,040	18,600	8,817	-	893	1,232	1,628	3,354	-	1,299	-	-	-	**61,863**
Food Retail	2017	8,169	10,190	3,909	33,502	909	688	951	1,071	-	472	789	163	-	**60,813**
	2020	9,536	10,028	3,979	33,872	926	880	924	1,301	-	474	804	345	-	**63,068**
	2023	10,849	9,914	4,099	34,930	969	906	914	1,552	-	487	820	517	-	**65,958**
	2026	12,165	9,812	4,230	35,784	1,016	929	899	1,743	-	501	835	574	-	**68,489**
	2029	13,559	9,786	4,413	37,022	1,079	954	894	1,702	-	524	850	574	-	**71,357**
Large Accomodation	2017	9,754	4,933	2,051	360	6,988	354	2,396	481	-	355	390	58	-	**28,119**
	2020	10,151	4,787	2,075	363	7,455	453	2,281	582	-	356	398	58	-	**28,960**
	2023	10,722	4,692	2,146	389	8,039	467	2,210	691	-	370	405	58	-	**30,189**
	2026	11,309	4,581	2,221	401	8,632	479	2,145	772	-	386	413	58	-	**31,396**
	2029	12,525	4,491	2,325	418	9,316	492	2,108	748	-	409	421	58	-	**33,308**
Small Accomodation	2017	4,724	2,389	340	0	3,337	159	643	214	-	91	174	-	-	**12,069**
	2020	4,840	2,309	347	2	3,545	203	611	259	-	92	177	-	-	**12,384**
	2023	5,032	2,244	365	7	3,804	209	591	306	-	98	181	-	-	**12,836**
	2026	5,332	2,177	384	13	4,072	214	573	342	-	105	184	-	-	**13,396**
	2029	5,579	2,118	411	21	4,378	220	563	330	-	115	187	-	-	**13,922**

Exhibit 47 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year (MWh/yr.) (cont'd…)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Refrigeration	Domestic Hot Water	Computer Equipment	Secondary Lighting	Outdoor Lighting	Street Lighting	Space Cooling	Other Plug Loads	Food Service Equipment	Computer Servers	TOTAL
Healthcare	2017	36,691	1,670	14,522	162	2,587	1,197	3,849	1,606	-	692	151	173	140	**63,438**
	2020	37,767	1,723	14,946	168	2,858	1,525	3,707	1,938	-	701	154	345	237	**66,070**
	2023	38,734	1,702	15,160	179	3,157	1,566	3,629	2,280	-	709	157	518	242	**68,033**
	2026	39,687	1,903	15,425	193	3,472	1,604	3,580	2,531	-	723	160	576	246	**70,099**
	2029	40,867	1,986	15,793	213	3,770	1,642	3,586	2,424	-	746	163	576	251	**72,016**
Schools	2017	44,326	16,758	2,417	110	2,231	2,306	2,926	2,574	-	63	307	-	-	**74,016**
	2020	45,341	16,530	2,454	115	2,263	2,951	2,790	3,115	-	69	313	-	-	**75,940**
	2023	47,323	16,488	2,526	123	2,322	3,041	2,730	3,668	-	79	319	-	-	**78,619**
	2026	48,896	16,862	2,637	134	2,385	3,123	2,633	4,078	-	92	325	-	-	**81,164**
	2029	50,672	16,994	2,762	147	2,471	3,208	2,710	3,913	-	109	331	-	-	**83,318**
Universities and Colleges	2017	2,922	19,998	17,143	774	489	2,966	1,392	1,347	-	396	956	-	106	**48,488**
	2020	3,408	19,576	17,190	777	500	3,771	1,329	1,622	-	406	974	-	181	**49,734**
	2023	4,224	19,173	17,267	790	516	3,860	1,271	1,897	-	425	993	-	184	**50,599**
	2026	5,118	18,909	17,469	815	554	3,946	1,231	2,106	-	480	1,012	-	188	**51,826**
	2029	6,190	18,643	17,669	839	591	4,032	1,191	2,003	-	536	1,030	-	191	**52,915**
Warehouse/Wholesale	2017	9,491	11,239	727	852	574	555	442	978	-	17	-	-	-	**24,877**
	2020	11,448	11,412	746	862	582	711	411	1,179	-	18	-	-	-	**27,368**
	2023	13,713	11,260	793	986	609	732	394	1,394	-	20	-	-	-	**29,901**
	2026	16,359	11,294	835	1,046	634	751	370	1,548	-	22	-	-	-	**32,859**
	2029	18,576	11,180	886	1,130	666	771	511	1,485	-	25	-	-	-	**35,230**
Restaurants	2017	6,393	1,013	848	1,710	6,693	133	3,930	194	-	222	-	681	-	**21,817**
	2020	7,071	1,012	868	1,807	6,826	170	3,765	236	-	226	-	1,363	-	**23,343**
	2023	7,647	1,006	902	2,072	7,295	175	3,619	279	-	234	-	2,044	-	**25,274**
	2026	8,437	1,004	943	2,288	7,570	180	3,480	311	-	246	-	2,272	-	**26,729**
	2029	9,260	1,013	997	2,588	7,944	184	3,359	301	-	262	-	2,272	-	**28,181**
Labrador Isolated C/I Buildings	2017	- 330	2,812	277	647	49	306	431	542	-	-	157	-	-	**4,893**
	2020	- 310	2,864	310	1,034	53	405	428	529	-	-	160	-	-	**5,473**
	2023	- 266	2,895	343	1,427	56	418	423	516	-	-	164	-	-	**5,975**
	2026	- 221	2,951	384	1,610	59	431	425	507	-	-	167	-	-	**6,312**
	2029	- 174	3,013	436	1,702	64	443	434	502	-	-	170	-	-	**6,589**
Island Isolated C/I Buildings	2017	- 64	263	26	61	-	29	42	51	-	-	15	-	-	**422**
	2020	- 64	270	30	98	-	38	42	50	-	-	15	-	-	**479**
	2023	- 61	274	33	135	-	39	42	49	-	-	15	-	-	**525**
	2026	- 59	280	37	153	-	41	42	48	-	-	16	-	-	**558**
	2029	- 56	287	42	162	-	42	43	48	-	-	16	-	-	**584**

Exhibit 47 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year (MWh/yr.) (cont'd…)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Refrigeration	Domestic Hot Water	Computer Equipment	Secondary Lighting	Outdoor Lighting	Street Lighting	Space Cooling	Other Plug Loads	Food Service Equipment	Computer Servers	TOTAL
Large Other Buildings	2017	23,286	14,207	9,809	339	4,562	2,385	3,787	1,947	-	845	1,672	-	-	**62,840**
	2020	27,260	14,223	9,936	413	5,124	3,047	3,600	2,352	-	853	1,705	-	-	**68,514**
	2023	32,510	14,408	10,110	529	5,193	3,132	3,436	2,761	-	871	1,738	-	-	**74,687**
	2026	36,861	14,340	10,502	796	5,356	3,210	3,331	3,085	-	931	1,771	-	-	**80,183**
	2029	41,277	14,276	10,898	1,066	5,521	3,290	3,232	2,962	-	990	1,804	-	-	**85,316**
Small Other Buildings	2017	21,487	10,048	5,347	0	2,273	2,127	2,871	1,781	-	593	-	-	-	**46,529**
	2020	22,765	9,988	5,414	38	2,297	2,711	2,721	2,146	-	592	-	-	-	**48,672**
	2023	25,953	10,125	5,540	125	2,351	2,787	2,594	2,518	-	605	-	-	-	**52,597**
	2026	29,908	11,656	5,800	310	2,891	2,857	2,505	2,807	-	644	-	-	-	**59,377**
	2029	32,411	11,573	6,094	520	3,386	2,929	2,428	2,691	-	689	-	-	-	**62,719**
Other Institutional	2017	9,842	-	1,179	-	546	258	22	547	-	19	-	-	-	**12,412**
	2020	17,828	-	1,208	-	546	350	19	631	-	18	-	-	-	**20,600**
	2023	23,123	29	1,239	4	550	357	24	716	-	18	-	-	-	**26,061**
	2026	28,089	2,627	2,411	7	554	364	27	798	-	47	-	-	-	**34,924**
	2029	30,009	2,600	2,439	11	559	371	32	847	-	47	-	-	-	**36,916**
Street Lighting	2017	-	-	-	-	-	-	-	-	17,083	-	-	-	-	**17,083**
	2020	-	-	-	-	-	-	-	-	16,530	-	-	-	-	**16,530**
	2023	-	-	-	-	-	-	-	-	15,941	-	-	-	-	**15,941**
	2026	-	-	-	-	-	-	-	-	15,311	-	-	-	-	**15,311**
	2029	-	-	-	-	-	-	-	-	14,638	-	-	-	-	**14,638**
Grand Total	2017	284,135	165,544	97,271	40,886	36,012	28,181	33,762	20,374	17,083	10,585	7,655	1,074	1,423	**743,986**
	2020	313,812	163,484	99,116	41,968	37,946	36,040	32,199	24,477	16,530	10,714	7,826	2,110	2,418	**788,639**
	2023	347,403	162,458	102,169	44,234	40,157	37,109	31,040	28,751	15,941	11,143	7,998	3,137	2,465	**834,005**
	2026	377,351	177,479	107,245	46,188	42,841	38,078	30,028	31,999	15,311	11,775	8,165	3,479	2,511	**892,450**
	2029	410,430	177,969	112,300	48,622	45,797	39,084	29,576	30,931	14,638	12,600	8,333	3,479	2,558	**936,317**

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
4) MWh/yr. savings are not incremental. The space heating savings in 2029 are not in addition to the savings from the previous milestone years. Rather, they are the difference between the Reference Case space heating consumption in 2029 and the space heating consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 48 Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Building Recommissioning	137,102	133,362	128,738	128,412	123,507
High-Efficiency Air Source Heat Pumps	45,572	71,317	96,559	120,842	144,057
Ductless Mini-Split Heat Pump	79,528	81,486	80,623	82,501	82,190
Advanced Building Automation Systems	54,053	52,542	50,623	47,612	45,501
Programmable Thermostats	53,150	51,176	48,444	45,286	42,110
Occupancy Sensors (Lighting)	39,154	38,926	39,384	38,737	38,093
Demand Control Ventilation (DCV)	38,334	36,498	42,422	38,946	35,175
ENERGY STAR Computers	19,568	26,603	27,114	27,626	28,137
VFDs on HVAC Motors	24,176	24,176	24,176	24,205	24,205
LED Tubular Lamps	20,749	18,649	16,599	32,973	31,915
Ventilation Heat Recovery	19,429	23,712	23,712	23,712	23,712
High Performance T8 Fixtures	21,584	22,254	21,869	21,403	20,938
New Construction (25% More Efficient)	925	6,523	17,289	30,239	47,934
Low-Flow Faucet Aerators	19,005	18,906	18,814	18,722	18,629
LED Outdoor Fixtures	7,605	14,484	21,161	26,078	24,502
LED Screw-In Lamps	20,760	19,513	18,277	17,053	15,840
LED Street Lighting	17,083	16,530	15,941	15,311	14,638
High Performance Glazing Systems	5,575	8,854	12,601	19,915	31,999
LED Screw-In Lamps	16,135	15,110	14,101	13,109	12,134
Refrigerated Cases with Doors	13,416	13,416	13,416	13,416	13,416
New Construction (40% More Efficient)	561	2,674	8,009	15,513	24,134
High Efficiency Compressors (Refrigeration)	9,347	9,368	9,389	9,410	9,431
Ground Source Heat Pumps	9,586	9,046	8,511	7,951	7,420
Activate PC Power Management	7,706	7,588	8,110	8,531	8,990
Lighting Controls (Outdoor)	12,729	9,731	6,882	4,659	4,463
Refrigerated Vending Machine Controllers	7,178	7,319	7,460	7,601	7,741
ECM Motors and Evaporator Fan Motor Controllers	6,672	6,574	6,973	6,870	6,768
Heat Pump Water Heaters	5,085	5,852	6,062	6,713	7,204
Low-Flow Showerheads	6,036	5,831	5,640	5,450	5,259
LED Tubular Lamps	6,232	5,870	5,515	5,162	5,122
LED High Bay Fixtures	5,218	5,059	4,900	4,739	4,567
Wall Insulation	2,671	3,437	4,204	5,504	6,443
T5HO Fixtures	4,545	4,503	4,251	3,938	3,633
Cooler Night Covers	4,153	4,138	4,116	4,124	4,138
Radiant Infrared Heaters	3,798	3,799	3,779	4,425	4,415
Refrigeration Controls	3,421	3,642	3,636	3,648	3,660
High Performance T8 Fixtures	3,642	3,568	3,506	3,432	3,357
Hotel Occupancy Sensors	3,293	3,234	3,174	3,097	2,942
ENERGY STAR Dishwashers	2,868	2,865	3,140	3,136	3,133
Roof Insulation	2,047	2,441	2,836	3,231	3,625
CEE-Rated Refrigerators and Freezers	2,096	2,478	2,859	2,986	2,986
High-Efficiency Cooking Equipment	1,074	2,110	3,137	3,479	3,479
Drainwater Heat Recovery	822	1,774	2,661	3,548	4,435

Exhibit 48 Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.) (cont'd)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Energy-Efficient Server Technologies	1,423	2,418	2,465	2,511	2,558
Premium Efficiency Motors	714	1,526	2,286	3,041	3,795
Demand Control Kitchen Ventilation (DCKV)	2,390	2,547	2,360	2,088	1,854
ENERGY STAR Office Equipment	907	1,849	1,885	1,921	1,956
Make Use of Daylighting	1,227	1,278	1,320	1,246	1,263
LED High Bay Fixtures	1,345	1,299	1,253	1,208	1,163
Low-Flow Pre-Rinse Spray Valves	1,171	1,160	1,152	1,143	1,135
T5HO Fixtures	1,153	1,075	1,040	963	888
Refrigeration Heat Recovery	931	922	913	905	896
Automatic Door Closers (Walk-In Coolers & Freezers)	669	670	665	666	667
Use Task Light Instead of Ambient	660	651	643	539	524
LED Refrigerated Display Case Lighting	985	792	598	403	207
Reduce Number of Fridges	477	507	538	564	592
LED Exit Signs	572	477	385	296	211
Use Shades/Blinds (Winter)	295	295	294	286	274
Keep Doors Closed (Winter)	189	184	179	167	157
Dimming Control (Daylighting)	112	129	131	133	135
LED Troffers	31	60	89	116	112
Use Shades/Blinds (Summer)	41	44	46	47	48
Use Natural Ventilation (Summer)	20	21	22	23	23
Keep Doors Closed (Summer)	11	12	12	13	13
Freezer Defrost Controllers	-	-	10	9	9
High Efficiency Chillers	5	4	4	3	3
HVAC Impact from Other Savings	- 35,027	- 36,221	- 34,898	- 39,084	- 38,142
Grand Total	**743,986**	**788,639**	**834,005**	**892,450**	**936,317**

Exhibit 49 Economic Potential Savings by Major End Use, Year and Region (MWh/yr.)

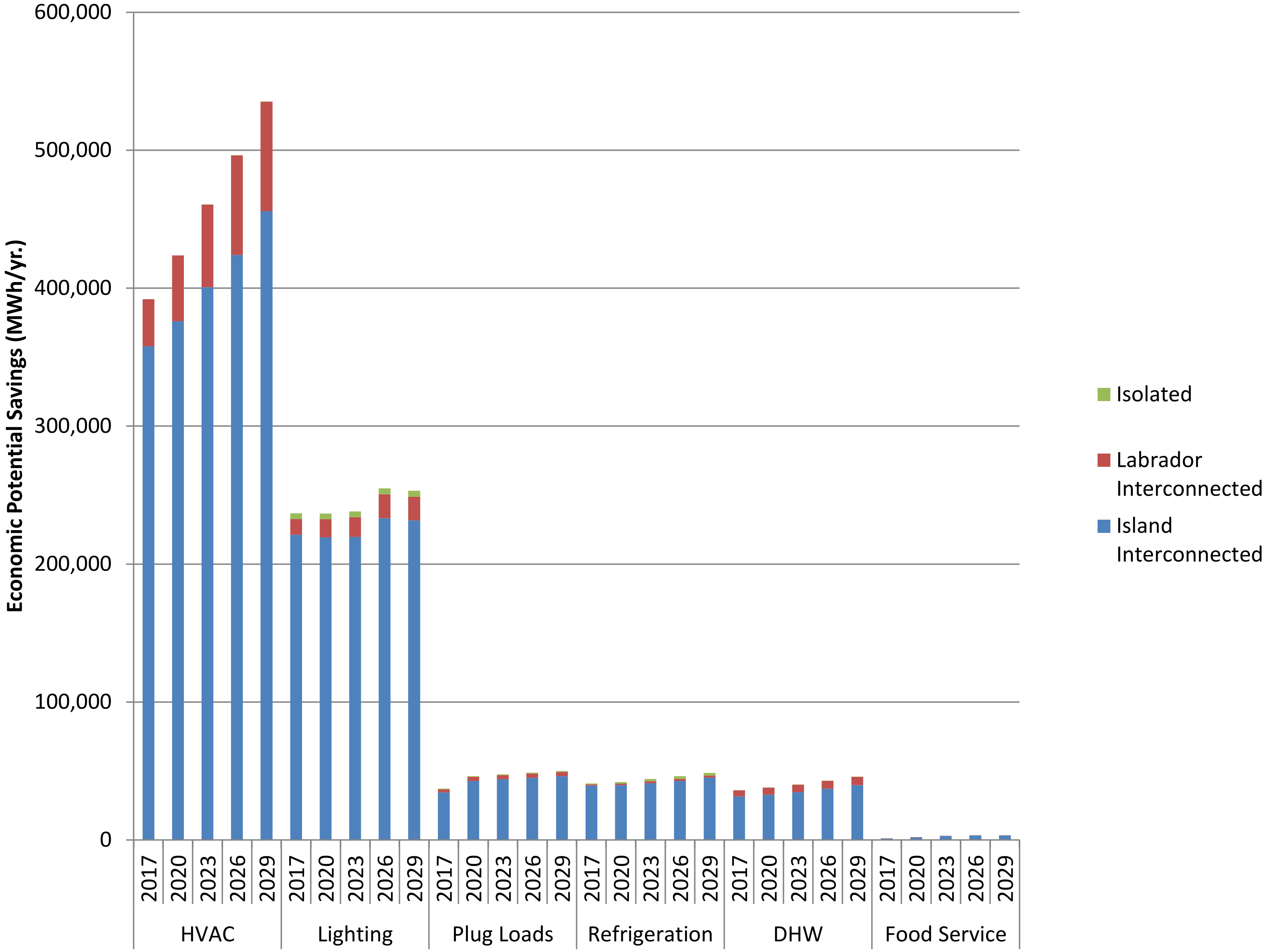


Exhibit 50 Economic Potential Savings by Major End Use, Year and Sub sector Type (MWh/yr.)

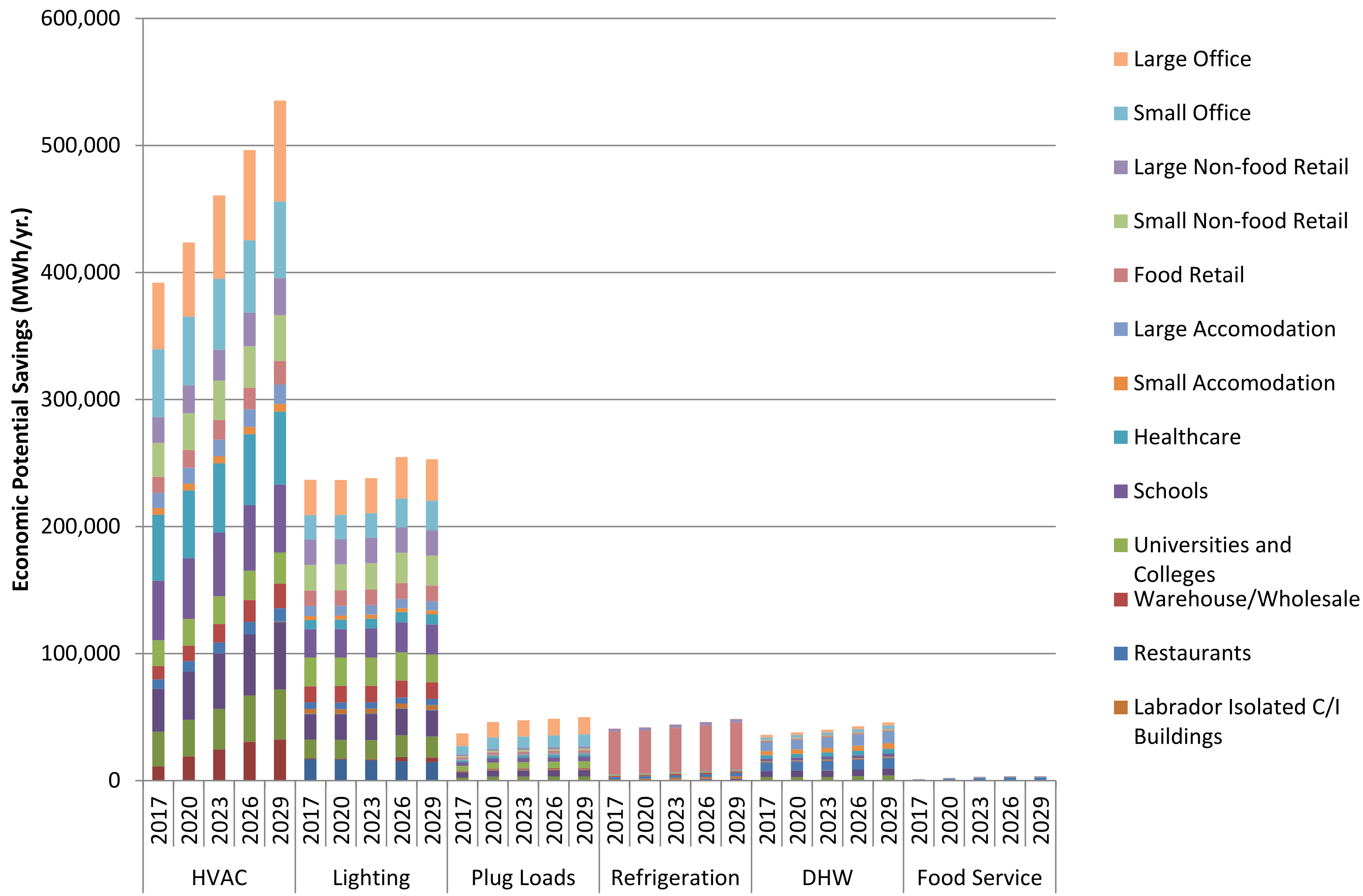
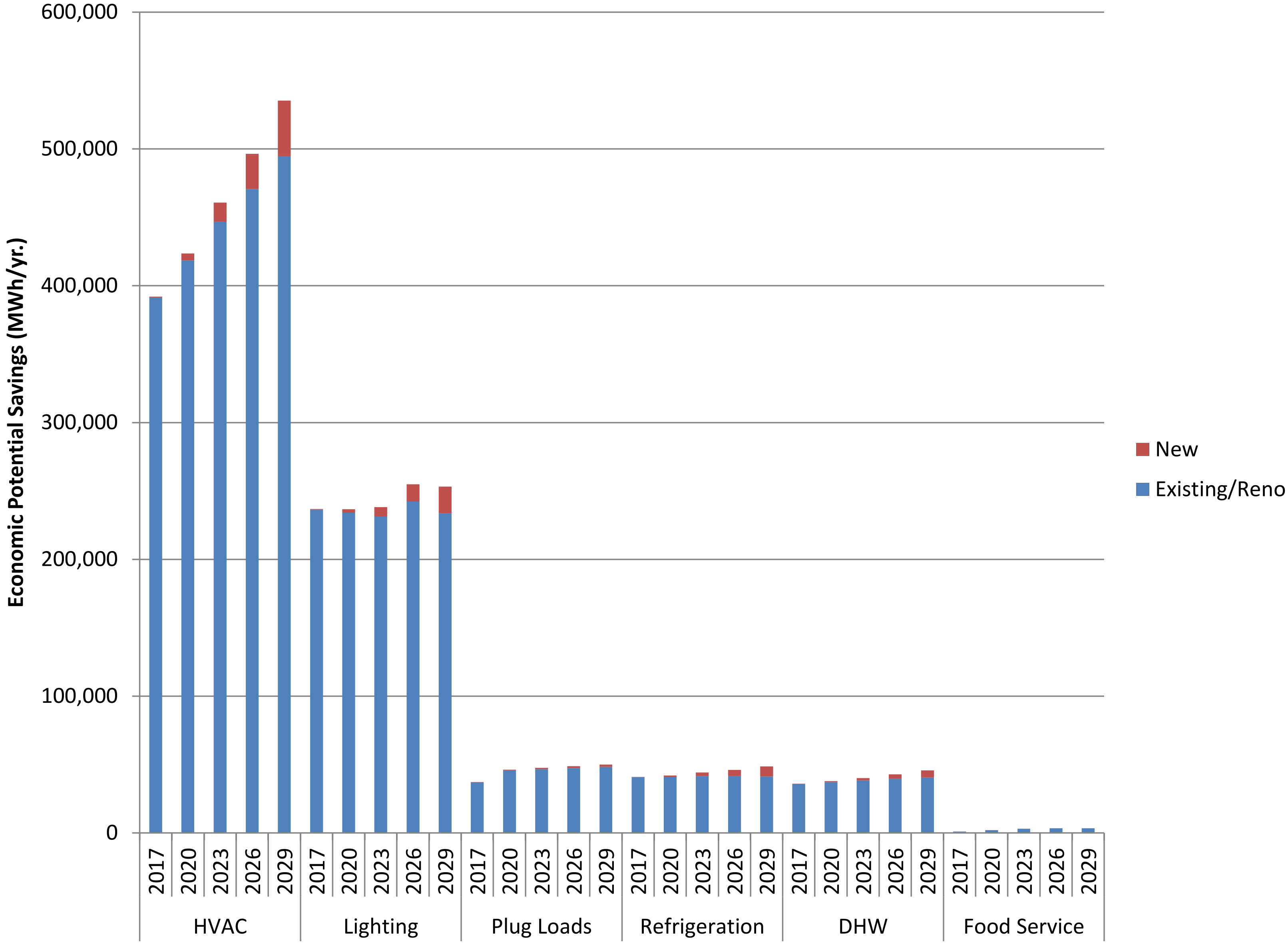


Exhibit 51 Economic Potential Savings by Major End Use, Year and Vintage (MWh/yr.)



8.5.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Savings by Milestone Year
The Economic Potential savings increase modestly from about 740 GWh/yr. in 2017 to approximately 940 GWh/yr. in 2029. As such, almost 80% of the savings possible at the end of the study period are already economically viable within the first milestone period. This occurs because it is economically attractive to implement the majority of the efficiency upgrades immediately, before the existing equipment reaches the end of its useful life. Many of the measures pass the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year.

Savings by Sub sector
Office Buildings account for about 24% of the potential savings in 2029, with over 10% of the potential savings in Small Offices and 14% of the savings occurring in Large Offices. This reflects their large share of the commercial floor area and energy use. Retail facilities, including Small Non-Food Retail, Large Non-Food Retail, and Food Retail, also account for a significant portion of the overall 2029 savings, at about 20%. Other notable sub sectors include Educational facilities at about 15% and Hospitality and Healthcare facilities each at about 8% of the 2029 economic potential savings.

Savings by Region
The Island Interconnected region accounts for the overwhelming majority of the potential savings in 2029, at about 88%. The Labrador Interconnected region accounts for about 11% of the 2029 potential savings, and the Isolated region accounts for the remaining 1% of the potential savings. This distribution reflects the overall breakdown in the consumption for the three regions but the 2029 potential savings versus the reference case are highest in the Labrador region (36%) and lowest in the Isolated region (32%). The economic potential savings in the Island region in 2029 represent 35% of the reference case consumption in that milestone year.

Savings By Existing Buildings versus New Construction
Savings in existing buildings account for almost all of the savings potential at the beginning of the study period but, as buildings are constructed, the savings potential associated with them occupies a progressively larger portion of the total. By 2029, savings from new buildings account for about 8% of the total economic potential.

Savings by End Use
Savings in the HVAC major end use (which includes space heating, space cooling, and HVAC Fans and Pumps) accounts for 57% of the total electrical savings in the Economic Potential Forecast. Nearly 77% of this savings, or 44% of the overall savings, is from space heating measures, including air source heat pumps (15% of overall savings), ductless mini-split heat pumps (9% of overall savings), recommissioning (5% of overall savings)[25], and demand control ventilation (4% of overall savings). Other space heating measures account for 3% or less of the overall savings. In addition, the "HVAC Impact from Other Savings" measure, which represents increased heating requirements due to less heat being generated in the buildings envelope, accounts for -4% of the overall economic potential savings (i.e. a penalty on the savings).

> Space heating measures dominate the results, including both efficient equipment and building envelope improvements.

[25] As noted below, the recommissioning measure applies to multiple end uses. As such, it accounts for a larger portion of the economic potential savings. Only the savings that apply to the space heating end use are noted here.

Measures related to HVAC Fans and Pumps account for 12% of the total Economic Potential savings. Recommissioning represents 4% of the overall savings[26], while 3% of the overall savings are from VFDs, 2% are from advanced BAS, and another 2% are from programmable thermostats. Space cooling measures account for only 1% of the overall economic potential savings, reflecting the relatively small space cooling load in Newfoundland and Labrador.

The Lighting major end use (which is made up of General Lighting, Secondary Lighting, Outdoor Lighting, and Street Lighting) accounts for 27% of the total electricity savings in the Economic Potential Forecast. General lighting measures account for about 70% lighting savings, followed by outdoor lighting measures (12%), secondary lighting measures (12%), and street lighting measures (6%). LED lighting measures account for about 13% of the total electricity savings at the beginning of the Economic Potential Forecast but fall to 12% by 2029. This is due to the expected natural adoption of LED lighting products or other products of similar efficiency by the end of the study period.

DHW measures account for 5% of the total electricity savings in the Economic Potential Forecast. This is made up of 3% of the overall savings from low flow fixtures, such as showerheads, faucets, and faucet aerators, and 1% of the overall savings from heat pump water heaters. Other DHW measures account for less than 1% of the potential savings.

Measures that pertain to Plug Loads (made up of the Computer Equipment, Computer Servers and Plug Loads end uses) account for 5% of the total electricity savings in the Economic Potential Forecast. Of this, 3% is from ENERGY STAR® Computers, 1% is from the behavior measure related to implementing PC power management features and 1% is from vending machine controllers.

Refrigeration measures also account for about 5% of the total electricity savings in the Economic Potential Forecast. Refrigerated display cases, high efficiency compressors and evaporator fan upgrades each account for approximately 1% of these overall economic potential savings. Other refrigeration measures account for less than 1% of total electricity savings.

Some measures are applied across multiple end uses. The energy saving measures applied across multiple end uses include recommissioning, advanced BAS and the high performance new construction (HPNC) measures. Recommissioning accounts for a total of 13% of the electricity savings in the Economic Potential Forecast, while the HPNC measures account for about 8% of the economic savings (i.e. 5% savings from HPNC (25% better) and 3% savings from HPNC (40% better)). The Advanced BAS measure accounts for approximately 5% of the overall economic potential savings.

8.5.3 Caveats on Interpretation of Results

A systems approach was used to model the energy impacts of the efficiency upgrades presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible. More specifically, there are two particularly important considerations:

- **More than one upgrade may affect a given end use:** For example, improved insulation reduces space heating electricity use, as does the installation of a heat pump. On its own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the

[26] As noted below, the recommissioning measure applies to multiple end uses. As such, it accounts for a larger portion of the economic potential savings. Only the savings that apply to the HVAC fans and pumps end use are noted here.

approach has been to select and model the impact of "bundles of measures" that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a high-efficiency space heating system).

- **There are interactive effects among end uses:** For example, the electricity savings from more efficient lighting result in reduced waste heat. During the space heating season, this waste heat contributes to the building's internal heat gains, which lower the amount of heat that must be provided by the space heating system. Interactive effects have been taken into consideration with the measure "HVAC Impact from Other Savings". The magnitude of the interactive effects can be significant. For example, for low bay lighting measures, it was estimated that a 100 kWh savings in lighting electricity use results, on average, in an increased space heating load of up to 30 kWh (a 60% rate of interaction).

  However, it is important to note that assessing the impact of interactive effects in commercial facilities is more complex since heat may be generated in spaces that heat the main conditioned space much less effectively (e.g. high bay fixtures or equipment in mechanical rooms). Interactive effects were captured on a measure by measure basis for measures that were more likely to have an impact on space heating requirements and a 30% heating penalty was assumed for this subset of measures. The subset of measures included low bay lighting measures (i.e. LED screw-in lamps, LED tubular lamps, and high performance T8 fixtures), ENERGY STAR computers and office equipment, and refrigerated vending machine controllers.

  The model implements this interaction by multiplying the savings for any relevant measures with significant interactive effects by the 30% factor. This becomes the additional heating load for the building. This is, in turn, multiplied by the space heating electric share for the type of building, because the non-electric heating sources are assumed to provide their share of the additional heating load. Exhibit 48 shows the total heating penalty caused by internal end use savings as a separate line item, just before the grand total. In other words, the heating penalty is not subtracted from the savings of individual measures, but is instead shown as a separate item in the exhibit.

8.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 52 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Economic Potential Forecast. The reductions are shown by milestone year and region. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6. Exhibit 53 shows the same information graphically for the winter peak period.

Exhibit 52 and Exhibit 53 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct. For example, most of the heat pump measures will not produce any peak demand savings, because during the winter peak period heat pumps (i.e. air source and ductless mini-splits heat pump measures) will revert to back-up electric resistance heating. As such, there will be no net reduction in space heating peak demand for these measures. Accordingly, the demand reductions for the heat pump measures have been manually filtered out of the results presented in these exhibits.

Exhibit 54 shows the demand reductions associated with each electric energy savings measure contained in the Economic Potential Forecast for the milestone year 2029. The heat pump measures are omitted from the exhibit, as with the previous two exhibits.

One notable line item in the exhibit is “HVAC Impact from Other Savings” - the impact on peak space heating load resulting from the savings for other end uses within the facilities. This is to capture the fact that in an electrically-heated facility, savings of energy consuming devices within the facility will not reduce the winter peak demand. On the coldest winter days, reducing the energy used by a lamp will simply make the electric baseboard beside it work harder. However, heat from lamps and other equipment is often generated in areas where the heat is not useful (e.g. near the ceiling of a warehouse). The non-heating end uses also produce some peak load reductions in other cases, such as facilities that are heated by non-electric fuels, in outside light fixtures, or in heated water that drains out of the facility while still warm. The impact of demand reductions for other end uses on the space heating demand can be seen graphically. As the demand impacts for many of the other end uses rise with time, the demand impacts for space heating actually decreases over time.

Electric peak load reductions related to capacity-only measures are presented separately in Section 8.7.

Exhibit 52 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year, Peak Period and Sub sector (MW)

Sub Sector	Milestone Year	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Large Office	2017	19	0	0	19
	2020	19	0	0	19
	2023	20	0	0	20
	2026	20	0	0	20
	2029	21	0	0	21
Small Office	2017	13	0	0	13
	2020	13	0	0	14
	2023	14	0	0	14
	2026	14	0	0	15
	2029	16	0	0	16
Large Non-food Retail	2017	8	0	0	9
	2020	8	0	0	9
	2023	8	0	0	9
	2026	8	0	0	9
	2029	8	0	0	8
Small Non-food Retail	2017	8	1	0	9
	2020	8	1	0	9
	2023	8	1	0	9
	2026	9	1	0	10
	2029	9	1	0	10
Food Retail	2017	9	1	0	9
	2020	9	1	0	9
	2023	9	1	0	10
	2026	9	1	0	10
	2029	9	1	0	10
Large Accomodation	2017	5	1	0	6
	2020	5	1	0	6
	2023	6	1	0	6
	2026	6	1	0	7
	2029	6	1	0	7
Small Accomodation	2017	2	0	0	2
	2020	2	0	0	2
	2023	2	0	0	3
	2026	3	0	0	3
	2029	3	0	0	3
Healthcare	2017	9	0	0	9
	2020	10	1	0	10
	2023	10	1	0	11
	2026	11	1	0	12
	2029	12	1	0	12
Schools	2017	12	1	0	13
	2020	12	1	0	13
	2023	13	1	0	13
	2026	13	1	0	14
	2029	14	1	0	15
Universities and Colleges	2017	8	0	0	8
	2020	8	0	0	8
	2023	8	0	0	8
	2026	8	0	0	8
	2029	8	0	0	8

Exhibit 52 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year, Peak Period and Sub sector (MW) (cont'd)

Sub Sector	Milestone Year	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Warehouse/Wholesale	2017	5	0	0	5
	2020	5	0	0	5
	2023	5	0	0	5
	2026	5	0	0	5
	2029	5	0	0	5
Restaurants	2017	5	0	0	5
	2020	5	0	0	6
	2023	6	0	0	6
	2026	6	1	0	6
	2029	6	0	0	7
Labrador Isolated C/I Buildings	2017	0	0	1	1
	2020	0	0	1	1
	2023	0	0	1	1
	2026	0	0	1	1
	2029	0	0	1	1
Island Isolated C/I Buildings	2017	0	0	0	0
	2020	0	0	0	0
	2023	0	0	0	0
	2026	0	0	0	0
	2029	0	0	0	0
Large Other Buildings	2017	11	3	0	13
	2020	10	3	0	13
	2023	10	3	0	14
	2026	10	3	0	14
	2029	11	3	0	14
Small Other Buildings	2017	7	2	0	8
	2020	6	2	0	8
	2023	6	2	0	9
	2026	7	2	0	9
	2029	7	2	0	9
Other Institutional	2017	0	1	0	1
	2020	0	2	0	2
	2023	0	3	0	3
	2026	0	5	0	5
	2029	0	5	0	5
Street Lighting	2017	2	0	0	2
	2020	2	0	0	2
	2023	2	0	0	2
	2026	2	0	0	2
	2029	2	0	0	2
Grand Total	2017	123	10	1	134
	2020	124	12	1	137
	2023	127	14	1	142
	2026	131	16	1	148
	2029	136	16	1	153

Notes: 1) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.

Exhibit 53 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year End Use and Subsector, Winter Peak Period (MW)

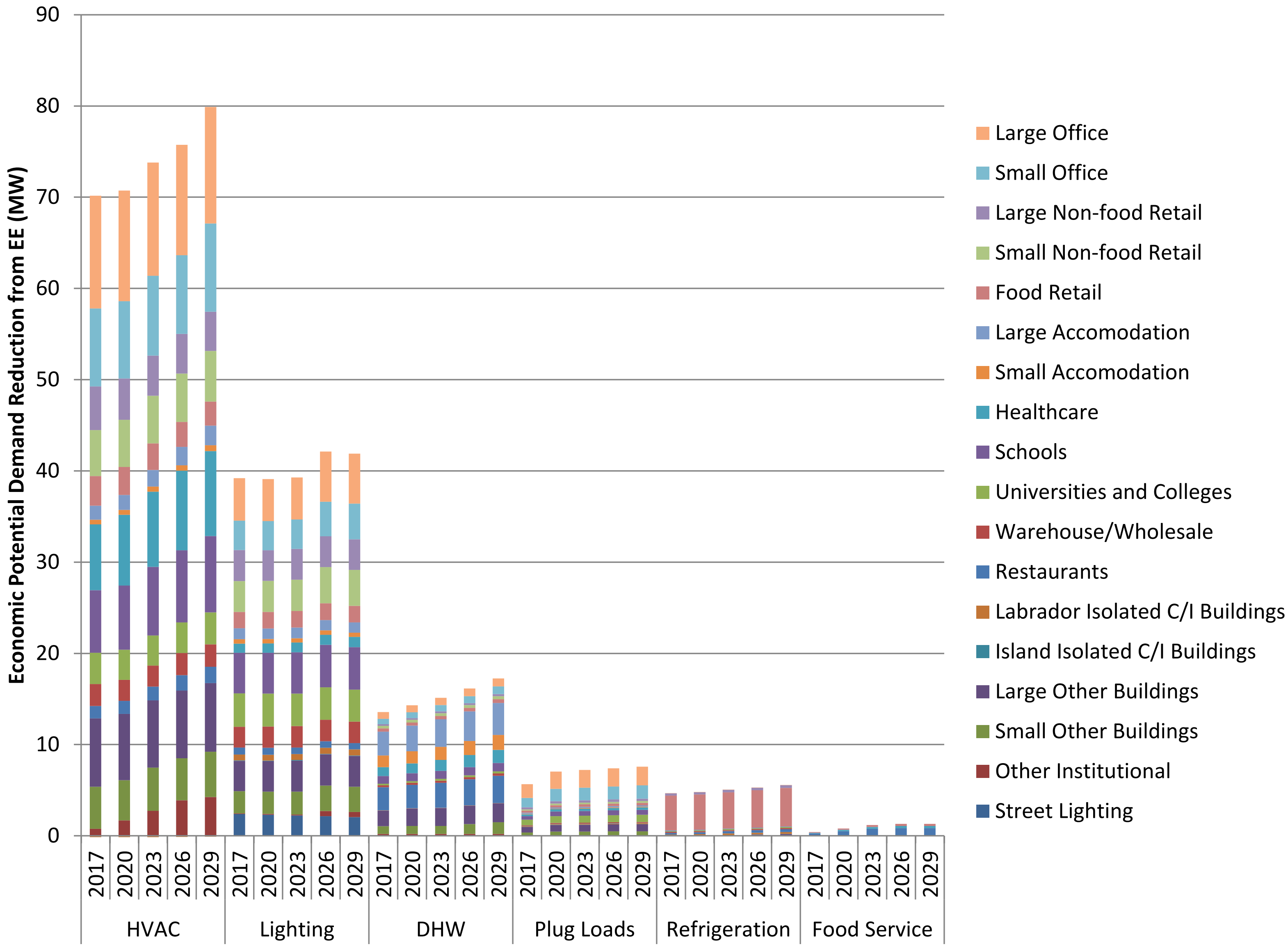


Exhibit 54 Electric Peak Load Reductions from Economic Energy Savings Measures, 2029 (MW)

Measure	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Building Recommissioning	24	4	0	28
Demand Control Ventilation (DCV)	9	2	0	11
New Construction (25% More Efficient)	11	0	0	11
Programmable Thermostats	9	2	0	11
Advanced Building Automation Systems	10	0	0	10
High Performance Glazing Systems	9	1	0	10
Ventilation Heat Recovery	6	1	0	7
Low-Flow Faucet Aerators	6	1	0	7
Occupancy Sensors (Lighting)	6	1	0	7
New Construction (40% More Efficient)	6	0	0	6
LED Tubular Lamps	5	0	0	5
ENERGY STAR Computers	4	0	0	4
High Performance T8 Fixtures	3	0	0	4
VFDs on HVAC Motors	3	0	0	4
LED Outdoor Fixtures	3	0	0	3
Heat Pump Water Heaters	2	0	0	3
LED Screw-In Lamps	2	0	0	2
Ground Source Heat Pumps	2	0	0	2
LED Street Lighting	2	0	0	2
LED Screw-In Lamps	2	0	0	2
Low-Flow Showerheads	2	0	0	2
Wall Insulation	2	0	0	2
Drainwater Heat Recovery	2	0	0	2
Refrigerated Cases with Doors	2	0	0	2
Radiant Infrared Heaters	1	0	0	1
Activate PC Power Management	1	0	0	1
High-Efficiency Cooking Equipment	1	0	0	1
Refrigerated Vending Machine Controllers	1	0	0	1
ENERGY STAR Dishwashers	1	0	0	1
Roof Insulation	1	0	0	1
High Efficiency Compressors (Refrigeration)	1	0	0	1
LED High Bay Fixtures	1	0	0	1
ECM Motors and Evaporator Fan Motor Controllers	1	0	0	1
Hotel Occupancy Sensors	1	0	0	1
LED Tubular Lamps	1	0	0	1
T5HO Fixtures	1	0	0	1
Lighting Controls (Outdoor)	1	0	0	1
Premium Efficiency Motors	1	0	0	1
Demand Control Kitchen Ventilation (DCKV)	1	0	0	1
High Performance T8 Fixtures	0	0	0	0
Cooler Night Covers	0	0	0	0
Low-Flow Pre-Rinse Spray Valves	0	0	0	0
Refrigeration Controls	0	0	0	0
Energy-Efficient Server Technologies	0	0	0	0

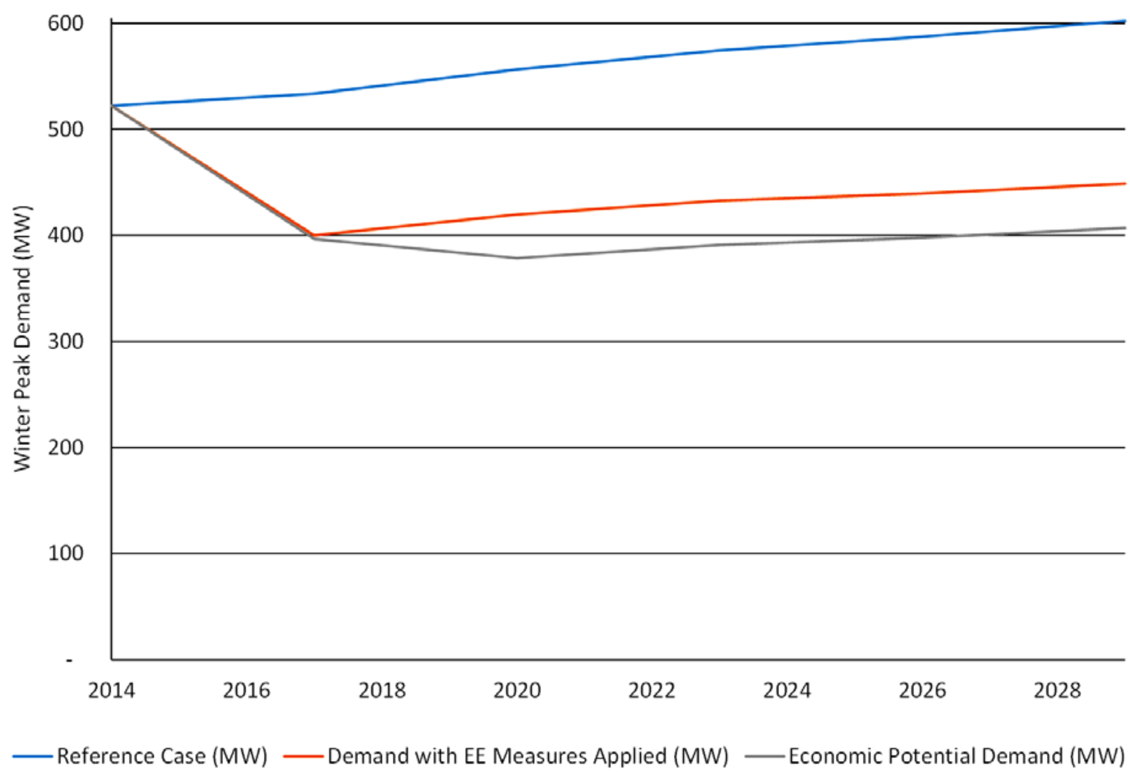
Exhibit 54 Electric Peak Load Reductions from Economic Energy Savings Measures, 2029 (MW) (cont'd…)

Measure	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
CEE-Rated Refrigerators and Freezers	0	0	0	0
Refrigeration Heat Recovery	0	0	0	0
ENERGY STAR Office Equipment	0	0	0	0
Make Use of Daylighting	0	0	0	0
LED High Bay Fixtures	0	0	0	0
T5HO Fixtures	0	0	0	0
Use Task Light Instead of Ambient	0	0	0	0
Reduce Number of Fridges	0	0	0	0
Use Shades/Blinds (Winter)	0	0	0	0
Automatic Door Closers (Walk-In Coolers & Freezers)	0	0	0	0
Keep Doors Closed (Winter)	0	0	0	0
LED Exit Signs	0	0	0	0
LED Refrigerated Display Case Lighting	0	0	0	0
Dimming Control (Daylighting)	0	0	0	0
LED Troffers	0	0	0	0
Use Shades/Blinds (Summer)	0	0	0	0
Use Natural Ventilation (Summer)	0	0	0	0
Keep Doors Closed (Summer)	0	0	0	0
High Efficiency Chillers	0	0	0	0
Freezer Defrost Controllers	0	0	0	0
HVAC Impact from Other Savings	-12	-1	0	-13
Grand Total	136	16	1	153

8.7 Summary of Peak Load Reduction

Exhibit 55 compares the Reference Case and Economic Potential Peak Demand Forecast levels of winter peak demand.[27] Under the Reference Case, commercial peak demand would grow from the Base Year level of about 520 MW to approximately 600 MW by 2029. This contrasts with the Economic Potential Forecast in which peak demand would decrease to approximately 400 MW for the same period, a difference of approximately 200 MW or about 32%. As illustrated in the exhibit, nearly 80% of this reduction comes from the impact of energy efficiency measures.

Exhibit 55 Reference Case Peak Demand versus Economic Potential Peak Demand in Commercial Sector (MW)[28]



[27] All results are reported at the customer's point-of-use and do not include line losses.
[28] Please note that all demand curtailment is accounted for in the Industrial sector analysis and reporting

8.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Economic Potential Forecast is provided in the following exhibits:[29]

- Exhibit 56 presents the results by end use, sub sector and milestone year
- Exhibit 57 provides a further disaggregation of the savings by end use, technology, and milestone year
- Exhibit 58 presents peak demand reduction by major end use, milestone year and supply system
- Exhibit 59 presents peak demand reduction by major end use, milestone year and sub sector
- Exhibit 60 presents peak demand reduction by major end use, milestone year and vintage

[29] MW reductions shown in the following exhibits are not incremental. For example, the space heating reductions in 2029 are not in addition to the space heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.

Exhibit 56 Total Economic Potential Peak Demand Reduction by End Use, Sub sector and Milestone Year (MW)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Large Office	2017	0	0	0	1	0	1
	2020	0	3	0	1	2	5
	2023	0	3	0	1	2	5
	2026	0	3	0	1	2	5
	2029	0	3	0	1	2	5
Small Office	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Large Non-food Retail	2017	0	0	0	0	0	0
	2020	0	2	0	0	1	3
	2023	0	2	0	0	1	3
	2026	0	2	0	0	1	3
	2029	0	2	0	0	1	3
Small Non-food Retail	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Food Retail	2017	0	0	0	0	0	0
	2020	0	1	1	0	1	2
	2023	0	1	1	0	1	2
	2026	0	1	1	0	1	2
	2029	0	1	1	0	0	2
Large Accomodation	2017	0	0	0	0	0	0
	2020	2	0	0	0	1	4
	2023	2	0	0	0	1	4
	2026	2	0	0	0	1	4
	2029	2	0	0	0	1	4
Small Accomodation	2017	0	0	0	0	0	0
	2020	1	0	0	0	0	1
	2023	1	0	0	0	1	2
	2026	1	0	0	0	1	2
	2029	1	0	0	0	1	2
Healthcare	2017	0	0	0	1	0	1
	2020	2	1	0	1	1	4
	2023	2	1	0	1	1	4
	2026	2	1	0	1	1	4
	2029	2	1	0	1	1	4
Schools	2017	0	0	0	0	0	0
	2020	0	1	0	0	1	2
	2023	0	1	0	0	1	2
	2026	0	1	0	0	2	3
	2029	0	1	0	0	2	3
Universities and Colleges	2017	0	0	0	0	0	0
	2020	0	1	0	0	0	2
	2023	0	2	0	0	0	2
	2026	0	2	0	0	0	2
	2029	0	2	0	0	0	2

Exhibit 56 Total Economic Potential Peak Demand Reduction by End Use, Sub sector and Milestone Year (MW) (cont'd…)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Warehouse/Wholesale	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	1	1
	2026	0	0	0	0	0	1
	2029	0	0	0	0	0	1
Restaurants	2020	4	0	0	0	0	4
	2023	4	0	0	0	0	4
	2026	4	0	0	0	0	4
	2029	4	0	0	0	0	4
Labrador Isolated C/I Buildings	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Island Isolated C/I Buildings	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Large Other Buildings	2017	0	0	0	0	0	0
	2020	2	1	0	1	1	5
	2023	2	2	0	1	1	5
	2026	2	2	0	1	1	5
	2029	2	2	0	1	1	5
Small Other Buildings	2017	0	0	0	0	0	0
	2020	2	0	0	0	1	3
	2023	2	0	0	0	1	3
	2026	2	0	0	0	1	3
	2029	2	0	0	0	1	3
Other Institutional	2017	0	0	0	0	0	0
	2020	0	1	0	0	1	2
	2023	0	1	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Grand Total	2017	0	0	0	3	0	3
	2020	13	10	1	4	13	41
	2023	13	11	1	4	13	42
	2026	13	11	1	4	13	42
	2029	13	11	1	4	12	42

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
4) MW reductions are not incremental. The space heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.
5) The values in this exhibit do not include peak demand reductions from energy efficiency measures.

Exhibit 57 Economic Potential Peak Demand Reduction by Measure and Milestone Year (MW)

Measure	Peak Demand Reduction, 2017 (MW)	Peak Demand Reduction, 2020 (MW)	Peak Demand Reduction, 2023 (MW)	Peak Demand Reduction, 2026 (MW)	Peak Demand Reduction, 2029 (MW)
DHW Controls	0	13	13	13	13
Heating Controls	0	13	13	13	12
Lighting Demand Controls	3	4	4	4	4
Refrigeration Demand Controls	0	1	1	1	1
HVAC Demand Controls	0	10	11	11	11
Grand Total	3	41	42	42	42

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
4) MW reductions are not incremental. The space heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.
5) The values in this exhibit do not include peak demand reductions from energy efficiency measures.
6) Demand-specific measure savings are impacted by the demand savings from conservation measures. The demand reference case to which demand-specific measures are applied already factors in the corresponding Economic Potential demand savings from conservation measures. So the more peak demand reductions are generated through conservation measures, the less peak demand remains for demand-specific measures to reduce.

Exhibit 58 Economic Peak Load Reduction by Major End Use, Year and Region (MW)

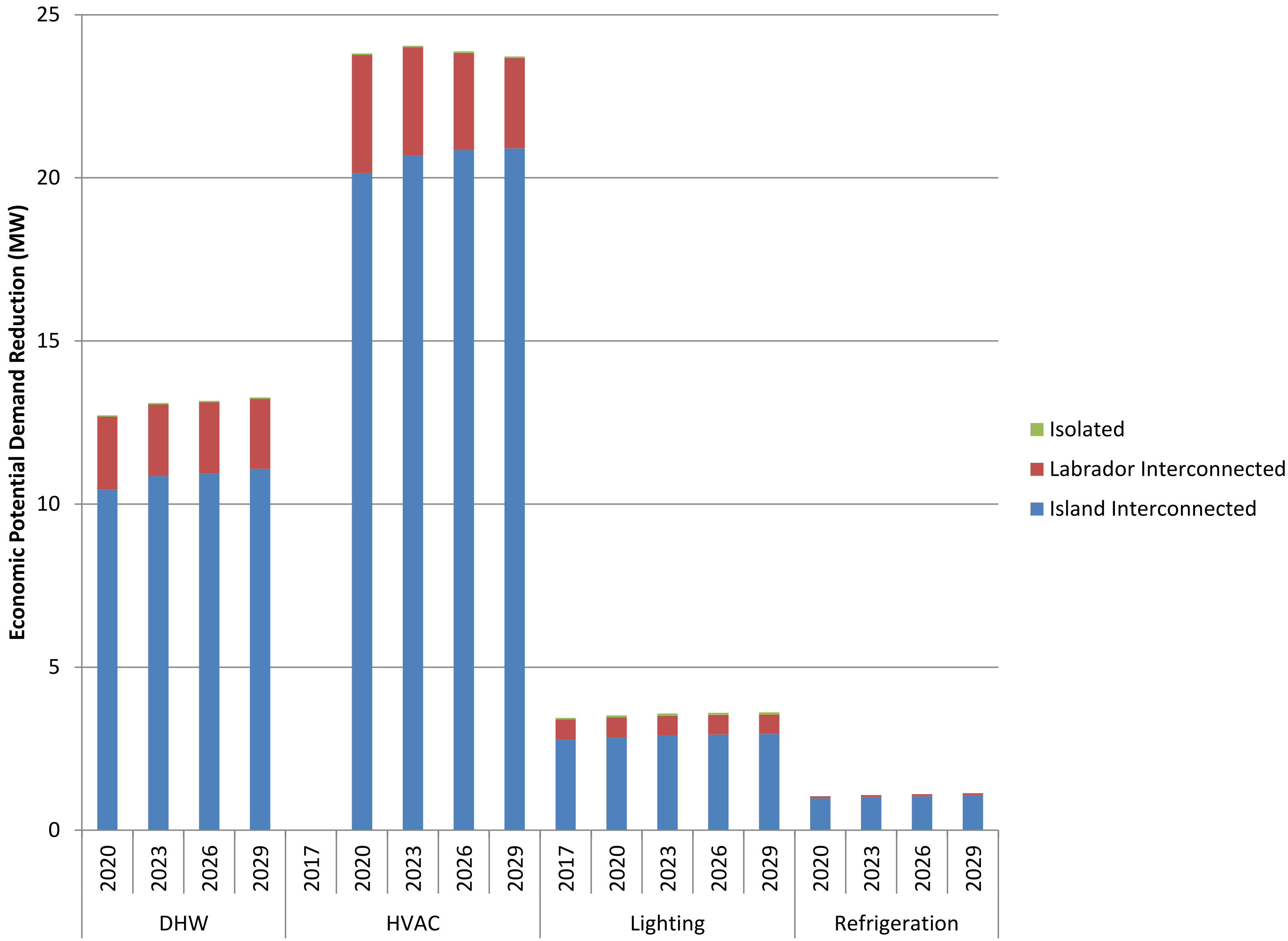


Exhibit 59 Economic Potential Peak Demand Reduction by Major End Use, Year and Sub sector (MW)

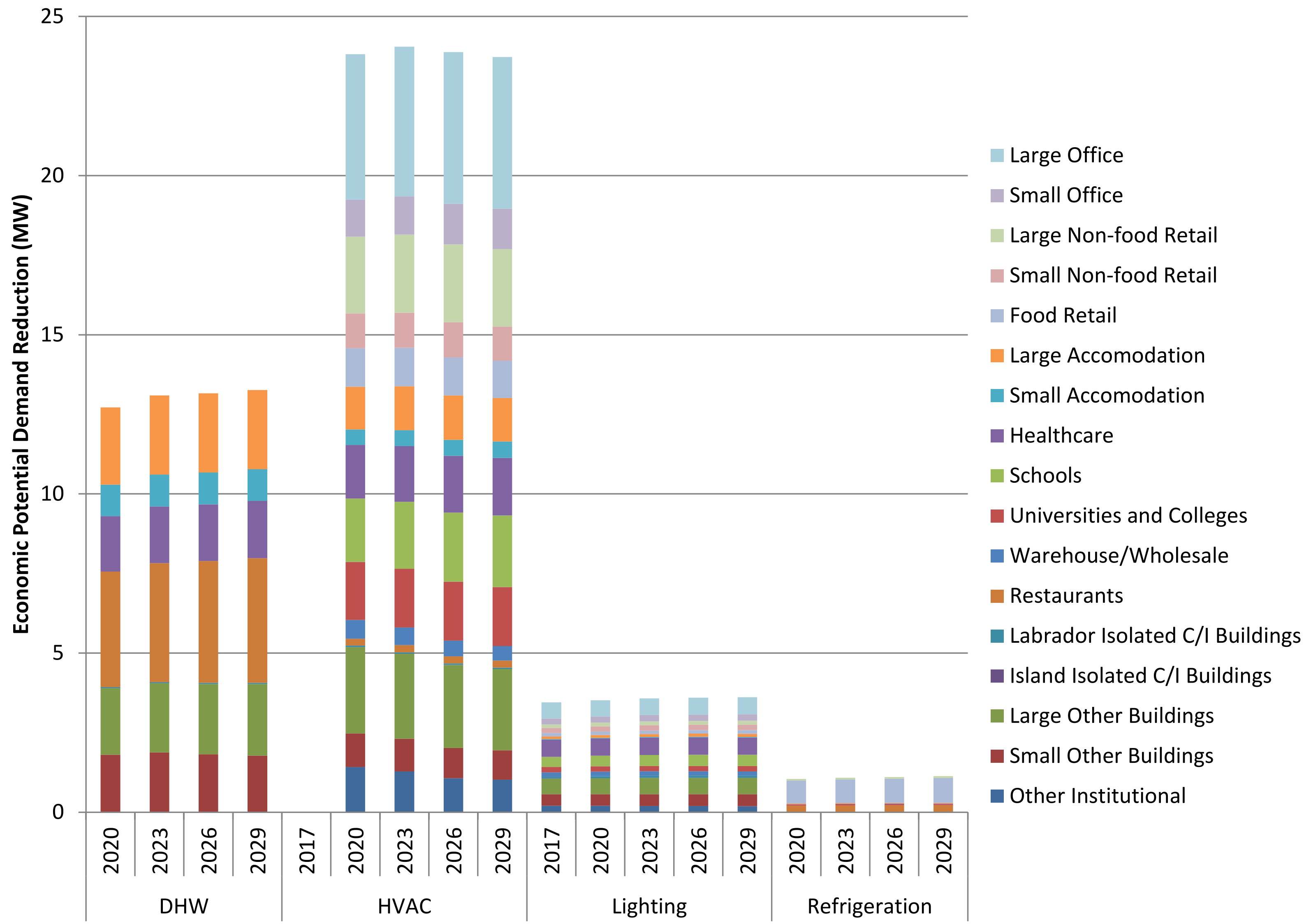
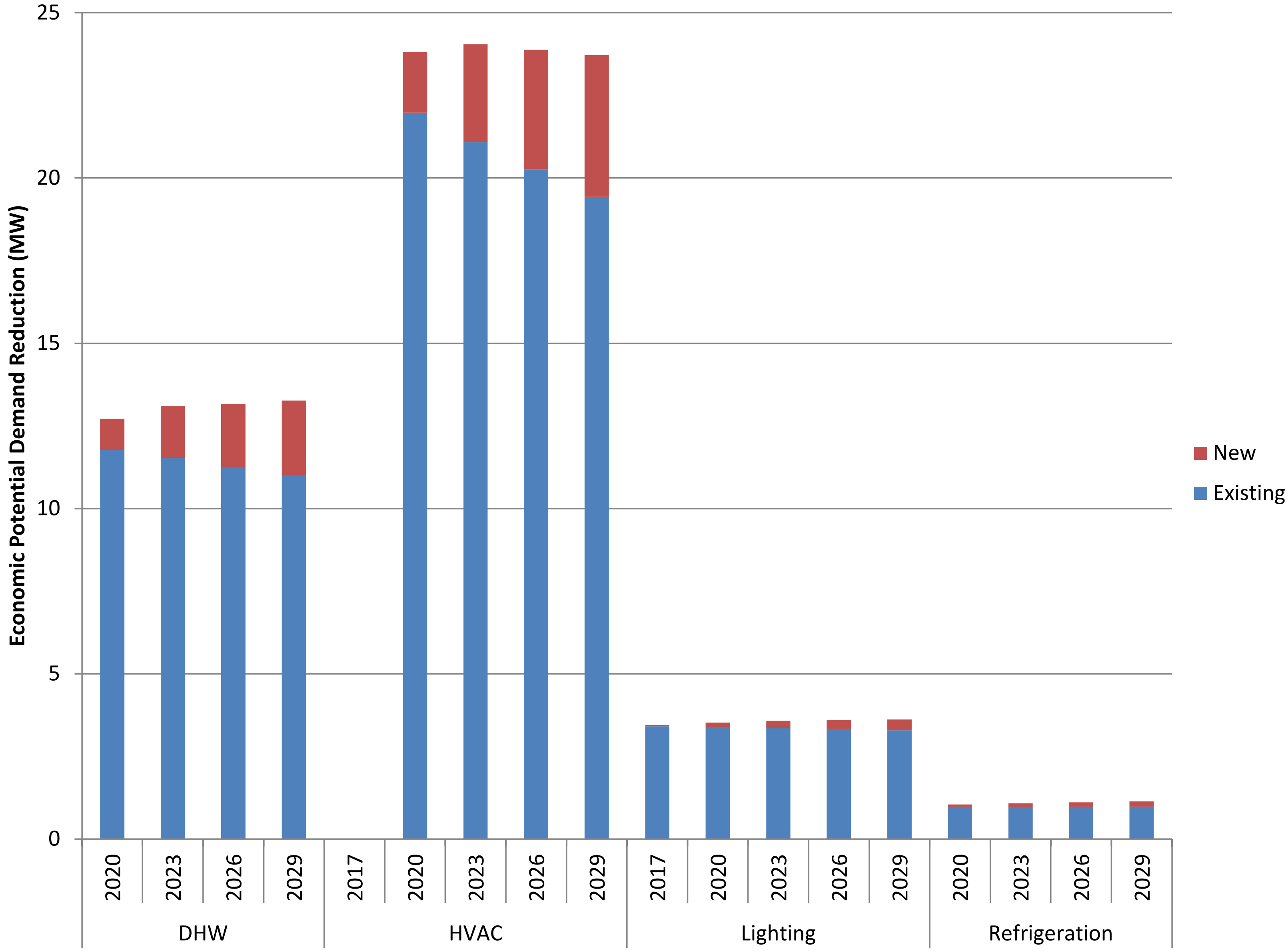


Exhibit 60 Economic Potential Peak Demand Reduction by Major End Use, Year and Vintage (MW)



8.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Milestone Year

The Economic Potential peak load reductions increase from about 3 MW in 2017 to 42 MW in 2029. From 2020 onwards, space heating controls, domestic hot water controls, and HVAC fans and pumps controls are cost effective. The CEPR for electric thermal storage systems does not fall below the avoided cost of demand throughout the study period. As such, this measure does not contribute to the economic potential savings.

Peak Demand Reduction by Sub Sector

Offices account for the largest portion of the potential peak load reductions, at 16%. Peak load reductions in the retail sub sectors also account for a significant portion of the overall peak load reductions in 2029 (14%). Other sub sectors with significant contributions to the peak load reductions include hotels (13%), education (11%), restaurants (10%), and healthcare (10%). Peak load reductions in hotels are mostly due to potential DHW and HVAC savings in this sector, while the potential peak reductions in the healthcare and restaurant sub sectors are largely driven by the relatively high domestic hot water consumption in these sub sectors for cooking, sterilization and bathing.

Peak Demand Reduction by Region

The Island Interconnected region accounts for 86% of the 2029 potential peak load reductions, while the Labrador Interconnected region accounts for about 13% of the potential peak load reductions, and the Isolated region contributes less than 1% to the potential peak load reductions in 2029.

Peak Demand Reduction by Existing Buildings versus New Construction

Peak load reductions in existing buildings account for almost all of the reduction potential at the beginning of the study period, but as buildings are constructed, the savings potential associated with them occupies a progressively larger portion of the total reduction potential. By 2029, peak load reductions from new buildings account for about 17% of the total potential peak load reductions.

Peak Demand Reduction by End Use

DHW controls account for 32% of the 2029 load reductions in the Economic Potential Forecast, not including load reductions from energy efficiency measures. Space heating controls and HVAC fans and pumps controls are also significant opportunities, accounting for 30% and 27% of the overall peak demand potential reductions in 2029, respectively (not including load reductions from energy efficiency measures).

8.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Economic Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

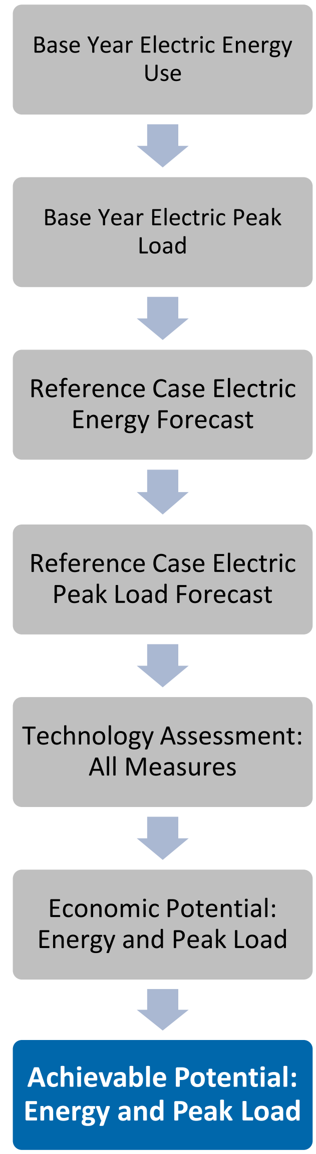
Exhibit 61 shows that the results are sensitive to this range of avoided costs. By 2029, the exhibit shows the following changes in potential:

- The lower range of reasonableness produces energy savings that are about 1% lower in the Island Interconnected and Isolated regions and 3% lower in the Labrador Interconnected region.
- The lower range of reasonableness produces peak demand reductions that are 1% lower in the Island Interconnected region and Isolated regions and less than 1% lower in the Labrador Interconnected region.
- The upper range of reasonableness produces energy savings that are 3% higher in the Island Interconnected region, 6% higher in the Labrador Interconnected region, and almost unchanged in the Isolated region.
- The upper range of reasonableness produces peak demand reductions that are 4% higher in the Island Interconnected and Labrador Interconnected regions, and almost unchanged in the Isolated region.
- The small changes in energy savings and peak demand reductions for the different scenarios reflect the fact that a large number of measures comfortably fall below the economic screen, as shown in the supply curves in Sections 7.5 and 7.6.

Exhibit 61 Sensitivity of the Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	680,044	125	685,417	126	697,977	139
	2020	706,717	157	712,673	159	728,517	163
	2023	737,037	161	743,138	162	763,376	167
	2026	770,962	165	785,647	167	803,522	173
	2029	816,944	171	821,902	172	842,106	180
Labrador Interconnected	2017	51,603	10	53,255	10	67,620	15
	2020	64,137	17	70,014	18	89,763	23
	2023	82,534	20	84,367	20	99,758	22
	2026	95,570	21	99,933	21	107,854	22
	2029	104,065	21	107,242	22	113,548	22
Isolated	2017	5,291	1	5,315	1	5,344	1
	2020	5,906	1	5,952	1	5,979	1
	2023	6,423	1	6,500	1	6,516	1
	2026	6,782	1	6,870	1	6,886	1
	2029	7,089	1	7,173	1	7,189	1

9 Achievable Potential: Electric Energy Forecast



9.1 Introduction

This section presents the Commercial sector Achievable Potential for the study period (2014 to 2029). The Achievable Potential is defined as the proportion of the energy-efficiency opportunities identified in the Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following sub-sections:

- Description of Achievable Potential
- Approach to the estimation of Achievable Potential
- Achievable Potential Workshop results
- Summary of potential electric energy savings
- Electric peak load reductions for energy efficiency measures
- Summary of peak load reductions
- Sensitivity of the results to changes in avoided cost
- Description of the application of net-to-gross ratios

9.2 Description of Achievable Potential

Achievable Potential recognizes that, in many instances, it is difficult to induce all customers to purchase and install all the energy-efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

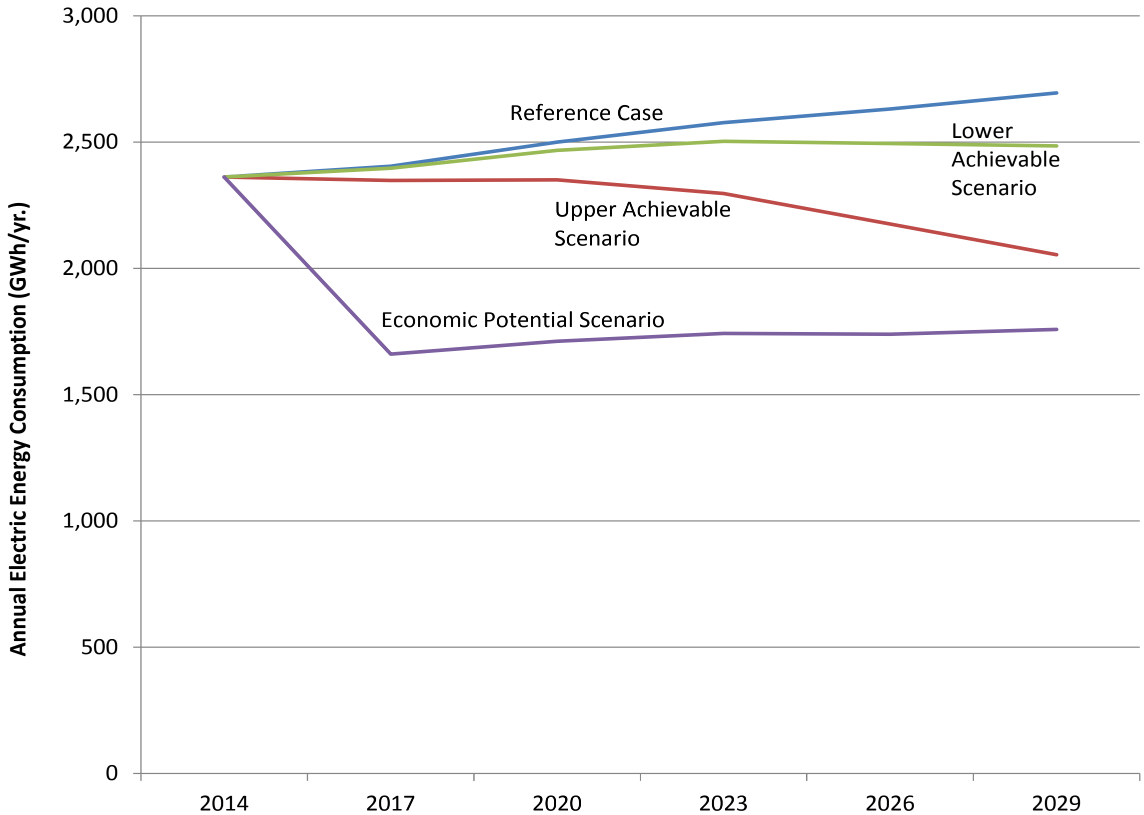
- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability
- Lack of available financial resources
- Lack of available human resources to implement the project
- Competing priorities for financial and human resources

The rate at which customers accept and purchase energy-efficiency products will be influenced by the level of financial incentives, information and other measures put in place by the Utilities and the Government of Newfoundland, other levels of government, and the private sector to remove barriers such as those noted above.

Exhibit 62 presents the levels of electricity consumption that are estimated in the Achievable Potential scenario. As illustrated, the Achievable Potential scenarios are banded by the two forecasts presented in previous sections: the Economic Potential Forecast and the Reference Case.

As illustrated in Exhibit 62 electric energy savings under the Achievable Potential scenario are less than in the Economic Potential Forecast. In this CDM study, the primary factor that contributes to the outcome shown in Exhibit 62 is the rate of market penetration. In the Economic Potential Forecast, efficient new technologies are theoretically assumed to fully penetrate the market as soon as it is economically attractive to do so. However, the Achievable Potential recognizes that it is unrealistic to expect customers to purchase and install all the electrical energy efficiency technologies that meet the criteria defined by the Economic Potential Forecast.

Exhibit 62 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Commercial Sector (GWh/yr.)



As also illustrated in Exhibit 62 the Achievable Potential results are presented as a band of possibilities, rather than a single line. This is because any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty. Consequently, the results are presented as a range, defined as Lower Achievable and Upper Achievable.

The Lower Achievable Potential assumes Newfoundland market conditions that are similar to those contained in the Reference Case. That is, the customers' awareness of energy-efficiency options and their motivation levels remain similar to those in the recent past, technology improvements continue at historical levels, and new energy performance standards continue as per current known schedules. It also assumes that the ability of the Newfoundland utilities and government to influence customers' decisions towards increased investments in energy-efficiency options remains roughly in line with previous company CDM experience.

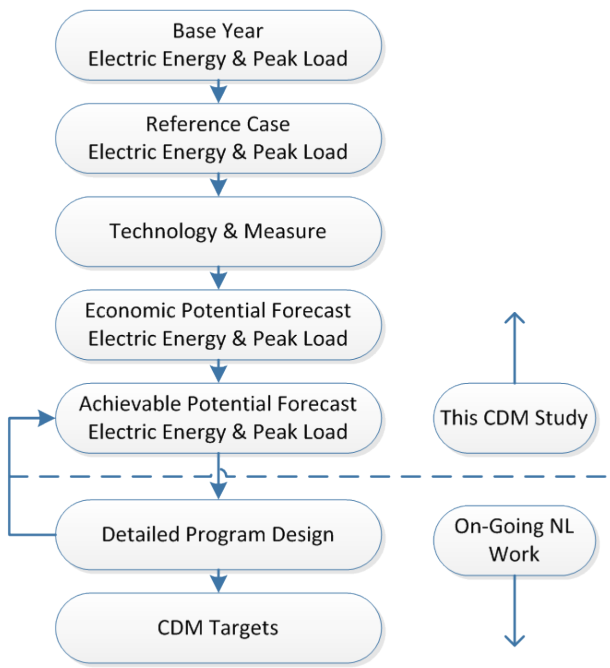
The Upper Achievable Potential assumes Newfoundland market conditions that aggressively support investment in energy efficiency. For example, this scenario assumes that real electricity prices increase over the study period. It also assumes that federal and territorial government actions to mitigate climate change result in increased levels of complementary energy-efficiency initiatives. The upper Achievable Potential typically does not reach economic potential levels; this recognizes that some portion of the market is typically constrained by barriers that cannot realistically be affected by CDM programs within the study period.

9.2.1 Achievable Potential versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.

Exhibit 63 illustrates the relationship between Achievable Potential and the more detailed program design.

Exhibit 63 Achievable Potential versus Detailed Program Design



This study examined about 80 technologies applicable to commercial electric end uses. Although considerable effort has been made to obtain up-to-date information on each technology and to tailor it to the local market in Newfoundland, this is not a substitute for the type of detailed groundwork needed to prepare a utility program. For each of the technologies selected for further investigation, it will be important to obtain further information on the technical viability and durability of the products in the Newfoundland climate, on the costs in the Newfoundland marketplace, and on real savings under local conditions. If the viability of the technology is confirmed, an assessment of the market barriers is required, leading to the development of program strategies to overcome these barriers.

9.3 Approach to the Estimation of Achievable Potential

Achievable Potential was estimated in a five-step approach.

- Priority opportunities were selected
- Opportunity profiles were created
- Opportunity worksheets were prepared
- A full-day workshop was held
- Workshop results were aggregated and applied to the remaining opportunities.

Further discussion is provided below.

Step 1 Select Priority Opportunities

The first step in developing the Achievable Potential estimates required selection of the energy-saving opportunities identified in the Economic Potential Forecasts to be discussed during the Achievable workshop. Several criteria determined selection, including:

- The priority measures should represent a substantial fraction of the overall economic potential
- The priority measures should represent several different energy end uses
- The priority measures should have a variety of different likely patterns of market adoption, so the discussions will be widely varied.

A summary of the selected energy-efficiency actions, along with the approximate percentage that it represents in the Economic Potential Forecast, is provided in Exhibit 64.

Exhibit 64 Commercial Sector Actions – Energy Efficiency

Measure #	Measure	End Use	Percentage of 2029 Economic Potential	
			Consumption Savings	Demand Savings from EE Measures
C1	LED Tubular Lamps	General Lighting	3%	2%
C2	High-Efficiency Air Source Heat Pumps	Space Heating	15%	21%
C3	ECM Motors and Evaporator Fan Motor Controllers	Refrigeration	1%	0%
C4	VFDs on HVAC Motors	HVAC Fans and Pumps	3%	2%
C5	Advanced Building Automation Systems	Multiple	5%	4%
C6	High Performance New Construction (25% Better)	Multiple	5%	5%
C7	PC Power Management	Computer Equipment	1%	1%
C8	High Performance Glazing Systems	Multiple	3%	4%
Grand Total			**36%**	**39%**

Step 2 Create Opportunity Assessment Profiles

The next step involved the development of brief profiles for each of the opportunities noted above in Exhibit 64, in the form of PowerPoint slides. The slides are presented in Appendix G.

The purpose of the opportunity profiles was to provide a high-level logic framework that would serve as a guide for participant discussions in the Achievable workshop (see Step 4 below). The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project. As illustrated in Appendix G, each opportunity profile addresses the following areas:

- **Technology Description:** Provides a summary statement of the broad goal and rationale for the action.
- **Target Sub sector and Typical Application:** Highlights the sub sectors and applications offering the most significant opportunities, and which provide a good starting point for discussion of the technology.
- **Financial and Economic Indicators:** Provides estimates of average simple payback, cost of conserved electricity (CCE) and basis of assessment (full-cost versus incremental).
- **Eligible Participants:** Provides an estimate of the sub sectors that could be affected during the study period if the entire Economic Potential were to be captured.
- **Economic Potential versus Time:** Shows the pattern of the changing size of the opportunity over the study period, for existing and new buildings. Some opportunities grow steadily through the study period, as more and more equipment reach the age when they would be replaced. Other opportunities are economical to capture immediately, and after that the growth over time is limited to opportunities in new buildings being built. Still other opportunities decline with time as they are eroded by natural conservation activities.

Step 3 Prepare Opportunity Worksheets

A draft assessment worksheet was also prepared for each opportunity profile in advance of the Achievable workshop. The assessment worksheets complemented the information contained in the opportunity profiles by providing quantitative data on the potential electric energy savings for each opportunity as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

The worksheets, including the results recorded during the workshop discussions, are provided in Appendix H. As illustrated in Appendix H, each opportunity assessment worksheet addresses the following areas:

- **Approximate Cost of Conserved Electricity:** Shows the approximate levelized cost of saving each kWh of electricity saved by the measure. For the purposes of the workshop, this information provided participants with an indication of the cost-effectiveness of measures in certain scenarios.
- **Customer Payback:** Shows the simple payback from the customer's perspective for the package of energy-efficiency measures included in the opportunity. This information provided an indication of the level of attractiveness that the opportunity would present to customers. This

provided an important reference point for the workshop participants when considering potential participation rates. When combined with the preceding CCE information, participants were able to roughly estimate the level of financial incentives that could be employed to increase the opportunity's attractiveness to customers without making it economically unattractive to the Newfoundland utilities.

- **Economic Potential in Terms of Applicable Participants (e.g., number of sites):** Shows the total number of potential participants in terms of either sites or equipment (as appropriate) that could theoretically take part in the opportunity. Numbers shown are from the eligible populations used in the Economic Potential Forecasts.

- **Participation Rates (%):** These fields were filled in during the workshops (described below in the following step), based on input from the participants. They show the percentage of economic savings that workshop participants concluded could be achievable in the last milestone period (usually 2029, but may be earlier for measures that peak earlier).

- **Achievable Potential in Terms of Applicable Participants (e.g., number of sites):** These fields were calculated by the spreadsheet based on the participation rates provided by the participants.

- **Participation Rates Relative to the Discussion Scenario:** These fields were filled in during the workshops to provide guidance to the consulting team on how participation might differ in other regions or sub sectors, or for related or similar technologies.

- **Other Parameters:** These fields were filled in during the workshop to capture highlights of the discussion.

Step 4 Conduct Achievable Workshop

The most critical step in developing the estimates of Achievable Potential was a one-day Achievable Potential workshop that was held on April 22, 2015. Workshop participants consisted of core members of the consultant team, CDM program and technical personnel from the Utilities, industry representatives, and representatives of other stakeholders. Together, the participating personnel brought many years of experience to the workshop related to the technologies and markets.

The purpose of this workshop was to:

- Promote discussion regarding the technical and market constraints confronting the identified energy-efficiency opportunities
- Identify potential strategies for addressing the identified constraints, including potential partners and delivery channels
- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

Following a brief consultant presentation that summarized the Commercial sector study results to date, the workshop provided a structured assessment of each of the selected opportunities. Opportunity assessment consisted of a facilitated discussion of the key elements affecting successful promotion and implementation of the CDM opportunity. More specifically:

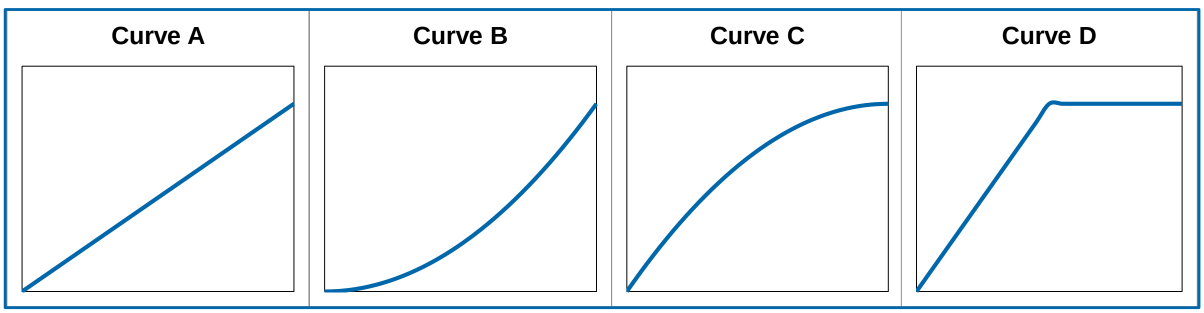
- What are the major constraints/challenges constraining customer adoption of the identified energy-efficiency opportunities?
  - How big is the "won't" portion of the market for this opportunity?
- Preferred strategies and potential partners for addressing identified constraints (high level only)

- Key criteria that determine customers' willingness to proceed
- Key potential channel partners
- Optimum intervention strategies e.g., push, pull, combination
- How sensitive is this opportunity to incentive levels?

Following discussion of market constraints and potential intervention strategies, the participants' views on potential participation rates were recorded. The process involved the following steps:

- The participation rate for the upper Achievable scenario in 2029 was estimated.
- The shape of the adoption curve was selected for the upper Achievable scenario. Rather than seek consensus on the specific values to be employed in each of the intervening years, workshop participants selected one of four curve shapes that best matched their view of the appropriate "ramp-up" rate for each opportunity (see Exhibit 65 below).
- The process was then repeated for the lower Achievable scenario.
- Once participation rates had been established for the specific technology, sub sector and service region selected for the opportunity discussion, workshop participants provided the consultants with guidelines for extrapolating the discussion results to the other sub sectors and service regions included in the opportunity, but not discussed in detail during the workshop. Where time permitted, participants also discussed how the adoption of similar, related technologies might differ from the technology being discussed.

Exhibit 65 Participation Rate "Ramp Up" Curves



Curve A represents a steady increase in the expected participation rate over the study period.

Curve B represents a relatively slow participation rate during the first half of the study period followed by a rapid growth in participation during the second half of the 20-year study period.

Curve C represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the study period.

Curve D represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first half of the study period.

Step 5 Aggregate and Extend Opportunity Results

The final step involved aggregating the results of the individual opportunities to provide a view of the potential Achievable in both the Residential and Commercial sectors.

9.4 Achievable Workshop Results

The following sub-sections present a summary of the workshop discussions for each of the commercial opportunities listed in Exhibit 64 above. The adoption rates and curves selected by the participant are summarized in Section 0. Included for each opportunity are:

- Participation estimates (for 2029) made by workshop participants, with comments, where needed, about values assumed in the calculations (presented in Section 0).
- Where needed, additional participation estimates made after the workshop for the purposes of the calculations (presented in Section 0).
- Selected highlights that attempt to capture key discussion themes related to the opportunity.

Appendix H provides copies of the assessment worksheets used during the workshop.

9.4.1 LED Tubular Lamps

For this technology, achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 70% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be C in the upper Potential scenario and B in the lower potential scenario.

Barriers that tend to lower adoption included the high cost of implementation, the lack of proper incentives, limited customer awareness of LED replacements for fluorescent tubes and public tendering act limitations. Uptake of this technology is limited due to the current economic crunch and in a lot of cases the lowest cost technology must be selected in some facilities where the public tendering act limits the technology that will be implemented. Since LED tubular lamp replacements for fluorescent tubes have not been around for very long, there is limited customer awareness of this particular option while others are still waiting for the LED technology to mature. In addition, workshop participants indicated that it is difficult for utilities to get in touch with the right contacts at the commercial facilities and while the Government in the province may tend to adopt such technologies quickly, the private sector is lagging behind.

Participants suggested that financial barriers could be addressed by using non-energy benefits to help sell the technology and spreading the word through implementers and lighting distributors. With no incentives in place, there are currently a limited number of individuals going to the marketplace to make the case for LED tubular lamps. As such, incentives are key to the overall strategy and there is a high sensitivity to this. Participants believed some facilities may be overlit already, which allows for a deeper savings opportunity. Government agencies are also much more developed than they were 20 years ago and they can be an important partner in spreading the word. Participants believed that this technology is changing very rapidly and the cost is coming down quite quickly.

The initial discussion focused on large offices on the Island grid. Participants believed that participation would be somewhat lower in the Labrador and Isolated regions because of the difficulty of finding materials and qualified installers in these communities. Participants also believed that participation would be similar for the retail sector, higher for the healthcare and education sectors and lower for warehouses and restaurants. Participants also discussed some of the other lighting measures. The adoption of LED Lamps, LED High Bay Fixtures and LED outdoor fixtures were expected to occur at a higher rate while reduced wattage T8 fixtures were expected to have a lower adoption rate. LED low bay fixtures were thought to be adopted at a similar rate.

9.4.2 High-Efficiency Air Source Heat Pumps

For this technology, achievable workshop participants provided 2029 participation rate estimates of 60% for the upper Achievable Potential scenario and 20% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper scenario and lower scenarios would be Curve B.

Participants believed that this technology is fairly mature but that the existing infrastructure is fairly old. They also indicated that rooftop units (RTUs) are not very prevalent in large offices and the savings may not be as significant in some retail applications since lighting and internal loads create quite a bit of heat. As such, the heating systems don't need to work as hard as one might expect. Participants indicated that variable refrigerant technology may make more sense in certain applications and that there is about 15% penetration of air source heat pumps (ASHPs) currently, although this may be limited to smaller RTUs. In particular, participants indicated that restaurants are starting to adopt this technology.

Barriers that tend to lower adoption included infrastructure limitations in offices, high maintenance costs, lack of awareness and lack of a push for this technology from HVAC contractors. ASHP's are not practical for many offices since RTUs aren't too common and zoning would be required. In addition, due to most office buildings being leased it is likely that landlords would implement low cost equipment instead. Participants also believed that chains from other jurisdictions have natural gas space heating and may not be aware that there is an opportunity in electric space heating. Finally, participants indicated that many schools in the province are not allowed to be air conditioned. As such, air conditioning capabilities would need to be disabled in these applications.

The initial discussion focused on food retail facilities on the Island grid. Participants believed that participation would be somewhat lower in the Labrador and Isolated regions because of the difficulty of finding materials and qualified installers in these communities. Participants also believed that participation would be similar for the non-food retail and school sectors, higher for the small office, large accommodations, and restaurant sectors and lower for large offices, small accommodations, healthcare, universities, and warehouses. Participants also discussed some of the other heating measures. The adoption of ductless mini-split heat pumps were expected to occur at a higher rate, while ground source heat pumps, high efficiency RTUs and high efficiency chillers were expected to have a lower adoption rate.

9.4.3 ECM Motors and Evaporator Fan Motor Controllers

For this technology, achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 25% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be B.

Participants noted that many larger facilities will already possess sophisticated equipment and have the support of qualified maintenance personnel. Smaller communities in Isolated regions have a lot of residential style equipment rather than centralised systems. Older equipment is also much less likely to be retrofitted.

Barriers that tend to lower adoption included implementation cost, especially in smaller facilities, long payback periods, and a lack of awareness of the technology. In addition, many smaller retailers lease space and landlords are unwilling to make the investments in improvements when tenants pay the energy bills. Existing service contracts for refrigeration systems can also restrict retrofits, and participants believe that the technology may not be as widely available as necessary. There may also be a perception among retailers that modifications to refrigeration systems can increase the risk of food spoiling.

Participants identified the need for two different strategies, one tailored to large facilities and another for smaller businesses.

The initial discussion focused on the food retail sector on the Island grid. Participants believed that participation would be somewhat lower in Labrador and much lower in the Isolated regions because of the difficulty of finding materials and qualified installers in these communities. Participants also believed that participation would be somewhat the same for large accommodations and universities, higher for warehouses, and lower for non-food retail and restaurants. Participants also discussed some of the related refrigeration measures. The adoption of LED refrigeration lighting and CEE rated fridges and freezers were expected to occur at a higher rate, while refrigerated display cases with doors, floating head pressure controls, defrost controllers, automatic door closers, and night covers were expected to be adopted more slowly. High efficiency compressors were expected to have a similar adoption rate to ECM Motors and Evaporator Fan Motor Controllers.

9.4.4 VFDs on HVAC Motors

For this technology, achievable workshop participants provided 2029 participation rate estimates of 70% for the upper Achievable Potential scenario and 5% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be B for both scenarios.

Participants report that awareness of this measure is quite high, and it is commonly implemented on both fan and pump systems. Implementation is straightforward in many facilities, but significant additional retrofits are required in some cases.

Barriers that tend to lower adoption include high implementation costs in certain situations, and landlords are less likely to make energy efficiency improvements in leased properties. Currently VFDs are only incented under the takeCHARGE Custom Program, which some contractors may not be aware of, and this may be slowing the adoption of VFDs.

Participants suggest that prescriptive incentives may make funding more accessible, but there are potential concerns with the variability of the savings. Other strategies for increasing adoption include working with contractors to drum up sales and awareness, bundling with other retrofit measures, and an increased number of energy audits in order to identify retrofit opportunities.

The initial discussion focused on the large office sector on the Island grid. Participants believed that participation would be somewhat lower in the Labrador and Isolated regions because of the difficulty of finding materials and qualified installers in these communities. Participants also believed that participation would be similar for the retail sectors, lower for small offices, and higher for large accommodations, healthcare, schools, and universities. Participants also discussed some of the related HVAC measures. The adoption of high efficiency motors is expected to occur at a higher rate, while lower adoption rates are expected for demand controlled ventilation (DCV) and kitchen fume hood DCV.

9.4.5 Advanced Building Automation Systems

For this technology, achievable workshop participants provided 2029 participation rate estimates of 70% for the upper Achievable Potential scenario and 20% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be B for both scenarios.

Barriers that tend to lower adoption include a lack of familiarity and trust of the technology among building operators, a lack of training for operators in the use of sophisticated control systems, a negative perception of the technology due to improperly installed and operated systems, and a reluctance among building owners to sign up for service contracts with controls suppliers. Equipment can also be relatively easily overridden which both erodes savings from installed systems and discourages the adoption of the technology.

Strategies to mitigate these barriers include ensuring that equipment is being well maintained and that there is a service contract in place, increased education for both building operators and contractors, and improved commissioning and continuous optimisation. Participants suggested that advanced BAS controls can be bundled with a recommissioning program.

The initial discussion focused on the large office sector on the Island grid. Participants believed that participation would be similar in Labrador and lower in the Isolated regions because of the difficulty of finding materials and qualified installers in these communities. Participants also believed that participation would be similar for the retail, large accommodation and school sectors, higher for healthcare, lower for small offices and universities, and much lower for warehouses. Participants also discussed some of the related controls measures. The adoption of hotel occupancy controls is expected to occur at a lower rate, daylighting controls at the same rate, and higher adoption rates are expected for programmable thermostats, and indoor and outdoor lighting controls.

9.4.6 High Performance New Construction

For this measure, achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 50% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be C for the upper achievable scenario and A for the lower achievable scenario.

The primary barrier to implementation is the incremental cost of high performance new construction. Additionally, high performance building rating systems like LEED include many measures that don't improve energy efficiency. Participants also noted that if energy efficiency improvements are missed at the time of new construction, it represents a major lost opportunity.

Participants indicated that much of the recent new construction in the province has been for government buildings, and many of these are being built to high energy efficiency standards which is pushing the local industry to adopt better building standards overall. Strategies to encourage further adoption include presenting the non-energy benefits as part of the business case, including the ability to rent high performance buildings at a premium. Expert engineering consultants are considered key to successfully delivering projects, and increased training for building owners and the design community would help, particularly workshops on how to deal with the administrative burden of certification or strategies to implement energy efficiency outside of established rating systems.

The initial discussion focused on large offices on the Island grid. Participants believed participation would be similar in Labrador and lower in Isolated regions. Participants also believed that participation would be higher for schools and universities, but lower in all other sub sectors. The adoption of high performance new construction practices that result in energy efficiency that is 40%

better than code are expected to be adopted at a much lower rate than practices that are 25% better than code.

9.4.7 PC Power Management

For this measure, achievable workshop participants provided 2029 participation rate estimates of 50% for the upper Achievable Potential scenario and 10% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be B for both scenarios.

Barriers that tend to lower adoption included the potential for IT departments needing to make updates during off hours, individuals overriding power management settings, and the increased use of remote work computers limiting the proportion of computer equipment that can be shut down.

Strategies to encourage adoption include driving implementation through the IT department and educating users in order to ensure the persistence of savings. Holding competitions among users, for example between different floors of an office building, can encourage participation.

The initial discussion focused on the large office sector on the Island grid. Participants believed that participation would be somewhat lower in the Labrador and Isolated regions. Participants also believed that participation would be similar for small offices, schools, and universities while participation is expected to be lower for all other sub sectors. Participants also discussed some of the related behavioural measures. The adoption of ENERGY STAR® certified computers, office equipment, and servers is expected to be similar, while the use of task lighting, natural ventilation, and keeping doors closed is expected to be lower.

9.4.8 High Performance Glazing Systems

For this measure, achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 10% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be C for the upper achievable scenario and B for the lower achievable scenario.

Barriers that tend to lower adoption include some presence of low quality products in the market, a lack of awareness about competitively priced high efficiency options, and a higher first cost. Landlords are also less likely to implement energy efficiency measures in leased buildings. Currently high performance glazing systems are only incented under the takeCHARGE Custom Program, which has seen a very low uptake to date.

Strategies to improve adoption include engaging architects and contractors as partners to promote high efficiency glazing options, ensuring that high efficiency glazing is specified during design, and promoting the non-energy benefits such as improved occupant comfort.

The initial discussion focused on the large office sector on the Island grid. Participants believed that participation would be higher in the Labrador and Isolated regions. Participants also believed that participation would be similar for large accommodations, higher for healthcare, schools, and universities, and lower for small offices, retail, small accommodations, warehouses, and restaurants. Participants also discussed some of the related whole building measures. The adoption of wall insulation and roof insulation is expected to be similar, while the penetration of recommissioning is expected to be higher.

9.4.9 Aggregate Results

Exhibit 66 summarizes the participant rate and "ramp up" curve assumptions discussed above.

Exhibit 66 Summary of Achievable Potential Participation Rates and Curves

Technology	Lower Potential Scenario		Upper Potential Scenario	
	2029 Participation Factor	Adoption Curve	2029 Participation Factor	Adoption Curve
C1: LED Tubular Lamps	70%	Curve B	80%	Curve C
C2: High-Efficiency Air Source Heat Pumps	20%	Curve B	60%	Curve B
C3: ECM Motors and Evaporator Fan Motor Controllers	25%	Curve B	80%	Curve B
C4: VFDs on HVAC Motors	5%	Curve B	70%	Curve B
C5: Advanced Building Automation Systems	20%	Curve B	70%	Curve B
C6: High Performance New Construction	50%	Curve A	80%	Curve C
C7: PC Power Management	10%	Curve B	50%	Curve B
C8: High Performance Glazing Systems	10%	Curve B	80%	Curve C

As noted earlier, it was not possible to fully address all opportunities in the one-day workshop. Consequently, the workshop focused on opportunities selected based on the criteria described in Step 1. Estimated participation rates for the remaining opportunities were extrapolated from the workshop results shown above and an aggregate set of results was prepared that included all of the eligible technologies.

The results shown in the attached appendices and in the following summary section incorporate the results of all these inputs.

9.5 Summary of Potential Electric Energy Savings

This section presents a summary of the electric energy savings for the upper and lower achievable potential scenarios. The summary is organized and presented in the following sub-sections:

- Overview and selected highlights
- Electric energy savings – Upper Achievable scenario
- Electric energy savings – Lower Achievable scenario.

It should be noted that measures are applied separately for each combination of region, sub sector, and milestone year. Some of the parameters that are used to assess measures in each circumstance can vary. For example, the potential savings or cost for a measure in one sub sector or region may be different from the savings or cost in another sub sector or region. In addition, the economic threshold value that is used to assess cost-effectiveness varies for each of the milestones. As such, measures that are marginally cost-effective, such as multi-split heat pumps, are only cost-effective in a subset of the regions, sub sectors, and milestone years being considered.

9.5.1 Overview and Selected Highlights

Exhibit 67 presents an overview of the results for the total Newfoundland service territory by milestone year, for three scenarios: Economic Potential, upper Achievable Potential and lower Achievable Potential.

Exhibit 67 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	744	31%	56	2.3%	8	0.3%
2020	789	32%	149	6.0%	32	1.3%
2023	834	32%	280	11%	73	2.8%
2026	892	34%	456	17%	137	5.2%
2029	936	35%	640	24%	209	7.8%

Selected Highlights – Potential Electric Energy Savings

Selected highlights of the potential electric energy savings for the upper and lower achievable potential scenarios shown in Exhibit 67 are summarized below. Further detail is provided in the following sub-sections and in the accompanying appendices.

Savings by Milestone Year

Savings in both Achievable scenarios are achieved somewhat more steadily throughout the period than in the Economic Potential scenario. In the upper Achievable Potential scenario, 23% of the 2029 savings would be achieved by 2020, rising to 44% in 2023 and 71% by 2026. In the lower Achievable Potential scenario, 15% of the 2029 savings would be achieved by 2020, rising to 35% in 2023 and 66% by 2026. Although there are some measures in both scenarios that can be implemented early in the study period, the majority are expected to follow an adoption curve that starts slowly and builds up towards 2029.

Savings by Sub Sector

Offices account for the largest portion of achievable savings with 21-23% of the achievable potential savings coming from this sector. Of this, large offices account for approximately 13% and 11% of the upper and lower Achievable Potential savings, respectively, and small offices account for 10% each of the upper and lower achievable potential savings. This reflects the larger market share of offices and their generally higher level of energy intensity. The retail sector accounts for 19-21% of the achievable potential savings with 6% of savings in large non-food retail for both scenarios, 7% savings in small non-food retail for both scenarios and 7% and 8% savings in food retail for the upper and lower scenarios respectively. Educational facilities also provide for a total of 16 -17% of achievable potential savings with schools accounting for approximately 11% and 10% of the upper and lower Achievable Potential savings, respectively, and Universities and colleges accounting for 6% each of the upper and lower achievable potential savings.

Savings by Region

The Island Interconnected region accounts are expected to comprise 88% of potential savings in 2029. The Labrador Interconnected region accounts provides 11% of the savings, and the Isolated region provides 1% of the potential savings in 2029.

Savings by End Use

Savings in the HVAC major end use (which includes space heating, space cooling, and HVAC Fans and Pumps) account for 57% of the upper achievable savings and 38% of the lower achievable savings in 2029. Space heating is the biggest contributor, at 42% of the overall upper achievable savings and 29% of the overall lower Achievable Potential savings. HVAC Fans and Pumps savings account for 13% of the overall 2029 upper Achievable Potential savings and 8% of the overall lower Achievable Potential savings. The most significant measures that save HVAC include ductless mini-split heat pumps, building recommissioning, air source heat pumps, demand control ventilation, and programmable thermostats.

Although HVAC accounts for a very large percentage of the potential, the space heating savings potential is also a very large percentage of the reference case space heating consumption. Between 7% and 32% of HVAC consumption could potentially be saved, respectively, in the lower and upper Achievable Potential scenarios.

Lighting savings accounts for 32% of the upper achievable savings and 53% of the lower achievable savings. Of this, the General Lighting savings accounts for 22% of the upper Achievable Potential savings in 2029 and 32% of the lower Achievable Potential savings. The most significant lighting savings come from LED lighting measures, building recommissioning, lighting occupancy sensors, and T8 Fixtures. Secondary Lighting accounts for 4% of the upper Achievable Potential savings and 10% of the lower Achievable Potential savings in 2029. The most significant savings for secondary lighting come from LED lighting measures. Street Lighting accounts for 2% of the upper Achievable Potential savings and 6% of the lower Achievable Potential savings. The potential reduction for street lighting comes solely from the LED Street Lighting measure.

Refrigeration accounts for 5% of each of the 2029 upper Achievable Potential savings and lower Achievable Potential savings. The most significant refrigeration measures are the refrigerated display cases, high efficiency compressors and the evaporator fan upgrades measure (ECM Motors and Evaporator Fan Motor Controllers).

The remaining major end uses are all under 5% in both scenarios. There are savings available in three other major end uses, including Domestic Hot Water, Food Service, and Plug Loads. Together they account for 7% of upper Achievable Potential savings in 2029 and 4% of lower Achievable Potential savings in 2029.

Savings by Measure

The most significant savings in the Achievable Potential come from the following measures:

- **Building recommissioning**, which accounts for 20% of the upper Achievable Potential savings in 2029 and 9% of the lower Achievable Potential savings in 2029
- **Ductless mini-split heat pumps**, which account for 10% of the upper Achievable Potential savings in 2029 and 11% of the lower Achievable Potential savings in 2029
- **Programmable Thermostats**, which accounts for 6% of each of the upper Achievable Potential savings and lower Achievable Potential savings in 2029
- **Air Source Heat Pumps**, which accounts for 6% of the upper Achievable Potential savings in 2029 and 7% of the lower Achievable Potential savings in 2029
- **Advanced BAS**, which accounts for 6% of each of the upper Achievable Potential savings and lower Achievable Potential savings in 2029
- **Lighting Occupancy sensors**, which accounts for 5% of the upper Achievable Potential savings in 2029 and 4% of the lower Achievable Potential savings in 2029
- **High performance new construction (25% better)**, which accounts for 5% of the upper Achievable Potential savings in 2029 and 8% of the lower Achievable Potential savings in 2029
- **LED tubes** (applied to general and secondary lighting), which accounts for 5% of the upper Achievable Potential savings in 2029 and 10% of the lower Achievable Potential savings in 2029
- **LED lamps** (applied to general and secondary lighting), which accounts for 4% of the upper Achievable Potential savings in 2029 and 11% of the lower Achievable Potential savings in 2029

There are numerous other smaller measures that contribute to the overall Achievable Potential results.

9.5.2 Electric Energy Savings – Upper Achievable Scenario

The following exhibits present the potential electricity savings[30] under the upper Achievable Potential scenario. The results shown are relative to the Reference Case. The results are broken down as follows:

- Exhibit 68 presents the results by region and by milestone year
- Exhibit 69 presents the results for the total NL service territory by sub sector and milestone year
- Exhibit 70 presents the results for the total NL service territory by end use and milestone year
- Exhibit 71 presents the results for the total NL service territory by technology and milestone year.

Exhibit 68 Upper Achievable Electricity Savings by Region (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Island Interconnected	52,821	137,859	255,655	407,167	566,388	24%	88%
Labrador Interconnected	2,763	10,142	22,594	45,474	70,163	24%	11%
Isolated	634	1,384	2,185	3,027	3,890	17%	1%
Grand Total	56,218	149,386	280,435	455,668	640,441	24%	100%

[30] Note: A value of “0” in the following exhibits means a relatively small number, not an absolute value of zero.

Exhibit 69 Upper Achievable Electricity Savings by Sub sector and Milestone Year (MWh/yr.)

Sub Sector	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	% of Total 2029 Savings
Large Office	5,972	16,935	33,303	56,863	80,714	25%	13%
Small Office	4,344	13,029	26,310	44,485	64,337	28%	10%
Large Non-food Retail	3,909	9,491	16,928	25,828	35,879	25%	6%
Small Non-food Retail	3,866	9,947	18,305	30,723	42,647	26%	7%
Food Retail	3,481	10,040	19,787	31,915	45,989	23%	7%
Large Accomodation	2,626	6,740	12,238	18,636	26,101	33%	4%
Small Accomodation	703	1,559	2,650	3,948	5,393	17%	1%
Healthcare	4,110	12,952	25,506	40,432	56,049	33%	9%
Schools	4,772	15,172	30,587	49,433	70,032	35%	11%
Universities and Colleges	3,683	9,793	18,078	28,355	39,881	30%	6%
Warehouse/Wholesale	2,324	5,191	8,925	13,422	18,393	20%	3%
Restaurants	1,473	3,655	6,850	10,856	15,287	12%	2%
Labrador Isolated C/I Buildings	581	1,270	2,008	2,783	3,579	17%	1%
Island Isolated C/I Buildings	53	114	178	244	311	16%	0%
Large Other Buildings	4,573	12,327	23,578	38,402	55,173	23%	9%
Small Other Buildings	3,294	8,581	16,430	28,921	41,187	21%	6%
Other Institutional	365	2,115	5,516	15,870	24,997	29%	4%
Street Lighting	6,088	10,474	13,256	14,552	14,491	40%	2%
Grand Total	56,218	149,386	280,435	455,668	640,441	26%	100%

Note: Any difference in totals is due to rounding.

Exhibit 70 Upper Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	% of Total 2029 Savings
Space Heating	5,847	37,190	94,421	173,631	269,770	35%	42%
Space Cooling	353	1,455	3,340	5,909	9,053	19%	1%
Secondary Lighting	10,833	18,230	22,812	24,915	25,251	20%	4%
Refrigeration	1,310	5,087	11,544	20,102	30,448	15%	5%
Outdoor Lighting	3,029	8,494	15,338	21,245	23,345	49%	4%
Other Plug Loads	237	968	2,222	4,028	6,416	9%	1%
HVAC Fans & Pumps	3,337	13,675	31,083	55,554	85,286	25%	13%
General Lighting	23,528	47,516	73,094	112,552	140,673	33%	22%
Food Service Equipment	21	102	282	389	389	0%	0%
Domestic Hot Water	1,026	4,297	9,967	17,954	28,026	22%	4%
Computer Servers	28	107	115	130	153	1%	0%
Computer Equipment	581	1,791	2,959	4,709	7,139	6%	1%
Street Lighting	6,088	10,474	13,256	14,552	14,491	40%	2%
Grand Total	56,218	149,386	280,435	455,668	640,441	26%	100%

Note: Any difference in totals is due to rounding.

Exhibit 71 Upper Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

Measure	Year					Adoption Curve	Weighted Average CCE		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
Energy-Efficient Server Technologies	28	107	115	130	153	B	0.0	0.0	N/A
Use Natural Ventilation (Summer)	0	2	4	7	10	B	0.0	0.0	N/A
Activate PC Power Management	185	780	1,852	3,433	5,598	B	0.0	0.0	0.0
Use Task Light Instead of Ambient	16	62	128	185	254	B	0.0	0.0	N/A
Use Shades/Blinds (Summer)	1	3	7	12	19	B	0.0	0.0	N/A
Use Shades/Blinds (Winter)	8	32	68	108	145	B	0.0	0.0	0.0
Make Use of Daylighting	30	117	250	393	561	B	0.0	0.0	0.0
Keep Doors Closed (Summer)	0	1	2	3	5	B	0.0	0.0	N/A
Keep Doors Closed (Winter)	4	16	35	58	80	B	0.0	0.0	N/A
ENERGY STAR Computers	378	921	1,010	1,168	1,415	B	0.0	0.0	0.0
ENERGY STAR Office Equipment	18	90	97	108	125	B	0.0	0.0	0.0
Reduce Number of Fridges	7	28	68	126	207	B	0.0	0.0	N/A
Low-Flow Showerheads	170	678	1,516	2,663	4,088	B	0.1	0.1	0.1
Low-Flow Faucet Aerators	588	2,348	5,273	9,347	14,544	B	0.2	0.1	0.1
Lighting Controls (Outdoor)	458	1,551	2,769	3,819	5,378	B	0.4	0.4	0.7
Low-Flow Pre-Rinse Spray Valves	37	149	335	594	923	B	0.4	0.5	1.1
Cooler Night Covers	149	578	1,236	2,041	2,894	B	0.7	0.7	0.7
Automatic Door Closers (Walk-In Coolers & Freezers)	18	70	154	264	393	B	1.2	1.2	N/A
LED Screw-In Lamps	6,843	11,430	14,044	14,968	14,474	C	1.7	1.6	1.6
Programmable Thermostats	2,091	8,157	17,286	28,318	39,705	B	1.7	2.0	1.4
High-Efficiency Air Source Heat Pumps	978	4,514	11,628	23,109	39,600	B	2.0	0.9	9.1
LED Screw-In Lamps	5,507	9,166	11,224	11,922	11,491	C	2.2	2.2	2.1
Refrigerated Vending Machine Controllers	230	939	2,154	3,901	6,209	B	2.6	2.6	2.6
High Efficiency Compressors (Refrigeration)	342	1,352	2,988	5,176	7,817	B	2.7	2.7	N/A
Heat Pump Water Heaters	125	523	1,139	2,042	2,979	B	2.7	3.9	12.2
High-Efficiency Cooking Equipment	21	102	282	389	389	B	2.8	2.7	N/A
High Performance T8 Fixtures	908	1,581	2,038	2,279	2,323	C	3.0	3.0	3.3
LED Outdoor Fixtures	2,562	6,843	12,228	16,737	16,806	C	3.0	2.9	11.3
VFDs on HVAC Motors	772	3,087	6,946	12,361	19,315	B	3.0	3.1	3.1
New Construction (25% More Efficient)	232	2,664	8,851	17,383	29,530	C	3.1	3.0	3.8
Building Recommissioning	6,339	24,394	51,663	89,675	126,323	B	3.2	4.0	2.8
Wall Insulation	731	1,216	1,853	2,918	3,790	C	3.2	3.6	5.6
Roof Insulation	545	795	1,123	1,498	1,888	C	3.5	2.5	4.9
LED Exit Signs	170	251	266	233	173	C	3.8	3.8	3.8
Hotel Occupancy Sensors	72	267	550	885	1,188	B	3.9	2.9	N/A
Premium Efficiency Motors	25	132	360	765	1,397	B	4.0	4.2	4.3

Exhibit 71 Upper Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.) (cont'd…)

Measure	Year					Adoption Curve	Weighted Average CCE		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
High Performance Glazing Systems	1,620	3,544	6,313	11,969	22,110	C	4.2	5.8	3.1
Demand Control Kitchen Ventilation (DCKV)	60	252	531	843	1,145	B	4.2	4.2	N/A
T5HO Fixtures	946	1,642	2,030	2,148	2,063	C	4.5	4.5	4.5
Refrigeration Controls	121	492	1,058	1,764	2,531	B	4.5	4.5	N/A
Occupancy Sensors (Lighting)	1,419	5,417	11,949	20,758	31,654	B	4.5	4.8	5.3
Drainwater Heat Recovery	13	73	199	423	773	B	4.5	4.5	4.5
ECM Motors and Evaporator Fan Motor Controllers	237	927	2,140	3,682	5,538	B	4.7	4.7	4.7
LED High Bay Fixtures	1,782	3,016	3,784	4,144	4,143	C	4.8	2.1	4.8
High Performance T8 Fixtures	4,967	9,019	11,633	13,012	13,259	C	4.8	4.2	4.2
T5HO Fixtures	317	525	662	701	673	C	5.0	4.3	3.6
ENERGY STAR Dishwashers	54	214	520	924	1,442	B	5.0	5.0	N/A
Ventilation Heat Recovery	570	2,636	5,932	10,545	16,477	B	5.2	4.2	4.1
LED High Bay Fixtures	504	848	1,058	1,156	1,156	C	5.2	3.6	3.8
New Construction (40% More Efficient)	106	807	3,037	6,827	11,360	C	5.3	2.6	7.1
Radiant Infrared Heaters	74	296	663	1,338	2,088	B	5.9	6.1	N/A
Demand Control Ventilation (DCV)	1,149	4,503	11,254	18,613	26,045	B	5.9	4.5	N/A
LED Tubular Lamps	2,078	3,435	4,205	4,482	4,598	C	6.0	3.5	6.8
Ground Source Heat Pumps	223	652	1,291	2,056	2,861	B	6.4	N/A	12.1
LED Tubular Lamps	6,452	9,659	11,469	25,145	25,694	C	7.1	N/A	8.7
LED Street Lighting	6,088	10,474	13,256	14,552	14,491	C	7.8	N/A	N/A
Advanced Building Automation Systems	1,960	7,531	15,931	25,891	36,727	B	8.1	4.3	N/A
Refrigeration Heat Recovery	18	71	158	277	429	B	8.2	N/A	N/A
CEE-Rated Refrigerators and Freezers	52	75	127	157	157	B	8.4	N/A	8.4
Ductless Mini-Split Heat Pump	2,651	10,777	23,888	42,741	66,022	B	8.9	2.4	6.0
High Efficiency Chillers	0	0	0	0	0	B	10.5	N/A	N/A
Refrigerated Cases with Doors	339	1,357	3,053	5,427	8,480	B	10.9	N/A	N/A
LED Refrigerated Display Case Lighting	35	42	52	66	82	B	11.5	N/A	16.0
Dimming Control (Daylighting)	2	10	22	39	62	B	N/A	N/A	18.6
Freezer Defrost Controllers	-	-	1	2	3	B	N/A	N/A	27.9
LED Troffers	8	22	41	62	66	C	N/A	N/A	19.3
HVAC Impact from Other Savings	(8,214)	(13,872)	(17,362)	(23,095)	(23,877)	N/A	N/A	N/A	N/A
Grand Total	56,218	149,386	280,435	455,668	640,441				

Note: Curves A and B in this exhibit are as presented in Exhibit 65. In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

9.5.3 Electric Energy Savings – Lower Achievable Scenario

The following exhibits present the potential electricity savings[31] under the lower Achievable Potential scenario. The results shown are relative to the Reference Case. The results are broken down as follows:

- Exhibit 72 presents the results by supply system, by region and milestone year
- Exhibit 73 presents the results for the total NL by sub sector and milestone year
- Exhibit 74 presents the results for the total NL by end use and milestone year
- Exhibit 75 presents the results for the total NL by technology and milestone year.

Exhibit 72 Lower Achievable Electricity Savings by Region (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	% of Total 2029 Savings
Island Interconnected	7,528	29,913	68,110	126,145	191,279	8%	91%
Labrador Interconnected	433	2,109	5,117	10,676	17,359	6%	8.3%
Isolated	14	77	172	311	498	2%	0.2%
Grand Total	7,974	32,099	73,399	137,132	209,136	8%	100%

[31] A value of “0” in the following exhibits means a relatively small number, not an absolute value of zero.

Exhibit 73 Lower Achievable Electricity Savings by Sub sector and Milestone Year (MWh/yr.)

Sub Sector	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	% of Total 2029 Savings
Large Office	790	3,113	7,361	15,622	23,795	7%	11%
Small Office	769	3,053	7,010	13,560	20,838	9%	10%
Large Non-food Retail	530	2,126	4,851	8,507	12,901	9%	6%
Small Non-food Retail	534	2,133	4,874	9,821	14,585	9%	7%
Food Retail	656	2,596	5,889	10,313	15,696	8%	8%
Large Accomodation	389	1,536	3,447	5,974	9,225	12%	4%
Small Accomodation	90	360	825	1,468	2,252	7%	1%
Healthcare	638	2,611	5,934	10,561	16,027	9%	8%
Schools	829	3,385	7,779	13,863	21,251	11%	10%
Universities and Colleges	513	2,018	4,471	7,906	11,862	9%	6%
Warehouse/Wholesale	295	1,181	2,728	4,895	7,432	8%	4%
Restaurants	176	733	1,721	3,082	4,870	4%	2%
Labrador Isolated C/I Buildings	12	70	157	284	455	2%	0%
Island Isolated C/I Buildings	1	7	15	27	43	2%	0%
Large Other Buildings	625	2,555	5,895	10,792	16,736	7%	8%
Small Other Buildings	432	1,732	4,027	8,414	12,723	6%	6%
Other Institutional	97	576	1,393	3,470	5,637	7%	3%
Street Lighting	598	2,314	5,021	8,574	12,808	35%	6%
Grand Total	7,974	32,099	73,399	137,132	209,136	8%	100%

Note: Any difference in totals is due to rounding.

Exhibit 74 Lower Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	% of Total 2029 Savings
Space Heating	1,763	7,874	19,308	35,251	60,300	8%	29%
Space Cooling	72	315	773	1,448	2,374	5%	1%
Secondary Lighting	1,079	4,102	8,770	14,713	21,848	17%	10%
Refrigeration	408	1,604	3,730	6,707	10,573	5%	5%
Outdoor Lighting	388	1,756	4,477	7,963	9,032	19%	4%
Other Plug Loads	66	271	621	1,126	1,793	3%	1%
HVAC Fans & Pumps	576	2,459	5,884	10,951	17,737	5%	8%
General Lighting	2,780	10,455	22,741	46,640	66,590	16%	32%
Food Service Equipment	7	34	94	130	130	0%	0%
Domestic Hot Water	115	536	1,363	2,658	4,486	4%	2%
Computer Servers	6	21	23	26	31	0%	0%
Computer Equipment	115	357	592	945	1,435	1%	1%
Street Lighting	598	2,314	5,021	8,574	12,808	35%	6%
Grand Total	7,974	32,099	73,399	137,132	209,136	9%	100%

Note: Any difference in totals is due to rounding.

Exhibit 75 Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

Measure	Year					Adoption	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029	Curve	Island	Labrador	Isolated
Energy-Efficient Server Technologies	6	21	23	26	31	B	0.0	0.0	N/A
Make Use of Daylighting	6	25	55	93	139	B	0.0	0.0	N/A
Keep Doors Closed (Summer)	0	0	0	1	1	B	0.0	0.0	N/A
Keep Doors Closed (Winter)	1	3	8	14	22	B	0.0	0.0	N/A
ENERGY STAR Computers	75	182	200	231	280	B	0.0	0.0	N/A
ENERGY STAR Office Equipment	3	18	19	21	25	B	0.0	0.0	N/A
Reduce Number of Fridges	1	6	14	25	41	B	0.0	0.0	N/A
Use Natural Ventilation (Summer)	0	0	1	2	2	B	0.0	0.0	N/A
Activate PC Power Management	37	157	373	692	1,130	B	0.0	0.0	0.0
Use Task Light Instead of Ambient	3	13	29	45	66	B	0.0	0.0	N/A
Use Shades/Blinds (Summer)	0	1	2	3	4	B	0.0	0.0	N/A
Use Shades/Blinds (Winter)	2	7	16	28	42	B	0.0	0.0	N/A
Low-Flow Showerheads	13	53	118	210	328	B	0.1	0.1	N/A
Low-Flow Faucet Aerators	43	173	390	693	1,083	B	0.2	0.1	N/A
Lighting Controls (Outdoor)	138	508	1,019	1,567	2,267	B	0.4	0.4	N/A
Low-Flow Pre-Rinse Spray Valves	3	11	25	44	69	B	0.4	0.5	N/A
Cooler Night Covers	46	184	408	709	1,076	B	0.7	0.7	N/A
Automatic Door Closers (Walk-In Coolers & Freezers)	6	22	50	87	134	B	1.2	1.2	N/A
Programmable Thermostats	610	2,418	5,269	9,022	13,483	B	1.6	2.0	N/A
LED Screw-In Lamps	682	2,564	5,401	8,953	12,985	B	1.7	1.6	N/A
Roof Insulation	8	15	33	64	113	B	2.0	2.5	N/A
High-Efficiency Air Source Heat Pumps	329	1,534	4,016	8,183	14,538	B	2.0	0.9	9.1
LED Screw-In Lamps	546	2,046	4,298	7,105	10,279	B	2.2	2.2	N/A
Refrigerated Vending Machine Controllers	65	265	608	1,101	1,751	B	2.6	2.6	N/A
Wall Insulation	10	26	60	149	259	B	2.6	3.6	N/A
High Efficiency Compressors (Refrigeration)	107	427	955	1,684	2,605	B	2.7	2.7	N/A
Heat Pump Water Heaters	42	180	412	793	1,287	B	2.7	3.8	N/A
High-Efficiency Cooking Equipment	7	34	94	130	130	B	2.8	2.7	N/A
High Performance T8 Fixtures	87	341	753	1,311	2,004	B	3.0	3.0	N/A
LED Outdoor Fixtures	247	1,210	3,313	6,067	6,135	B	3.0	2.9	N/A
VFDs on HVAC Motors	55	221	496	883	1,380	B	3.0	3.1	3.1
New Construction (25% More Efficient)	81	1,033	3,800	8,253	15,860	A	3.1	3.0	3.8
Building Recommissioning	821	3,253	7,153	13,099	19,702	B	3.2	4.0	N/A
LED Exit Signs	16	55	99	135	150	B	3.8	3.8	N/A

Exhibit 75 Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.) (cont'd…)

Measure	Year					Adoption	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029	Curve	Island	Labrador	Isolated
Hotel Occupancy Sensors	22	84	181	304	436	B	3.9	2.9	N/A
Premium Efficiency Motors	2	10	26	56	102	B	4.0	4.2	N/A
Demand Control Kitchen Ventilation (DCKV)	4	19	41	70	105	B	4.2	4.2	N/A
High Performance Glazing Systems	23	83	233	707	1,980	B	4.4	5.9	3.1
T5HO Fixtures	91	358	758	1,247	1,797	B	4.5	4.5	N/A
Refrigeration Controls	38	157	349	609	929	B	4.5	4.5	N/A
Occupancy Sensors (Lighting)	420	1,635	3,614	6,243	9,234	B	4.5	4.8	N/A
Drainwater Heat Recovery	1	5	14	30	55	B	4.5	4.5	N/A
ECM Motors and Evaporator Fan Motor Controllers	74	292	680	1,183	1,807	B	4.7	4.7	4.7
LED High Bay Fixtures	179	685	1,472	2,489	3,686	B	4.8	2.1	N/A
High Performance T8 Fixtures	476	1,947	4,305	7,490	11,449	B	4.8	4.2	N/A
T5HO Fixtures	31	114	247	407	586	B	5.0	4.3	N/A
ENERGY STAR Dishwashers	4	15	37	66	103	B	5.0	5.0	N/A
Ventilation Heat Recovery	41	188	423	753	1,176	B	5.2	4.2	N/A
LED High Bay Fixtures	56	213	455	767	1,132	B	5.3	3.6	N/A
New Construction (40% More Efficient)	37	301	1,291	3,273	6,140	A	5.3	2.6	N/A
Demand Control Ventilation (DCV)	83	331	852	1,485	2,245	B	5.9	4.5	N/A
Radiant Infrared Heaters	25	99	223	449	702	B	5.9	6.1	N/A
LED Tubular Lamps	202	754	1,584	2,615	3,983	B	6.0	3.5	N/A
Ground Source Heat Pumps	75	229	480	829	1,281	B	6.4	N/A	N/A
LED Tubular Lamps	637	1,941	3,896	14,090	17,506	B	7.3	N/A	8.7
LED Street Lighting	598	2,314	5,021	8,574	12,808	B	7.8	N/A	N/A
Advanced Building Automation Systems	573	2,258	4,938	8,421	12,606	B	8.0	4.3	N/A
Refrigeration Heat Recovery	1	5	11	20	31	B	8.2	N/A	N/A
CEE-Rated Refrigerators and Freezers	14	14	14	14	14	B	8.4	N/A	N/A
Ductless Mini-Split Heat Pump	887	3,624	8,099	14,683	23,256	B	8.9	2.3	N/A
High Efficiency Chillers	0	0	0	0	0	B	10.5	N/A	N/A
Refrigerated Cases with Doors	106	424	954	1,696	2,650	B	10.9	N/A	N/A
LED Refrigerated Display Case Lighting	10	10	10	10	10	B	11.5	N/A	N/A
HVAC Impact from Other Savings	(832)	(3,017)	(6,319)	(12,875)	(18,078)	N/A	0.0	0.0	0.0
Grand Total	7,974	32,099	73,399	137,132	209,136				

Note: Curves A, B, and C in this exhibit are as presented in Exhibit 65.

9.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 76 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Achievable Potential Forecast. The reductions are shown by milestone year, region and sub sector for both lower and upper achievable potential savings. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6. Exhibit 77 and Exhibit 78 show the lower and upper Achievable Potential savings by region, sub sector and principal end use for each milestone year.

Exhibit 76, Exhibit 77 and Exhibit 78 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct. For example, most of the heat pump measures will not produce any peak demand savings, because during the winter peak period the heat pumps and mini-splits will revert to back-up electric resistance heating.[32] Therefore, there will be no net reduction in space heating peak demand for these measures. Accordingly, the demand reductions for the heat pump measures have been manually filtered out of the results presented in these exhibits.

Exhibit 79 shows the demand reductions associated with each electric energy savings measure contained in the Achievable Potential Forecast for the milestone year 2029. The heat pump measures are omitted from the exhibit, as with the previous two exhibits. One notable line item in the exhibit is "HVAC Impact from Other Savings" - the impact on peak space heating load resulting from the savings for other end uses within the sub sector. This is to capture the fact that in an electrically-heated building, savings of energy consuming equipment within the building will not reduce the winter peak demand. The impact of demand reductions for other end uses on the space heating demand can be seen graphically in Exhibit 77. As the demand impacts for many of the other end uses rise with time, the demand impacts for space heating actually decreases over time.

Electric peak load reductions related to capacity-only measures are presented separately in Section 9.7.

[32] In fact, this is a conservative assumption for the Island Interconnected region. Although the demand peak occurs on the coldest winter days, in a climate such as that of St. John's the temperature is typically not very extreme on those peak days. Therefore, many heat pumps will continue to work in heat pump mode and not revert to electric resistance. In this study, we have retained the conservative assumption that they do not provide demand relief.

Exhibit 76 Electric Peak Load Reductions from Lower and Upper Achievable Potential Energy Savings Measures by Milestone Year, Region and Subsector (MW)

Sub Sector	Milestone Year	Island Interconnected		Labrador Interconnected		Isolated		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Large Office	2017	0.1	1.1	0.0	0.0	0.0	0.0	0.1	1.1
	2020	0.6	3.4	0.0	0.0	0.0	0.0	0.6	3.4
	2023	1.3	7.0	0.0	0.0	0.0	0.0	1.3	7.0
	2026	2.6	11.7	0.0	0.0	0.0	0.0	2.6	11.7
	2029	4.1	16.8	0.0	0.0	0.0	0.0	4.1	16.8
Small Office	2017	0.1	0.7	0.0	0.0	0.0	0.0	0.1	0.7
	2020	0.4	2.1	0.0	0.0	0.0	0.0	0.4	2.1
	2023	0.9	4.2	0.0	0.1	0.0	0.0	0.9	4.2
	2026	1.7	6.7	0.0	0.1	0.0	0.0	1.7	6.8
	2029	2.7	9.7	0.0	0.1	0.0	0.0	2.7	9.9
Large Non-food Retail	2017	0.1	0.5	0.0	0.0	0.0	0.0	0.1	0.5
	2020	0.3	1.5	0.0	0.1	0.0	0.0	0.3	1.6
	2023	0.7	2.9	0.0	0.1	0.0	0.0	0.8	3.0
	2026	1.3	4.6	0.1	0.2	0.0	0.0	1.3	4.9
	2029	1.9	6.5	0.1	0.4	0.0	0.0	2.0	6.9
Small Non-food Retail	2017	0.1	0.5	0.0	0.0	0.0	0.0	0.1	0.6
	2020	0.3	1.5	0.0	0.2	0.0	0.0	0.3	1.6
	2023	0.7	2.9	0.1	0.3	0.0	0.0	0.7	3.3
	2026	1.3	5.0	0.1	0.6	0.0	0.0	1.4	5.6
	2029	1.9	6.9	0.2	0.8	0.0	0.0	2.1	7.7
Food Retail	2017	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.4
	2020	0.3	1.3	0.0	0.1	0.0	0.0	0.3	1.4
	2023	0.7	2.7	0.1	0.2	0.0	0.0	0.8	3.0
	2026	1.2	4.5	0.1	0.4	0.0	0.0	1.3	4.9
	2029	1.9	6.4	0.1	0.6	0.0	0.0	2.0	7.0
Large Accomodation	2017	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.4
	2020	0.2	1.1	0.0	0.1	0.0	0.0	0.2	1.2
	2023	0.5	2.1	0.0	0.2	0.0	0.0	0.5	2.4
	2026	0.8	3.4	0.1	0.4	0.0	0.0	0.9	3.8
	2029	1.3	4.8	0.1	0.5	0.0	0.0	1.4	5.3
Small Accomodation	2017	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
	2020	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
	2023	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
	2026	0.2	0.5	0.0	0.0	0.0	0.0	0.2	0.5
	2029	0.3	0.7	0.0	0.0	0.0	0.0	0.3	0.7
Healthcare	2017	0.1	0.7	0.0	0.0	0.0	0.0	0.1	0.7
	2020	0.4	2.3	0.0	0.1	0.0	0.0	0.4	2.4
	2023	0.9	4.7	0.0	0.2	0.0	0.0	1.0	4.9
	2026	1.7	7.5	0.1	0.4	0.0	0.0	1.7	7.8
	2029	2.5	10.3	0.1	0.5	0.0	0.0	2.6	10.8
Schools	2017	0.1	0.9	0.0	0.0	0.0	0.0	0.1	0.9
	2020	0.5	2.9	0.0	0.1	0.0	0.0	0.5	3.0
	2023	1.2	5.8	0.1	0.3	0.0	0.0	1.3	6.1
	2026	2.1	9.3	0.1	0.6	0.0	0.0	2.3	9.8
	2029	3.3	12.9	0.2	0.8	0.0	0.0	3.5	13.7
Universities and Colleges	2017	0.1	0.5	0.0	0.0	0.0	0.0	0.1	0.5
	2020	0.3	1.5	0.0	0.0	0.0	0.0	0.3	1.5
	2023	0.7	2.8	0.0	0.1	0.0	0.0	0.7	2.9
	2026	1.2	4.6	0.0	0.1	0.0	0.0	1.2	4.7
	2029	1.8	6.6	0.0	0.2	0.0	0.0	1.8	6.8
Warehouse/Wholesale	2017	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.4
	2020	0.2	0.9	0.0	0.0	0.0	0.0	0.2	1.0
	2023	0.5	1.6	0.0	0.1	0.0	0.0	0.5	1.7
	2026	0.8	2.4	0.0	0.2	0.0	0.0	0.9	2.6
	2029	1.3	3.2	0.1	0.3	0.0	0.0	1.3	3.5

Exhibit 76 Electric Peak Load Reductions from Lower and Upper Achievable Potential Energy Savings Measures by Milestone Year, Region and Subsector (MW) (cont'd…)

Sub Sector	Milestone Year	Island Interconnected		Labrador Interconnected		Isolated		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Restaurants	2017	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
	2020	0.1	0.6	0.0	0.0	0.0	0.0	0.1	0.7
	2023	0.2	1.3	0.0	0.1	0.0	0.0	0.3	1.4
	2026	0.5	2.2	0.0	0.2	0.0	0.0	0.5	2.4
	2029	0.7	3.2	0.0	0.2	0.0	0.0	0.8	3.4
Labrador Isolated C/I Buildings	2017	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
	2020	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
	2023	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
	2026	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4
	2029	0.0	0.0	0.0	0.0	0.1	0.5	0.1	0.5
Island Isolated C/I Buildings	2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2029	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Large Other Buildings	2017	0.1	0.6	0.0	0.1	0.0	0.0	0.1	0.8
	2020	0.3	1.8	0.1	0.5	0.0	0.0	0.4	2.3
	2023	0.8	3.5	0.2	1.1	0.0	0.0	1.0	4.7
	2026	1.5	6.0	0.4	1.8	0.0	0.0	1.8	7.9
	2029	2.3	8.6	0.6	2.9	0.0	0.0	2.8	11.4
Small Other Buildings	2017	0.0	0.4	0.0	0.1	0.0	0.0	0.1	0.5
	2020	0.2	1.2	0.0	0.3	0.0	0.0	0.2	1.4
	2023	0.4	2.2	0.1	0.7	0.0	0.0	0.6	2.9
	2026	0.9	4.0	0.2	1.1	0.0	0.0	1.2	5.0
	2029	1.4	5.5	0.4	1.7	0.0	0.0	1.8	7.2
Other Institutional	2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2020	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.2
	2023	0.0	0.0	0.1	0.8	0.0	0.0	0.1	0.8
	2026	0.0	0.0	0.5	2.7	0.0	0.0	0.5	2.7
	2029	0.0	0.0	0.8	4.5	0.0	0.0	0.8	4.5
Non-Buildings	2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2029	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Street Lighting	2017	0.1	0.9	0.0	0.0	0.0	0.0	0.1	0.9
	2020	0.3	1.5	0.0	0.0	0.0	0.0	0.3	1.5
	2023	0.7	1.9	0.0	0.0	0.0	0.0	0.7	1.9
	2026	1.2	2.0	0.0	0.0	0.0	0.0	1.2	2.0
	2029	1.8	2.0	0.0	0.0	0.0	0.0	1.8	2.0
Grand Total	2017	1.1	8.3	0.1	0.5	0.0	0.1	1.2	8.8
	2020	4.5	23.7	0.3	1.8	0.0	0.2	4.8	25.7
	2023	10.3	46.1	0.8	4.3	0.0	0.3	11.1	50.7
	2026	19.0	74.4	1.7	8.8	0.0	0.4	20.7	83.6
	2029	29.1	104.2	2.7	13.4	0.1	0.6	31.8	118.2

Exhibit 77 Electric Peak Load Reductions from Upper Achievable Potential Energy Savings Measures, by Milestone Year End Use and Sub sector, Winter Peak Period (MW)

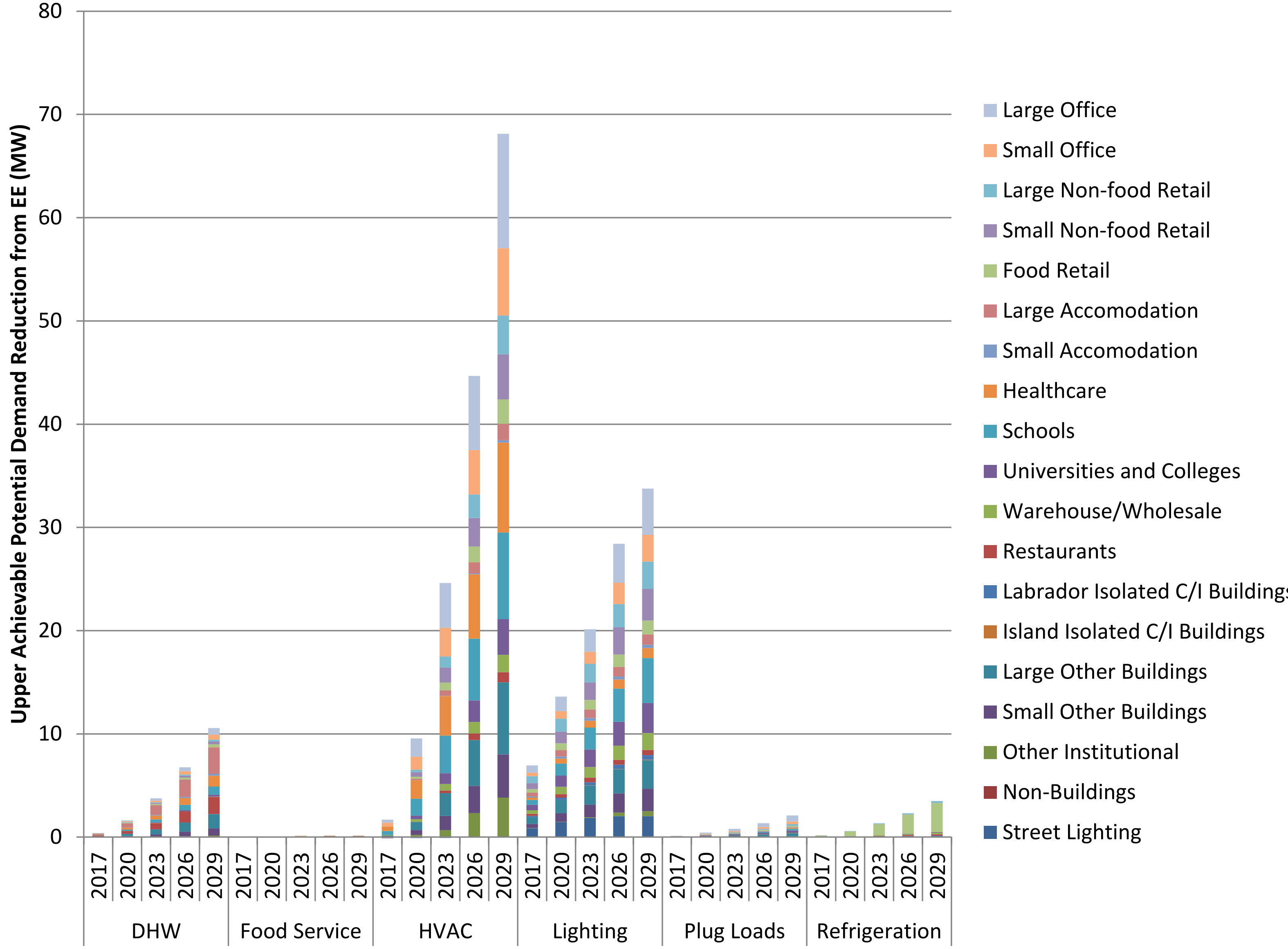


Exhibit 78 Electric Peak Load Reductions from Lower Achievable Potential Energy Savings Measures, by Milestone Year End Use and Sub sector, Winter Peak Period (MW)

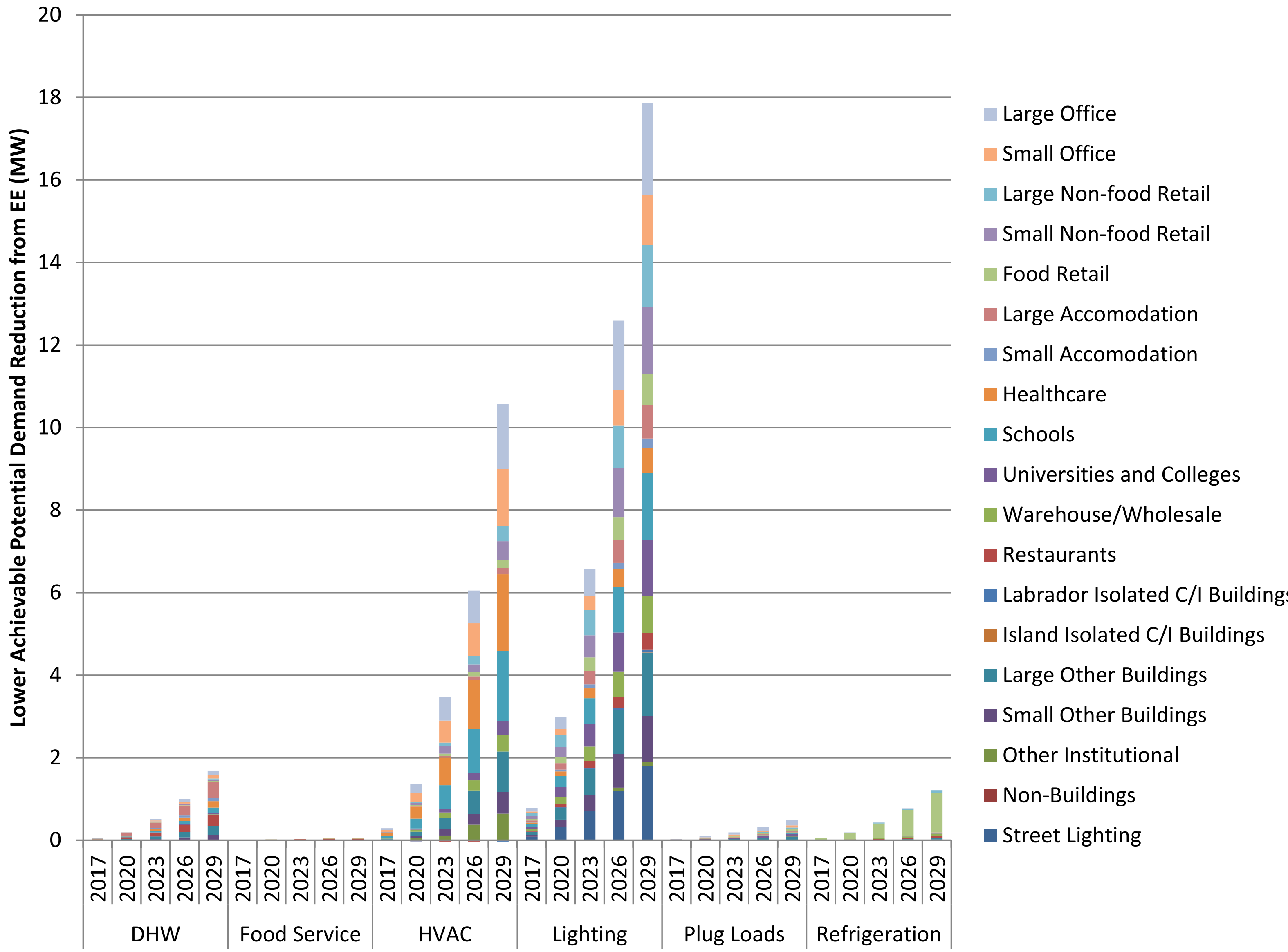


Exhibit 79 Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW)

Measure	Island		Labrador		Isolated		Grand Total	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Building Recommissioning	4.0	24.9	0.8	5.1	0.0	0.2	4.8	30.1
New Construction (25% More Efficient)	3.7	6.9	0.1	0.3	0.0	0.1	3.9	7.2
Programmable Thermostats	3.1	8.8	0.6	1.9	0.0	0.0	3.7	10.7
Advanced Building Automation Systems	3.0	8.6	0.0	0.1	0.0	0.0	3.1	8.7
LED Tubular Lamps	2.9	4.3	0.0	0.0	0.1	0.1	2.9	4.3
High Performance T8 Fixtures	1.9	2.1	0.1	0.1	0.0	0.0	2.0	2.3
LED Screw-In Lamps	1.8	2.0	0.2	0.2	0.0	0.0	2.0	2.2
LED Street Lighting	1.8	2.0	0.0	0.0	0.0	0.0	1.8	2.0
Occupancy Sensors (Lighting)	1.6	5.3	0.1	0.5	0.0	0.0	1.7	5.8
LED Screw-In Lamps	1.5	1.7	0.2	0.2	0.0	0.0	1.7	1.9
New Construction (40% More Efficient)	1.4	2.6	0.0	0.0	0.0	0.0	1.4	2.7
LED Outdoor Fixtures	0.8	2.1	0.1	0.2	0.0	0.0	0.9	2.4
LED High Bay Fixtures	0.6	0.7	0.0	0.0	0.0	0.0	0.7	0.7
Demand Control Ventilation (DCV)	0.6	7.3	0.1	1.3	0.0	0.0	0.7	8.6
LED Tubular Lamps	0.6	0.7	0.0	0.0	0.0	0.0	0.6	0.7
High Performance Glazing Systems	0.5	5.6	0.2	1.3	0.0	0.0	0.6	6.9
Heat Pump Water Heaters	0.4	1.0	0.1	0.2	0.0	0.0	0.5	1.1
Ground Source Heat Pumps	0.4	0.9	0.0	0.0	0.0	0.0	0.4	0.9
Low-Flow Faucet Aerators	0.3	4.7	0.1	0.8	0.0	0.0	0.4	5.5
Ventilation Heat Recovery	0.3	4.5	0.0	0.6	0.0	0.0	0.4	5.1
Refrigerated Cases with Doors	0.3	1.0	0.0	0.0	0.0	0.0	0.3	1.0
T5HO Fixtures	0.3	0.3	0.0	0.0	0.0	0.0	0.3	0.4
High Efficiency Compressors (Refrigeration)	0.3	0.9	0.0	0.0	0.0	0.0	0.3	0.9
Lighting Controls (Outdoor)	0.3	0.7	0.0	0.1	0.0	0.0	0.3	0.8
High Performance T8 Fixtures	0.3	0.3	0.0	0.0	0.0	0.0	0.3	0.3
Refrigerated Vending Machine Controllers	0.2	0.8	0.0	0.1	0.0	0.0	0.3	1.0
Radiant Infrared Heaters	0.2	0.6	0.0	0.1	0.0	0.0	0.2	0.7
ECM Motors and Evaporator Fan Motor Controllers	0.2	0.6	0.0	0.0	0.0	0.0	0.2	0.6
VFDs on HVAC Motors	0.2	2.7	0.0	0.2	0.0	0.0	0.2	2.8
LED High Bay Fixtures	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.2
Activate PC Power Management	0.2	0.8	0.0	0.0	0.0	0.0	0.2	0.9
Cooler Night Covers	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
Low-Flow Showerheads	0.1	1.4	0.0	0.2	0.0	0.0	0.1	1.5
Hotel Occupancy Sensors	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
Refrigeration Controls	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
T5HO Fixtures	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Wall Insulation	0.1	1.1	0.0	0.0	0.0	0.0	0.1	1.1
High-Efficiency Cooking Equipment	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
ENERGY STAR Computers	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
ENERGY STAR Dishwashers	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5
Roof Insulation	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.6
Demand Control Kitchen Ventilation (DCKV)	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
Make Use of Daylighting	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1

Exhibit 79 Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW) (cont'd…)

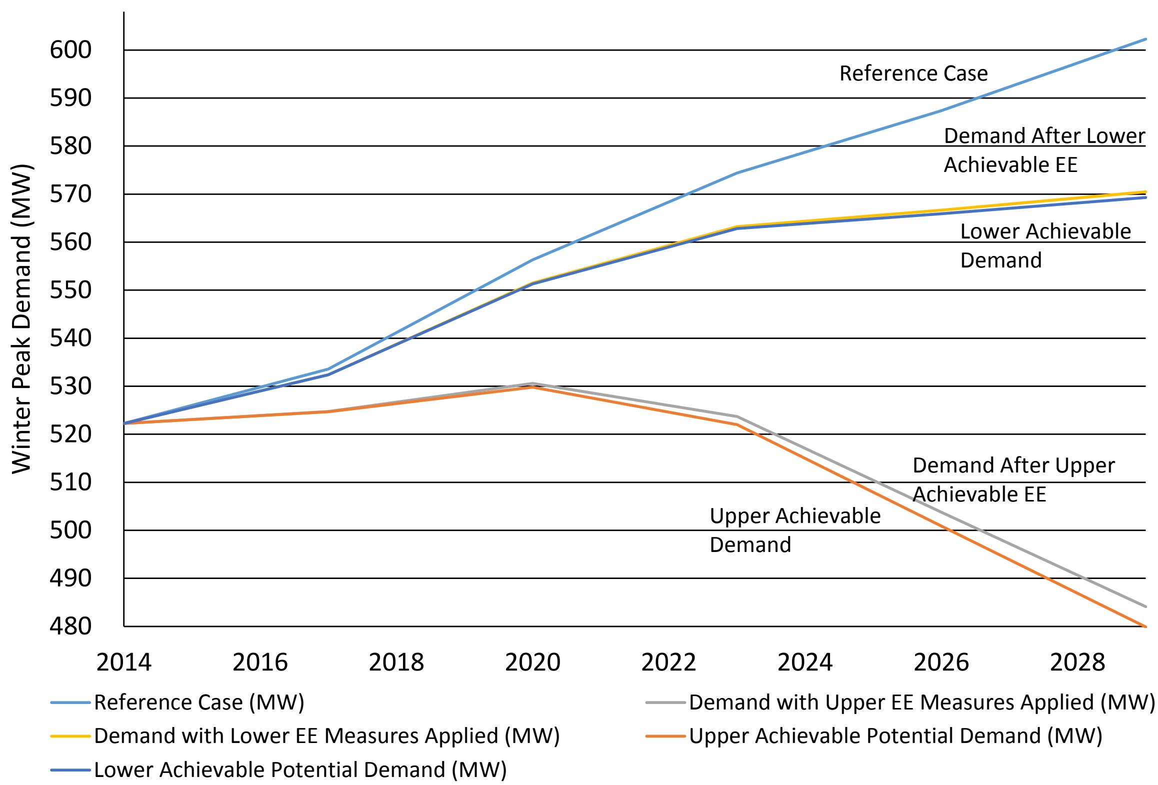
Measure	Island		Labrador		Isolated		Grand Total	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Low-Flow Pre-Rinse Spray Valves	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
Drainwater Heat Recovery	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
LED Exit Signs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Premium Efficiency Motors	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
Automatic Door Closers (Walk-In Coolers & Freezers)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use Shades/Blinds (Winter)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigeration Heat Recovery	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
Use Task Light Instead of Ambient	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keep Doors Closed (Winter)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reduce Number of Fridges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy-Efficient Server Technologies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENERGY STAR Office Equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use Shades/Blinds (Summer)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CEE-Rated Refrigerators and Freezers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LED Refrigerated Display Case Lighting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use Natural Ventilation (Summer)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keep Doors Closed (Summer)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High Efficiency Chillers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Freezer Defrost Controllers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LED Troffers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dimming Control (Daylighting)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC Impact from Other Savings	-5.8	-7.5	-0.3	-0.3	0.0	-0.1	-6.0	-8.0
Grand Total	**29.1**	**104.2**	**2.7**	**13.4**	**0.1**	**0.6**	**31.8**	**118.2**

9.7 Summary of Peak Load Reductions

This section presents a summary of the electric peak load reductions that would result from the application of peak demand measures. Exhibit 80 compares the Reference Case, Lower Achievable Potential and Upper Achievable Potential Peak Demand Forecast levels of winter peak demand.[33]

As illustrated, under the Reference Case commercial peak demand would grow from the Base Year level of 520 MW to approximately 600 MW by 2029. This contrasts with the Lower Achievable Potential Forecast in which peak demand would decrease to approximately 570 MW for the same period, a difference of approximately 35 MW or about 6%. The Upper Achievable Potential forecasts peak demand at 480 MW, a difference of approximately 120 MW or 20%. The other two lines on the chart show the peak demand that would result if all the energy efficiency measures were applied but none of the demand reduction measures in each of the Lower and Upper Achievable Potential scenarios. As illustrated in the exhibit, approximately 97% of the reduction comes from the impact of energy efficiency measures in both the Upper Achievable Potential scenario and the Lower Achievable Potential scenario.

Exhibit 80 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Commercial Sector (MW)[34]



[33] All results are reported at the customer's point-of-use and do not include line losses.
[34] Please note that all demand curtailment is accounted for in the Industrial sector analysis and reporting

9.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Upper and Lower Achievable Potential Forecast is provided in the following exhibits:[35]

- Exhibit 81 presents the results by end use, sub sector and milestone year
- Exhibit 82 provides a further disaggregation of the peak demand reduction by technology and milestone year
- Exhibits 83 and 84 present peak demand reduction by major end use, milestone year and region
- Exhibits 85 and 86 present peak demand reduction by major end use, milestone year and sub sector
- Exhibit 87 and Exhibit 88 present 2029 peak demand reduction by major end use and vintage.

[35] MW reductions shown in the following exhibits are not incremental. For example, the space heating reductions in 2029 are not in addition to the space heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Lower or Upper Achievable Potential scenario are implemented.

Exhibit 81 Total Lower and Upper Achievable Potential Peak Demand Reduction by End Use, Sub sector and Milestone Year (MW)

Sub sector	Milestone Year	Domestic Hot Water		HVAC Fans & Pumps		Refrigeration		Secondary Lighting		Space Heating		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Large Office	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	2020	0.00	0.00	0.03	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12
	2023	0.00	0.00	0.07	0.27	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.28
	2026	0.00	0.00	0.13	0.46	0.00	0.00	0.00	0.01	0.00	0.01	0.14	0.48
	2029	0.00	0.00	0.21	0.69	0.00	0.00	0.00	0.01	0.00	0.02	0.22	0.72
Small Office	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
	2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.01	0.04
	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.02	0.06
	2029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.08	0.03	0.08
Large Non-food Retail	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06
	2023	0.00	0.00	0.03	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.13
	2026	0.00	0.00	0.06	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.23
	2029	0.00	0.00	0.10	0.32	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.34
Small Non-food Retail	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
Food Retail	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.01	0.02	0.01	0.03	0.00	0.00	0.00	0.01	0.02	0.07
	2023	0.00	0.00	0.01	0.05	0.02	0.07	0.00	0.01	0.00	0.01	0.04	0.15
	2026	0.00	0.00	0.03	0.09	0.03	0.12	0.00	0.02	0.01	0.02	0.07	0.25
	2029	0.00	0.00	0.04	0.13	0.05	0.18	0.01	0.03	0.01	0.03	0.11	0.36
Large Accomodation	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.01	0.10	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11
	2023	0.03	0.21	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.25
	2026	0.06	0.34	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.40
	2029	0.09	0.46	0.03	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.12	0.57
Small Accomodation	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
	2023	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10
	2026	0.03	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.19
	2029	0.04	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.30

Exhibit 81 Total Lower and Upper Achievable Potential Peak Demand Reduction by End Use, Sub sector and Milestone Year (MW) (cont'd…)

Sub sector	Milestone Year	Domestic Hot Water		HVAC Fans & Pumps		Refrigeration		Secondary Lighting		Space Heating		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Healthcare	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.08
	2023	0.00	0.01	0.04	0.13	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.17
	2026	0.00	0.02	0.07	0.20	0.00	0.00	0.00	0.00	0.01	0.04	0.08	0.27
	2029	0.01	0.05	0.10	0.26	0.00	0.00	0.00	0.01	0.02	0.05	0.13	0.36
Schools	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.03
	2023	0.00	0.00	0.01	0.04	0.00	0.00	0.01	0.03	0.00	0.01	0.02	0.07
	2026	0.00	0.00	0.02	0.07	0.00	0.00	0.01	0.05	0.00	0.01	0.03	0.12
	2029	0.00	0.00	0.03	0.10	0.00	0.00	0.02	0.07	0.00	0.02	0.05	0.19
Universities and Colleges	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.02	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09
	2023	0.00	0.00	0.05	0.17	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.18
	2026	0.00	0.00	0.09	0.27	0.00	0.00	0.00	0.00	0.00	0.01	0.09	0.29
	2029	0.00	0.00	0.13	0.35	0.00	0.01	0.00	0.00	0.00	0.02	0.14	0.38
Warehouse/ Wholesale	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.03
	2029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.01	0.04
Restaurants	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2023	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.04
	2026	0.01	0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.07
	2029	0.01	0.08	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.01	0.02	0.12
Labrador Isolated C/I Buildings	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	2029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02
Island Isolated C/I Buildings	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exhibit 81 Total Lower and Upper Achievable Potential Peak Demand Reduction by End Use, Sub sector and Milestone Year (MW) (cont'd…)

Sub sector	Milestone Year	Domestic Hot Water		HVAC Fans & Pumps		Refrigeration		Secondary Lighting		Space Heating		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Large Other Buildings	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.02	0.06	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.09
	2023	0.00	0.01	0.04	0.14	0.00	0.00	0.01	0.04	0.00	0.00	0.05	0.19
	2026	0.00	0.03	0.07	0.23	0.00	0.00	0.02	0.07	0.00	0.01	0.09	0.33
	2029	0.01	0.05	0.11	0.34	0.00	0.00	0.03	0.10	0.00	0.01	0.14	0.50
Small Other Buildings	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	2023	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.01	0.04
	2026	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.02	0.07
	2029	0.01	0.04	0.00	0.00	0.00	0.00	0.02	0.08	0.00	0.01	0.03	0.12
Other Institutional	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2020	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	2023	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
	2026	0.00	0.00	0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07
	2029	0.00	0.00	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09
Grand Total	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.01	0.03
	2020	0.02	0.15	0.12	0.46	0.01	0.04	0.01	0.05	0.01	0.06	0.18	0.76
	2023	0.05	0.36	0.28	1.00	0.02	0.09	0.03	0.12	0.03	0.13	0.41	1.69
	2026	0.10	0.63	0.50	1.66	0.04	0.15	0.06	0.21	0.05	0.22	0.75	2.87
	2029	0.16	0.97	0.78	2.36	0.07	0.23	0.09	0.33	0.09	0.32	1.18	4.21

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) MW reductions are not incremental. The space heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.
5) The values in this exhibit do not include peak demand reductions from energy efficiency measures.
6) Demand-specific measure savings will fluctuate based on the demand savings from conservation measures. The demand reference case to which demand-specific measures are applied already factors in the corresponding Upper or Lower Achievable demand savings from conservation measures. So the more peak demand reductions are generated through conservation measures, the less peak demand remains for demand-specific measures to reduce.

Exhibit 82 Lower and Upper Achievable Potential Peak Demand Reduction by Measure and Milestone Year (MW)

Measure	Lower Achievable Potential Peak Demand Reduction (MW)					Upper Achievable Potential Peak Demand Reduction (MW)				
	2017	2020	2023	2026	2029	2017	2020	2023	2026	2029
DHW Controls	0.00	0.02	0.05	0.10	0.16	0.00	0.15	0.36	0.63	0.97
Heating Controls	0.00	0.01	0.03	0.05	0.09	0.00	0.06	0.13	0.22	0.32
Lighting Demand Controls	0.01	0.01	0.03	0.06	0.09	0.03	0.05	0.12	0.21	0.33
Refrigeration Demand Controls	0.00	0.01	0.02	0.04	0.07	0.00	0.04	0.09	0.15	0.23
HVAC Demand Controls	0.00	0.12	0.28	0.50	0.78	0.00	0.46	1.00	1.66	2.36
Grand Total	0.01	0.18	0.41	0.75	1.18	0.03	0.76	1.69	2.87	4.21

Exhibit 83 Lower Achievable Potential Peak Load Reduction by Major End Use, Year and Region (MW)

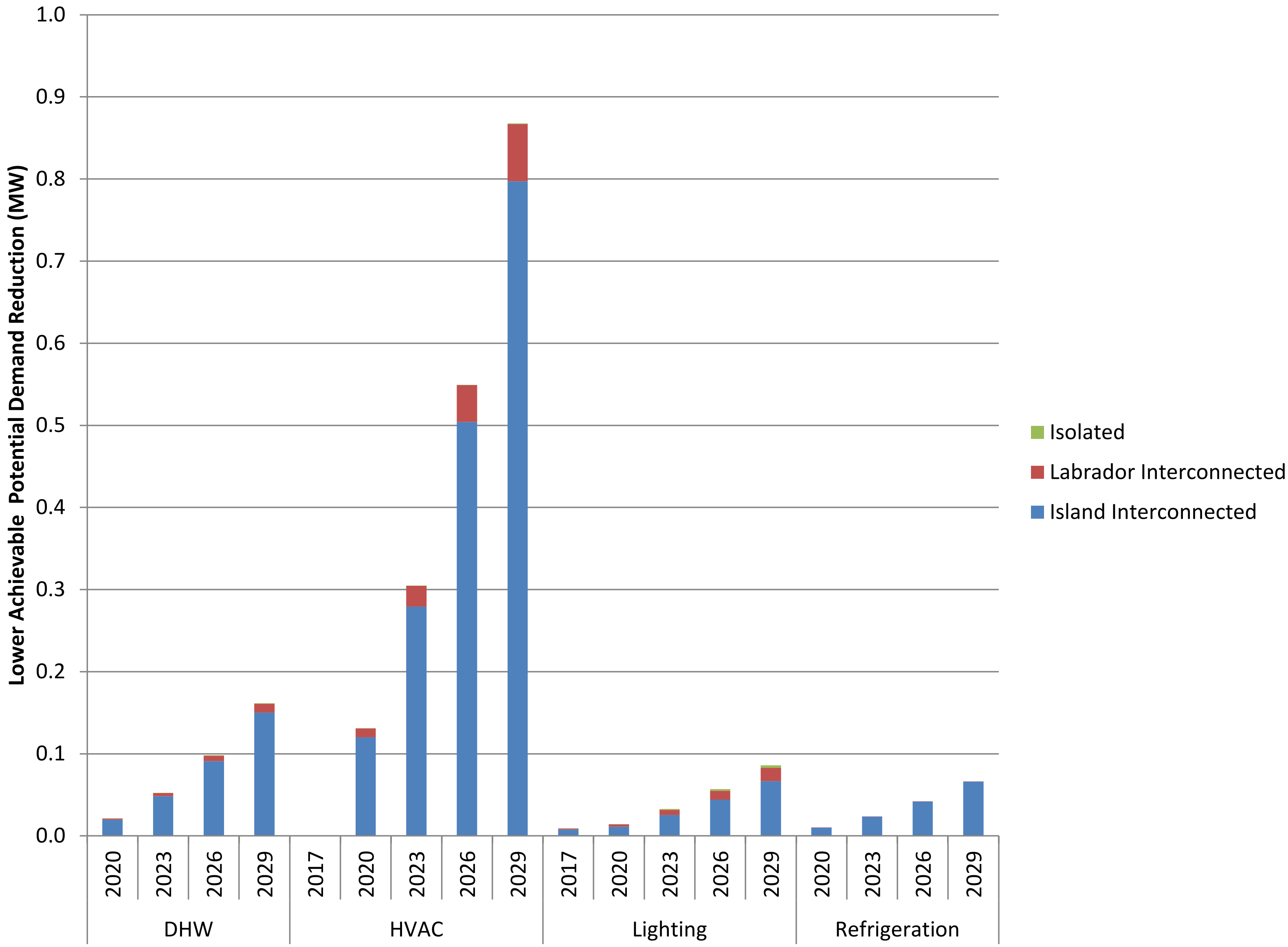


Exhibit 84 Upper Achievable Potential Peak Load Reduction by Major End Use, Year and Region (MW)

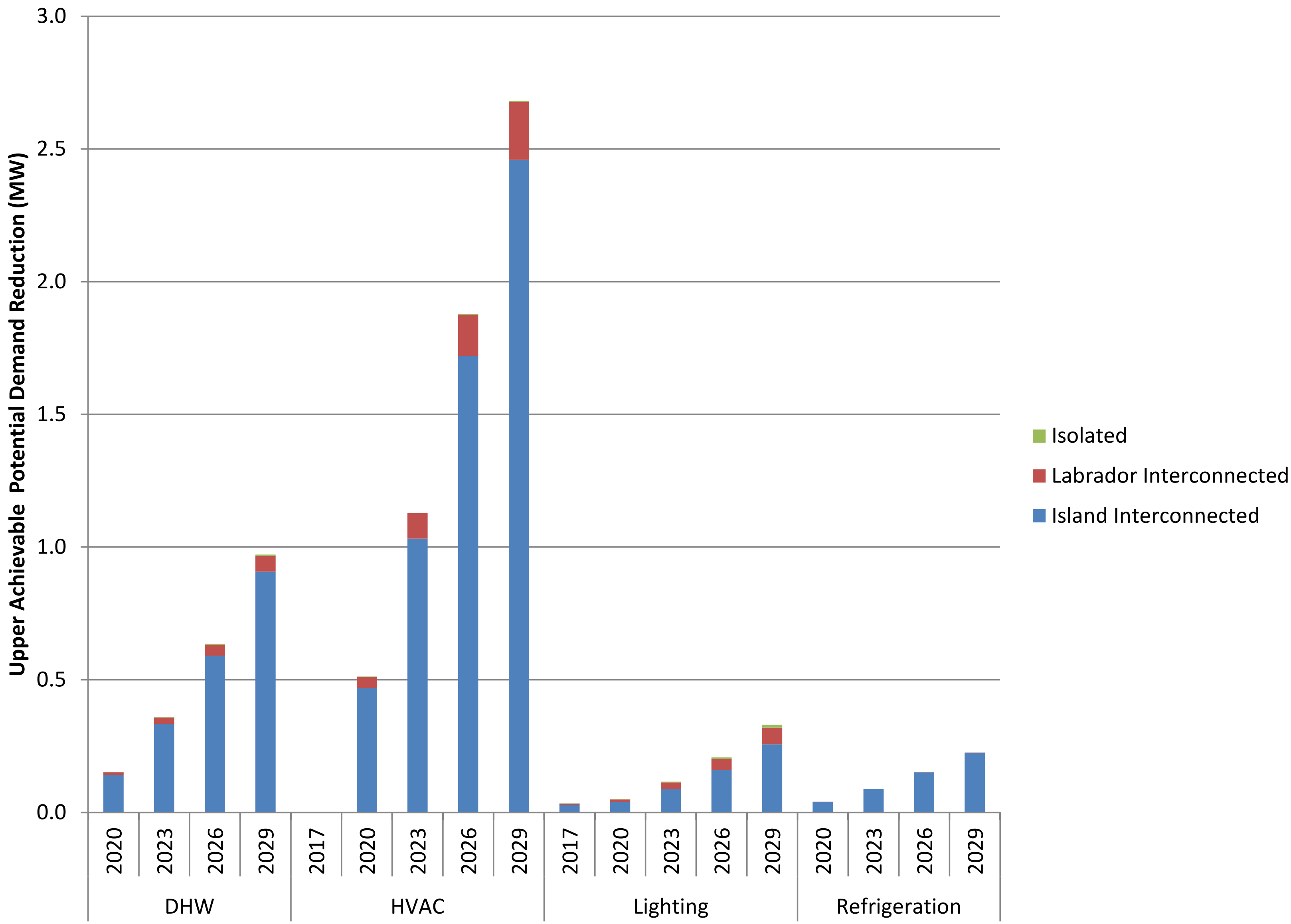


Exhibit 85 Lower Achievable Potential Peak Demand Reduction by Major End Use, Year and Sub sector (MW)

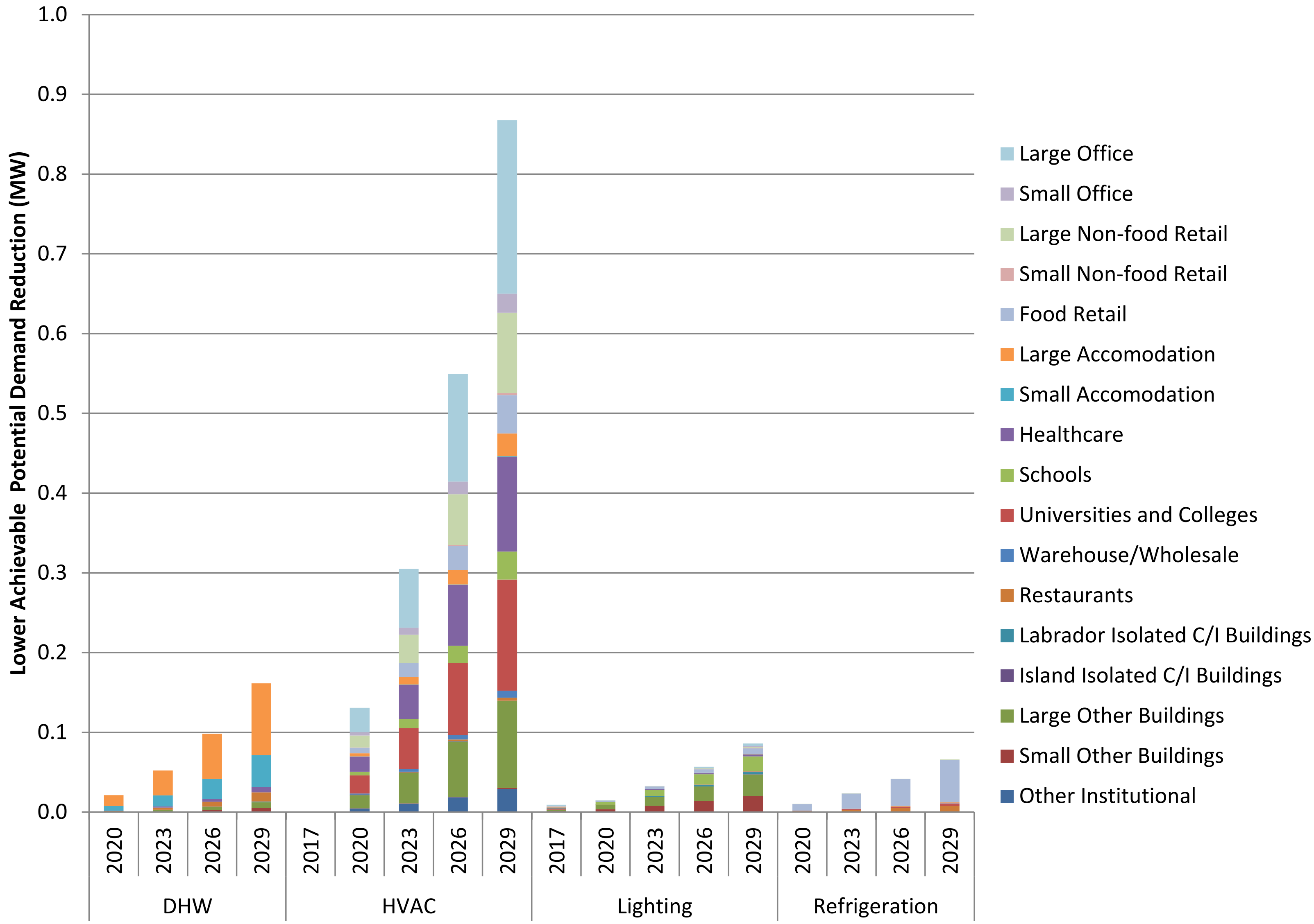


Exhibit 86 Upper Achievable Potential Peak Demand Reduction by Major End Use, Year and Sub sector (MW)

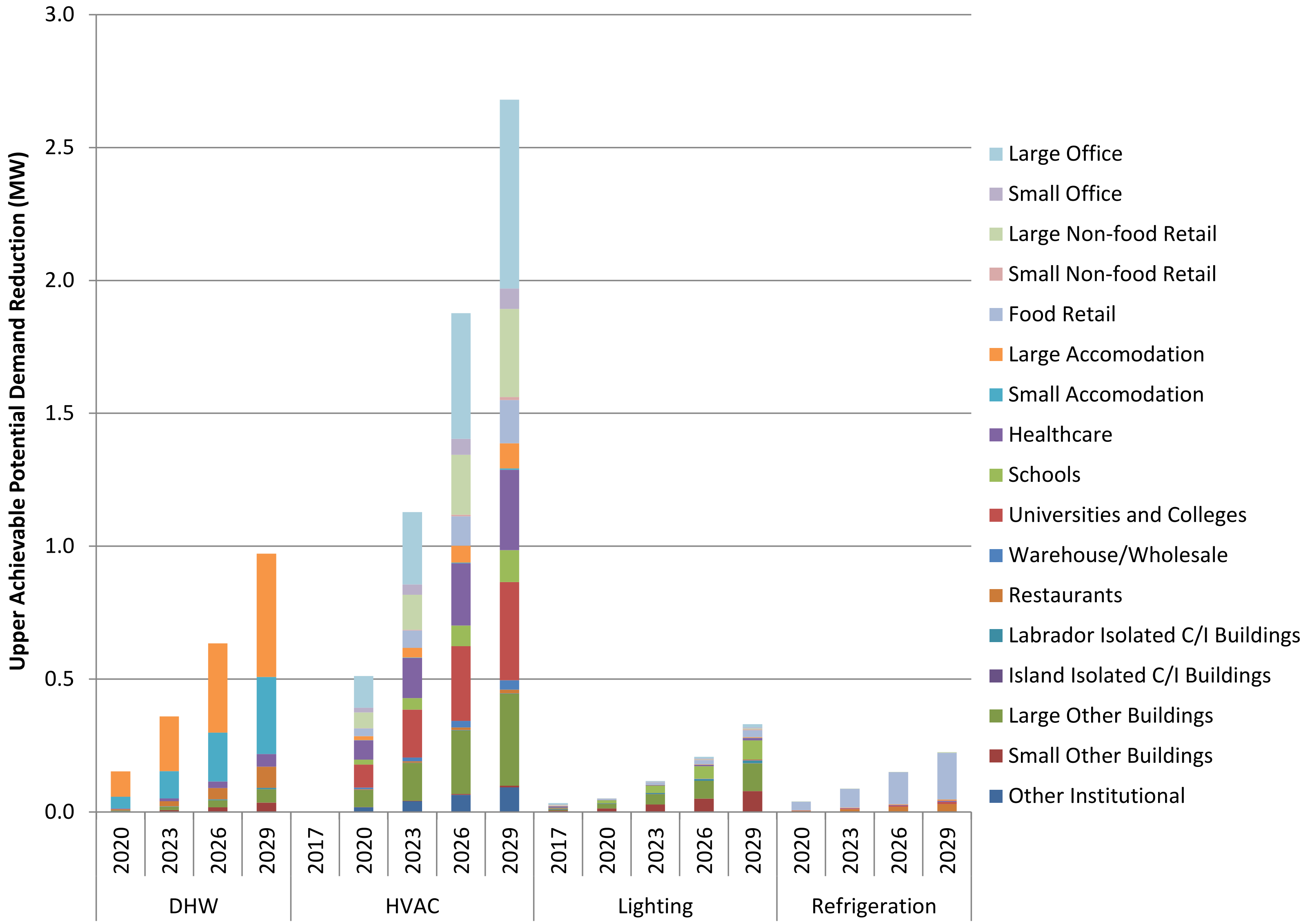


Exhibit 87 Lower Achievable Potential Peak Load Reduction by Major End Use, Year and Vintage (MW)

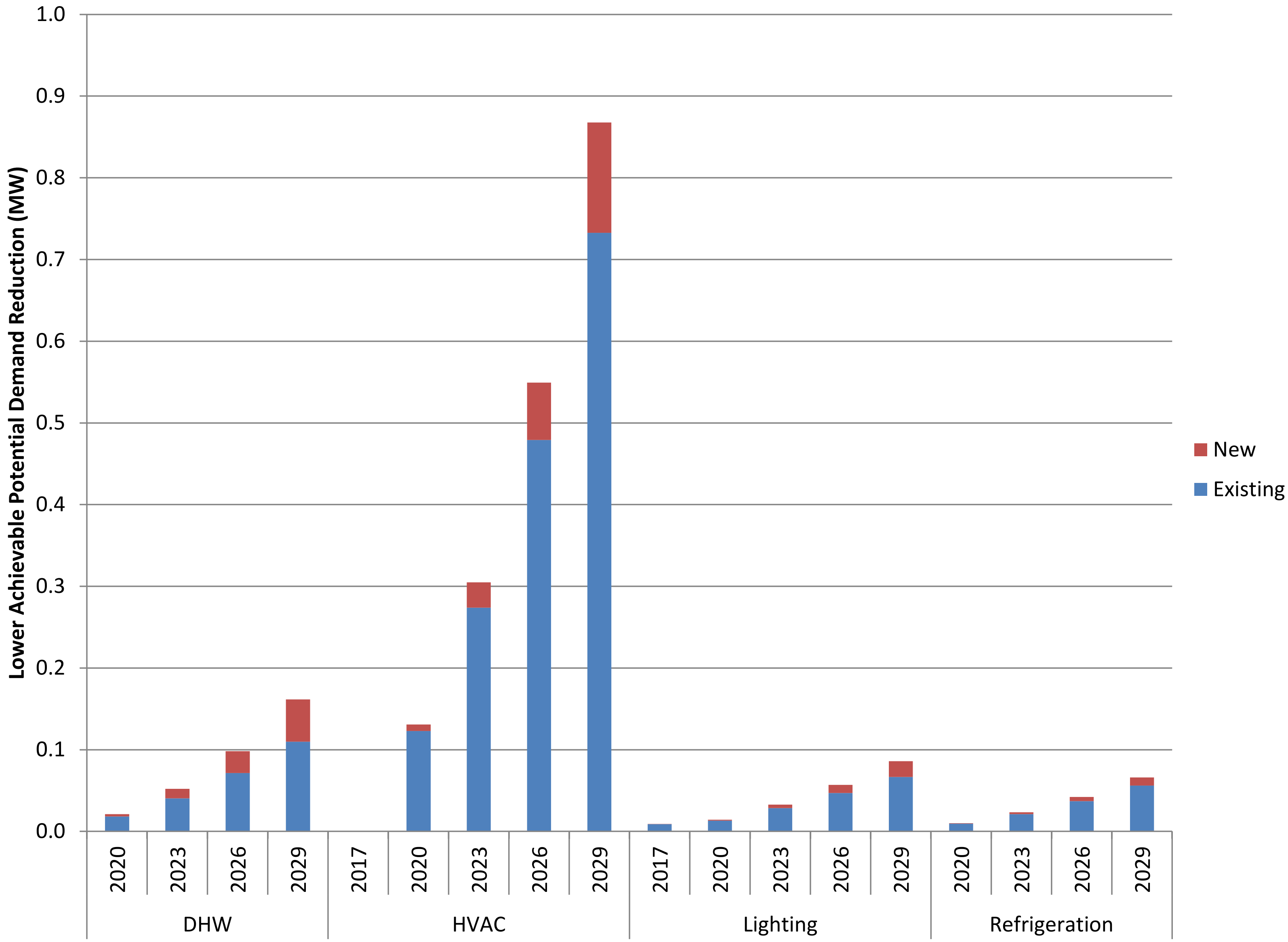
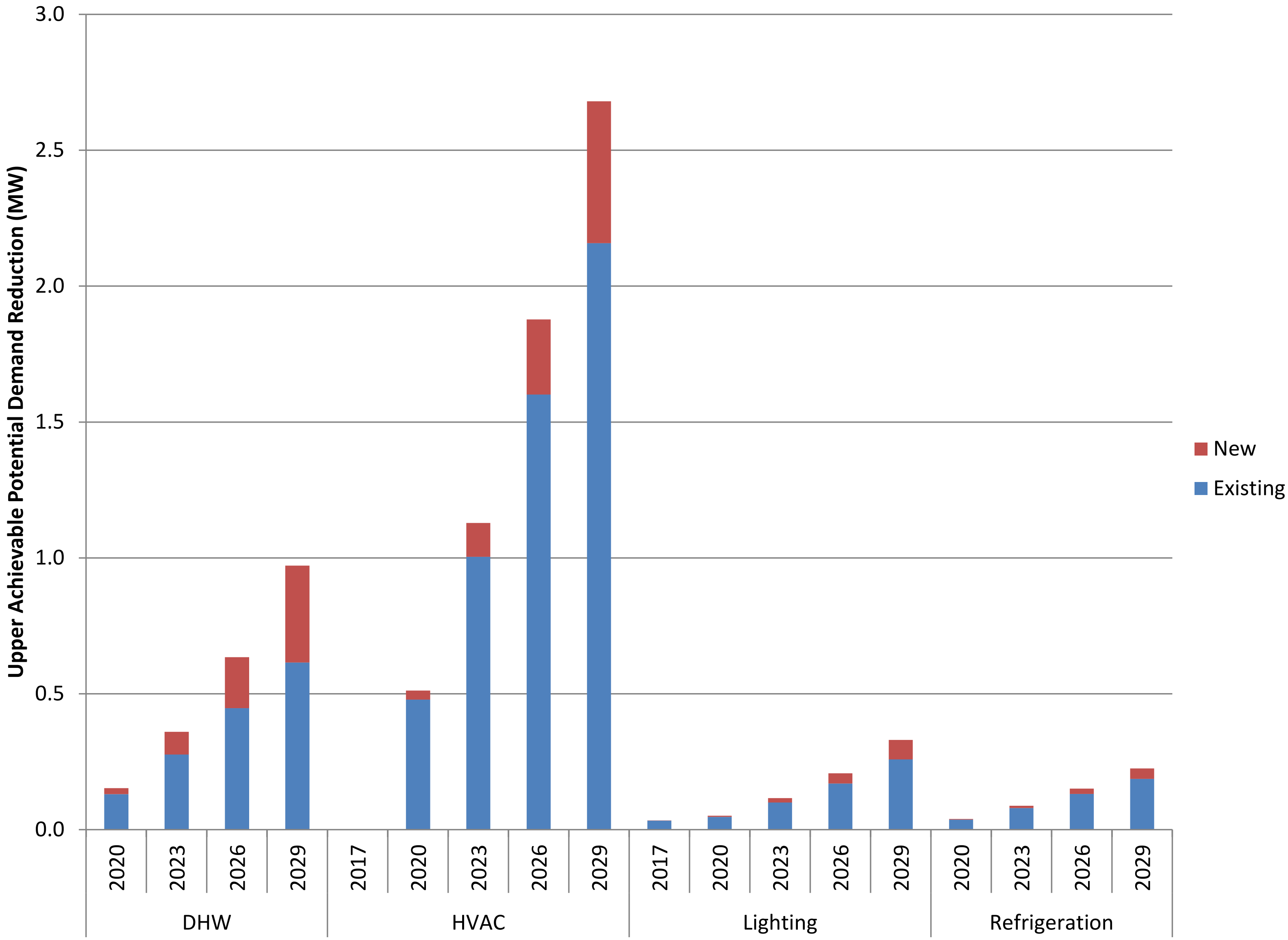


Exhibit 88 Upper Achievable Potential Peak Load Reduction by Major End Use, Year and Vintage (MW)



9.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Milestone Year
The Lower Achievable Potential peak load reductions increase from 0.01 MW in 2017 to 1.18 MW in 2029. The Upper Achievable Potential peak load reductions increase from 0.03 MW in 2017 to 4.21 MW in 2029.

Peak Demand Reduction by Sub sector
The hospitality sector accounts for the largest peak load reduction potential with 23% of the peak load reduction from this sector. Of this, 13% of the achievable peak load reduction savings are from the large accommodations sub sector as a result of the higher achievable savings for DHW and HVAC in these facilities. Office buildings account for 19% of the potential peak load reductions; this reflects their large market share and their generally high level of electrical intensity. Peak load reductions in the retail facilities and other buildings each account for 17% of the potential savings; and educational facilities account for 14% of the potential savings. Healthcare facilities account for 9% of the peak load reductions. The other sub sectors each account for less than 1% of the potential peak load reductions.

Peak Demand Reduction by Region
The Island Interconnected region accounts for 91% of the potential peak load reductions. The Labrador Interconnected region accounts for 8% of the potential peak load reductions, and the Isolated region accounts for less than 1% of the potential peak load reductions.

Peak Demand Reduction by Existing Buildings versus New Construction
Peak load reductions in existing buildings account for almost all of the reduction potential at the beginning of the study period; as new homes are constructed, the load reduction potential associated with them occupies a progressively larger portion of the total. By 2029, peak load reductions from new construction accounts for 24% of the total potential.

Peak Demand Reduction by End Use
HVAC measures account for 68% of the total load reductions in the Upper Achievable Potential Forecast in 2020, not including load reductions from energy efficiency measures; this decreases by to 64% by 2029. HVAC measures account for just over 74% of the total load reductions in the Lower Achievable Potential Forecast in 2020, not including load reductions from energy efficiency measures. With less than 1% of a decrease, the load reduction from HVAC remains at almost 74% by 2029. Of the 64% of 2029 reductions that come from HVAC in the Upper Achievable Potential scenario, approximately 56% of it is from the HVAC Demand Controls measure and almost 8% is from the Heating Controls measure.

DHW measures account for approximately 20% of the total load reductions in the Upper Achievable Potential Forecast in 2020, not including load reductions from energy efficiency measures; this rises to 23% of the total by 2029. DHW measures account for approximately 12% of the total load reductions in the Lower Achievable Potential Forecast in 2020, not including load reductions from energy efficiency measures; this rises to 14% of the total by 2029. All of the potential savings come from the DHW controls measure.

Lighting and Refrigeration makes up a smaller portion of the total load reduction opportunity with Lighting demand controls accounting for 8% of the total 2029 upper achievable potential savings and refrigeration demand controls accounting for 5% of the 2029 upper achievable potential savings.

9.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Achievable Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

Exhibit 89 shows that the lower Achievable Potential results are sensitive to this range of avoided costs. By 2029, the exhibits show the following changes in achievable potential:

- The lower range of reasonableness produces lower Achievable Potential energy savings that are 1% higher in the Island Interconnected region, 5% lower in the Labrador region, and almost unchanged in the Isolated region.
- The lower range of reasonableness produces lower Achievable Potential peak demand reductions that are almost unchanged in the Island Interconnected and Isolated regions and 4% lower in the Labrador region.
- The upper range of reasonableness produces lower Achievable Potential energy savings that are 2% higher in both the Island Interconnected region and Labrador region and almost unchanged in the Isolated region.
- The upper range of reasonableness produces lower Achievable Potential peak demand reductions that are 4% higher in the Island Interconnected region, 2% higher in the Labrador region and almost unchanged in the Isolated region.

Exhibit 89 Sensitivity of the Lower Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	7,466	1	7,528	1	7,665	1
	2020	29,627	5	29,913	5	30,932	5
	2023	67,673	11	68,110	11	71,079	11
	2026	120,163	19	126,145	20	127,373	20
	2029	193,198	30	191,279	30	194,392	31
Labrador Interconnected	2017	416	0	433	0	507	0
	2020	1,979	0	2,109	0	2,580	0
	2023	4,967	1	5,117	1	6,418	1
	2026	9,969	2	10,676	2	11,532	2
	2029	16,462	3	17,359	3	17,740	3
Isolated	2017	14	0	14	0	14	0
	2020	77	0	77	0	77	0
	2023	172	0	172	0	172	0
	2026	311	0	311	0	311	0
	2029	498	0	498	0	498	0

Exhibit 90 shows that the upper Achievable Potential results are sensitive to this range of avoided costs. By 2029, the exhibits show the following changes in achievable potential:

- The lower range of reasonableness produces lower Achievable Potential energy savings that are almost unchanged in the Island Interconnected region, 4% lower in the Labrador region, and 1% lower in the Isolated region.
- The lower range of reasonableness produces lower Achievable Potential peak demand reductions that are almost 1% lower in the Island Interconnected region, 4% lower in the Labrador region and 2% lower in the Isolated region.
- The upper range of reasonableness produces lower Achievable Potential energy savings that are 2% higher in the Island Interconnected region, 1% higher in the Labrador region and almost unchanged in the Isolated region.
- The upper range of reasonableness produces lower Achievable Potential peak demand reductions that are 3% higher in the Island Interconnected region, 1% higher in the Labrador region and almost unchanged in the Isolated region.

Exhibit 90 Sensitivity of the Upper Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	52,454	8	52,821	8	53,297	9
	2020	136,874	24	137,859	24	141,796	25
	2023	254,170	47	255,655	48	265,788	50
	2026	396,303	75	407,167	77	415,059	79
	2029	563,888	107	566,388	108	577,793	112
Labrador Interconnected	2017	2,616	0	2,763	0	3,438	1
	2020	9,342	2	10,142	2	13,357	3
	2023	22,055	4	22,594	4	30,071	6
	2026	43,418	9	45,474	9	49,237	10
	2029	67,045	13	70,163	14	70,976	14
Isolated	2017	626	0	634	0	639	0
	2020	1,362	0	1,384	0	1,392	0
	2023	2,146	0	2,185	0	2,195	0
	2026	2,973	0	3,027	0	3,037	0
	2029	3,837	1	3,890	1	3,901	1

9.9 Net-to-Gross

Net-to-gross ratios are used to estimate the free-ridership occurring in CDM programs. Free riders are program participants who would have undertaken an efficiency or demand management measure naturally, even without the influence of the utility's program. A net-to-gross ratio is a factor that represents the net program impact divided by the gross program impact. The net impact can be found by multiplying the gross impact by the net-to-gross ratio.

Net-to-gross ratios have been estimated for many of the utility programs conducted in NL over the past several years. Though net-to-gross ratios are dependent on many factors, the estimates from previous programs were assumed to provide a reasonable approximation for the ratios in the near future. Where measures in the present study were not included in past programs, the net-to-gross ratio for the most similar program was used.

Sources

The following sources were used to estimate the measure net-to-gross ratios shown in the following exhibits:

- Net-to-gross ratios provided by Newfoundland Power, from evaluations of the CDM programs that have been run in the province.
- Ontario Energy Board TRC Guide recommendations.[36]
- Performance Plus Impact and Process Evaluation, 2012, from the Efficiency Nova Scotia Corporation.[37]
- Emera Maine Heat Pump Pilot Program Final Report, 2014.[38]

Caveat

The estimates produced by the models in this study are not purely gross achievable potential estimates, because the reference case includes some naturally occurring savings. In order to calibrate the model's reference case to the Utilities' load forecast, it was essential to make reasonable assumptions about what efficiency improvements customers would make during the study period, in the absence of new utility programs. The economic, upper achievable, and lower achievable potentials were all calculated from this reference baseline that includes some naturally occurring savings. If the results are then adjusted for net-to-gross ratios, the following adjustments are both being made in the model:

- Naturally occurring savings, from customers who would adopt the efficiency measures in the absence of new utility programs, are being accounted for in the reference case
- Free-ridership, from customers who participate in a program but would have adopted the efficiency measures without its influence, are being accounted for in the net-to-gross ratio

It appears likely that there is some double-counting between naturally occurring savings and free-ridership: some of the customers who would have adopted the measures naturally and some of the customers who would be free-riders in a program are actually the same people. Therefore, the exhibits shown below with net upper and lower achievable potential, are likely underestimates of the true net potential.

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[36] Ontario Energy Board, *Total Resource Cost Guide.* October, 2006.
[37] Efficiency Nova Scotia Corporation, *Performance Plus Impact and Process Evaluation, 2012*. March, 2013.
[38] Emera Maine, *Heat Pump Pilot Program Final Report*. November, 2014.

Results

The net and gross achievable potential results are presented in the following four exhibits:

- Exhibit 91 shows the gross and net upper achievable potential for energy efficiency, by measure and region for the year 2029, along with the net-to-gross ratios used
- Exhibit 92 shows the gross and net lower achievable potential for energy efficiency, by measure and region for the year 2029, along with the net-to-gross ratios used
- Exhibit 93 shows the gross and net upper achievable potential for demand reduction, by measure and region for the year 2029, along with the net-to-gross ratios used
- Exhibit 94 shows the gross and net lower achievable potential for demand reduction, by measure and region for the year 2029, along with the net-to-gross ratios used

At this time, net-to-gross ratios were not available for demand reduction programs in NL. Because these measures offer no financial advantages to the customer where time of use rates are not in use, free-ridership is assumed to be zero for these measures. The net-to-gross ratios are therefore assumed to be 1.0, and the net potential is equal to the gross potential.

Exhibit 91 Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
Building Recommissioning	0.70	103,530	72,471	21,748	15,223	1,046	732
Ductless Mini-Split Heat Pump	0.88	57,531	50,628	8,381	7,376	109	96
Advanced Building Automation Systems	0.85	36,414	30,952	313	266	0	0
High-Efficiency Air Source Heat Pumps	0.88	34,680	30,518	4,913	4,323	8	7
Programmable Thermostats	0.85	32,186	27,358	7,457	6,338	63	53
Occupancy Sensors (Lighting)	0.80	28,764	23,011	2,646	2,117	244	195
New Construction (25% More Efficient)	0.76	27,945	21,238	1,158	880	427	325
LED Tubular Lamps	0.95	25,296	24,032	0	0	398	378
Demand Control Ventilation (DCV)	0.85	21,370	18,165	4,675	3,974	0	0
VFDs on HVAC Motors	0.75	18,170	13,628	1,136	852	8	6
High Performance Glazing Systems	0.50	17,405	8,703	4,686	2,343	18	9
LED Outdoor Fixtures	0.90	14,742	13,268	1,747	1,572	316	285
LED Street Lighting	0.90	14,491	13,042	0	0	0	0
Ventilation Heat Recovery	0.85	14,225	12,091	2,238	1,902	14	12
LED Screw-In Lamps	0.90	13,152	11,837	1,188	1,070	134	121
High Performance T8 Fixtures	0.80	12,391	9,912	694	555	175	140
Low-Flow Faucet Aerators	0.70	12,338	8,637	2,188	1,532	17	12
New Construction (40% More Efficient)	0.76	11,165	8,485	11	8	184	140
LED Screw-In Lamps	0.90	10,124	9,112	1,093	984	274	247
Refrigerated Cases with Doors	0.70	8,480	5,936	0	0	0	0
High Efficiency Compressors (Refrigeration)	0.90	7,497	6,747	320	288	0	0
Refrigerated Vending Machine Controllers	0.85	5,533	4,703	580	493	96	82
Activate PC Power Management	0.70	5,294	3,706	234	164	70	49
ECM Motors and Evaporator Fan Motor Controllers	0.75	5,221	3,916	304	228	13	10
Lighting Controls (Outdoor)	0.80	4,674	3,739	654	523	50	40
LED Tubular Lamps	0.95	4,515	4,289	9	9	74	71
LED High Bay Fixtures	0.70	4,091	2,864	30	21	22	15

Exhibit 91 Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029 (cont'd…)

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
Low-Flow Showerheads	0.70	3,596	2,517	490	343	2	1
Wall Insulation	0.80	3,583	2,866	176	141	30	24
Ground Source Heat Pumps	0.88	2,859	2,516	0	0	3	2
Cooler Night Covers	0.70	2,739	1,917	121	85	34	24
Heat Pump Water Heaters	0.88	2,558	2,251	416	366	5	5
Refrigeration Controls	0.85	2,426	2,062	105	89	0	0
High Performance T8 Fixtures	0.80	2,034	1,627	256	205	33	26
T5HO Fixtures	0.60	1,930	1,158	123	74	9	5
Radiant Infrared Heaters	0.70	1,837	1,286	252	176	0	0
Roof Insulation	0.80	1,800	1,440	60	48	28	22
ENERGY STAR Dishwashers	0.70	1,338	937	104	73	0	0
ENERGY STAR Computers	0.70	1,316	921	84	58	15	11
Premium Efficiency Motors	0.75	1,283	963	109	82	4	3
LED High Bay Fixtures	0.70	1,099	770	50	35	7	5
Demand Control Kitchen Ventilation (DCKV)	0.85	1,059	900	85	73	0	0
Hotel Occupancy Sensors	0.80	1,030	824	158	126	0	0
Low-Flow Pre-Rinse Spray Valves	0.70	823	576	99	69	1	1
Drainwater Heat Recovery	0.85	709	602	64	54	0	0
T5HO Fixtures	0.60	624	374	45	27	3	2
Make Use of Daylighting	0.70	523	366	20	14	18	13
Refrigeration Heat Recovery	0.85	429	365	0	0	0	0
High-Efficiency Cooking Equipment	0.70	362	253	27	19	0	0
Automatic Door Closers (Walk-In Coolers & Freezers)	0.70	354	248	39	28	0	0
Use Task Light Instead of Ambient	0.70	251	176	3	2	0	0
Reduce Number of Fridges	0.70	205	144	2	1	0	0
Energy-Efficient Server Technologies	0.70	150	105	3	2	0	0

Exhibit 91 Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029 (cont'd…)

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
LED Exit Signs	0.75	144	108	27	20	2	1
Use Shades/Blinds (Winter)	0.70	143	100	2	1	0	0
ENERGY STAR Office Equipment	0.70	118	82	6	4	1	1
Keep Doors Closed (Winter)	0.70	70	49	11	7	0	0
CEE-Rated Refrigerators and Freezers	0.70	46	32	0	0	111	78
LED Refrigerated Display Case Lighting	0.95	32	31	0	0	49	47
Use Shades/Blinds (Summer)	0.70	19	13	0	0	0	0
Use Natural Ventilation (Summer)	0.70	10	7	0	0	0	0
Keep Doors Closed (Summer)	0.70	4	3	0	0	0	0
High Efficiency Chillers	0.90	0	0	0	0	0	0
LED Troffers	1.00	0	0	0	0	66	59
Dimming Control (Daylighting)	1.00	0	0	0	0	62	50
Freezer Defrost Controllers	1.00	0	0	0	0	3	3
Grand Total	0.80	588,731	471,578	71,336	55,262	4,251	3,408

Exhibit 92 Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Ductless Mini-Split Heat Pump	0.88	20,295	17,860	2,961	2,605	0	0
LED Tubular Lamps	0.95	17,149	16,291	0	0	357	339
Building Recommissioning	0.70	16,308	11,416	3,393	2,375	0	0
New Construction (25% More Efficient)	0.76	15,011	11,409	624	475	225	171
LED Street Lighting	0.90	12,808	11,527	0	0	0	0
High-Efficiency Air Source Heat Pumps	0.88	12,785	11,251	1,750	1,540	3	3
Advanced Building Automation Systems	0.85	12,503	10,627	103	88	0	0
LED Screw-In Lamps	0.90	11,943	10,749	1,042	938	0	0
Programmable Thermostats	0.85	11,075	9,413	2,409	2,048	0	0
High Performance T8 Fixtures	0.80	10,842	8,673	608	486	0	0
LED Screw-In Lamps	0.90	9,321	8,389	958	862	0	0
Occupancy Sensors (Lighting)	0.80	8,472	6,777	762	610	0	0
New Construction (40% More Efficient)	0.76	6,134	4,662	6	4	0	0
LED Outdoor Fixtures	0.90	5,475	4,928	660	594	0	0
LED Tubular Lamps	0.95	3,980	3,781	3	2	0	0
LED High Bay Fixtures	0.70	3,676	2,573	10	7	0	0
Refrigerated Cases with Doors	0.70	2,650	1,855	0	0	0	0
High Efficiency Compressors (Refrigeration)	0.90	2,505	2,255	100	90	0	0
Lighting Controls (Outdoor)	0.80	2,005	1,604	263	210	0	0
Demand Control Ventilation (DCV)	0.85	1,863	1,584	382	324	0	0
High Performance T8 Fixtures	0.80	1,780	1,424	224	179	0	0
ECM Motors and Evaporator Fan Motor Controllers	0.75	1,708	1,281	95	71	4	3
T5HO Fixtures	0.60	1,689	1,013	108	65	0	0
Refrigerated Vending Machine Controllers	0.85	1,585	1,347	166	141	0	0
High Performance Glazing Systems	0.50	1,422	711	557	278	1	1
VFDs on HVAC Motors	0.75	1,298	973	81	61	1	0

Exhibit 92 Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029 (cont'd…)

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Ground Source Heat Pumps	0.88	1,281	1,127	0	0	0	0
Heat Pump Water Heaters	0.88	1,117	983	170	149	0	0
LED High Bay Fixtures	0.70	1,089	762	44	30	0	0
Activate PC Power Management	0.70	1,069	748	47	33	14	10
Cooler Night Covers	0.70	1,034	724	42	30	0	0
Ventilation Heat Recovery	0.85	1,016	864	160	136	0	0
Low-Flow Faucet Aerators	0.70	927	649	157	110	0	0
Refrigeration Controls	0.85	893	759	36	30	0	0
Radiant Infrared Heaters	0.70	618	433	84	59	0	0
T5HO Fixtures	0.60	546	328	40	24	0	0
Hotel Occupancy Sensors	0.80	379	303	57	46	0	0
Low-Flow Showerheads	0.70	293	205	36	25	0	0
ENERGY STAR Computers	0.70	263	184	17	12	0	0
Wall Insulation	0.80	243	194	16	13	0	0
Make Use of Daylighting	0.70	134	94	5	3	0	0
LED Exit Signs	0.75	127	95	23	18	0	0
Automatic Door Closers (Walk-In Coolers & Freezers)	0.70	121	85	13	9	0	0
High-Efficiency Cooking Equipment	0.70	121	84	9	6	0	0
Roof Insulation	0.80	108	86	5	4	0	0
Demand Control Kitchen Ventilation (DCKV)	0.85	98	83	8	6	0	0
ENERGY STAR Dishwashers	0.70	96	67	7	5	0	0
Premium Efficiency Motors	0.75	95	71	8	6	0	0
Use Task Light Instead of Ambient	0.70	66	46	1	0	0	0
Low-Flow Pre-Rinse Spray Valves	0.70	62	43	7	5	0	0
Drainwater Heat Recovery	0.85	51	43	5	4	0	0

Exhibit 92 Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029 (cont'd…)

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Use Shades/Blinds (Winter)	0.70	42	29	0	0	0	0
Reduce Number of Fridges	0.70	41	29	0	0	0	0
Refrigeration Heat Recovery	0.85	31	26	0	0	0	0
Energy-Efficient Server Technologies	0.70	30	21	1	0	0	0
ENERGY STAR Office Equipment	0.70	24	16	1	1	0	0
Keep Doors Closed (Winter)	0.70	19	13	3	2	0	0
CEE-Rated Refrigerators and Freezers	0.70	14	10	0	0	0	0
LED Refrigerated Display Case Lighting	0.95	10	10	0	0	0	0
Use Shades/Blinds (Summer)	0.70	4	3	0	0	0	0
Use Natural Ventilation (Summer)	0.70	2	2	0	0	0	0
Keep Doors Closed (Summer)	0.70	1	1	0	0	0	0
High Efficiency Chillers	0.90	0	0	0	0	0	0
Grand Total	0.83	208,345	173,595	18,264	14,821	605	527

Exhibit 93 Gross Versus Net Upper Achievable Demand Reduction Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MW)	Net Upper Achievable Potential (MW)	Gross Upper Achievable Potential (MW)	Net Upper Achievable Potential (MW)	Gross Upper Achievable Potential (MW)	Net Upper Achievable Potential (MW)
DHW Controls	1.00	0.9	0.9	0.1	0.1	0.0	0.0
Heating Controls	1.00	0.3	0.3	0.0	0.0	0.0	0.0
HVAC Demand Controls	1.00	2.1	2.1	0.2	0.2	0.0	0.0
Lighting Demand Controls	1.00	0.3	0.3	0.1	0.1	0.0	0.0
Refrigeration Demand Controls	1.00	0.2	0.2	0.0	0.0	0.0	0.0
Grand Total	1.00	3.8	3.8	0.3	0.3	0.0	0.0

Exhibit 94 Gross Versus Net Lower Achievable Demand Reduction Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MW)	Net Lower Achievable Potential (MW)	Gross Lower Achievable Potential (MW)	Net Lower Achievable Potential (MW)	Gross Lower Achievable Potential (MW)	Net Lower Achievable Potential (MW)
DHW Controls	1.00	0.2	0.2	0.0	0.0	0.0	0.0
Heating Controls	1.00	0.1	0.1	0.0	0.0	0.0	0.0
HVAC Demand Controls	1.00	0.7	0.7	0.1	0.1	0.0	0.0
Lighting Demand Controls	1.00	0.1	0.1	0.0	0.0	0.0	0.0
Refrigeration Demand Controls	1.00	0.1	0.1	0.0	0.0	0.0	0.0
Grand Total	1.00	1.1	1.1	0.1	0.1	0.0	0.0

10 References

The sources listed below include references used in preparation of this report and additional resources likely to be helpful for research on energy consumption patterns and efficient technologies. Additional references on specific technologies may be found in the TRC Analysis Workbooks, supplied as an accompanying deliverable with this report.

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11 Glossary

Achievable Potential:
The portion of the economic conservation potential that is achievable through utility interventions and programs given institutional, economic and market barriers.

Avoided Cost:
By reducing electricity consumption and capacity requirements through the implementation of conservation and demand management programs, the NL utilities avoid the cost of having to buy electricity on the open market, contract for long term supply, and/or build and run new generation facilities. This avoided cost is used to develop a benchmark against which the cost of energy efficiency measures can be compared.

Base Year:
The base year for the 2015 CDM potential assessment is the 2014 sales for the two utilities. This number is derived from 2014 sales and forecast 2014 electric energy and capacity requirements as is explained in each report.

Benchmark for Economic Analysis:
The study established benchmarks for the economic cut-off for new avoided electrical supply on each of the different supply systems in NL. These values were selected to provide the CDM potential assessment with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost-effective over time. The following values were used:

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.11	$0.04	$0.21
2017	$0.13	$0.04	$0.23
2020	$0.05	$0.05	$0.26
2023	$0.06	$0.05	$0.29
2026	$0.07	$0.06	$0.34
2029	$0.08	$0.07	$0.37

Cost of Conserved Energy (CCE):
The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Cost of Electric Peak Reduction (CEPR):
The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.

Conservation and Demand Management (CDM):
CDM is the influencing of customers' electricity use to obtain desirable and quantifiable changes in that use. For example, CDM comprises such cooperative joint customer and utility initiatives as peak

clipping, valley filling, load shifting, strategic conservation, strategic load growth, flexible load shape, customer on-site generation and other similar activities.

Economic Potential:
The Economic Potential is the savings in electricity consumption due to energy efficient measures whose Cost of Conserved Energy (CCE) is less than or equal to the Benchmark for Economic Analysis.

Effective Measure Life (EML):
The estimated median number of years that the measures installed under a program are still in place and operable. EML incorporates: field conditions, obsolescence, building remodelling, renovation, demolition, and occupancy changes.

Electricity Audit:
An on-site inspection and cataloguing of electricity-using equipment/buildings, electricity consumption and the related end uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, for CDM program design, and identifying specific energy savings projects.

Electric Capacity:
The maximum electric power that a device or network is capable of producing or transferring.

Electricity Conservation:
Activities by utilities or electricity users that result in a reduction of electric energy use without adversely affecting the level or quality of energy service provided. Electricity conservation measures include substitution of high-efficiency motors for standard efficiency ones, occupancy sensors in office buildings, insulation in residences, etc.

Electricity Efficiency:
The ratio of the useful energy delivered by a dynamic system to the amount of electric energy supplied to it.

Electric Energy:
Energy in the form of electricity. Energy is the ability to perform work. Electric energy is different from electric power. Electric energy is measured in kilowatt-hours, megawatt-hours or gigawatt-hours.

Electricity Intensity:
Electric energy use measured per application or end use. Examples would include kilowatt-hours per square meter of lit office space per day, kilowatt-hours per tonne of pulp produced, and kilowatt-hours per year per residential refrigerator. Electricity intensity increases as electricity efficiency decreases.

Electric Power:
The rate at which electric energy is produced or transferred, usually measured in watts, kilowatts and megawatts.

End use:
The services of economic value to the users of energy. For example, office lighting is an end use, whereas electricity sold to the office tenant is of no value without the equipment (light fixtures, wiring, etc.) necessary to convert the electricity into visible light. End use is often used interchangeably with energy service.

Energy Service:
An amenity or service supplied jointly by energy and other components such as buildings, motors and lights. Examples of energy services include residential space heating, commercial refrigeration, paper production, and lighting. The same energy service can frequently be supplied with different mixes of equipment and energy.

Financial Incentive:
Certain financial features in the utility's conservation and demand management programs designed to motivate customer participation. These may include features designed to reduce a customer's net cash outlay, pay-back period or cost of finance to participate in a specific conservation and demand management measure or technology.

Flexible Load Shape:
This is utility action to present customers with variations in service quality in exchange for incentives. Programs involved may be variations of interruptible or curtailable load, concepts of pooled, integrated energy management systems, or individual customer load control devices offering service constraints.

Gigawatt-hour (GWh):
One gigawatt-hour is one million kilowatt-hours.

Integrated Planning or Integrated Resource Planning (IRP):
See Supply Planning.

Integrated Electricity Planning (IEP):
See Supply Planning.

Kilowatt (kW):
One thousand watts; the basic unit of measurement of electric energy. One kilowatt-hour represents the power of one thousand watts (one kilowatt) for a period of one hour. A typical non-electrically heated detached home in NL uses about 10,700 kWh per year. A four foot fluorescent lamp in an office might use about 100-200 kWh per year and a large coal-fired plant might produce about three billion kWh per year.

Levelized Cost of Conservation (LCC):
The LCC is calculated for each energy efficiency measure. The LCC is the annualized incremental capital and O&M cost of the measure divided by the annual energy conserved, excluding any administrative or program costs. The LCC represents the cost of generating or conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity. In the context of commercial energy efficiency measures, it is essentially the same as the cost of conserved energy (CCE), which is the term used in this report.

Load Forecast:
This is a forecast of electricity demand over a specified time period. Long-term load forecasts usually pertain to a 10 to 20-year period. In the case of NL, the load forecast assumes a specific set of rates or prices for electricity and competing energy forms, as well as many other economic variables. In addition, forecasts of electricity conserved through CDM programs are incorporated into the Supply Planning process.

Load Research:
Research to disaggregate and analyze patterns of electricity consumption by various sub sectors and end uses is defined as load research. Load research supports the development of the load forecast and the design of conservation and demand management programs.

Load Shape:
The time pattern and magnitude of a utility's electrical demand.

Load Shifting:
Utility program activity to shift demand from peak to off-peak periods is defined as load shifting.

Measure Total Resource Cost (TRC):
The measure TRC calculates the net present value of energy savings that result from an investment in an energy-efficiency measure. The measure TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual energy and O&M costs. This calculation includes, among others, the following inputs: the avoided electricity supply costs, the life of the technology, and the selected discount rate, which in this analysis has been set at 7%.

A measure with a positive measure TRC value is included in subsequent stages of the analysis, which consists of the Economic and Achievable Potential scenarios. A measure with a negative TRC value is not economically attractive and is therefore not included in subsequent stages of the analysis.

Megawatt (MW):
One thousand kilowatts.

Natural Change in Electricity Intensity:
The future change in electricity intensity in a given end use that is expected to occur in the absence of conservation and demand management programs. In developing an estimate of natural change in electricity intensity it is necessary to make an explicit assumption about the future prices of electricity and competing fuels.

Peak Clipping:
Utility program activity to reduce peak demand without reducing demand at other times of the day or year.

Peak Demand:
Peak demand is the maximum electric power required by a customer or electric system during a short time period, typically one hour. The peak is the time (usually of day or year) at which peak demand occurs. The peak period of interest in NL is from 7 a.m. to noon and 4 p.m. to 8 p.m. on the four coldest days of the winter, for a total of 36 hours.

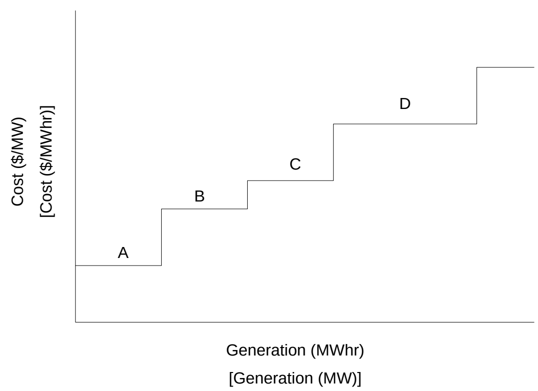
Rate Structure:
The formulas used to calculate charges for the use of electricity. For example, the present rate structures for both NL utilities for most commercial customers consists of a fixed monthly charge and charges for both electric energy usage and monthly peak demand usage.

Reference Case:
Provides a forecast of electricity sales that includes natural conservation (that which would occur in the absence of CDM programs) but no impacts of utility CDM programs. The reference case for the study is based on the 2014 base year and the Utilities' Load Forecast.

Sector:
A group of customers having a common type of economic activity. This CDM potential assessment includes the Residential, Commercial, and Industrial sectors.

Sub sectors:
A classification of customers within a sector by common features. Residential sub sectors are by type of home (single-family dwelling or apartment). Commercial sub sectors are generally by type of commercial service (retail and wholesale trade).

Supply Curves:
A graph that depicts the volume of energy at the appropriate screened price in ascending order of cost. Steps A through D below represent programs options, or technologies arranged as a supply curve.



Supply Planning:
The process of long-term planning of electricity generation and associated transmission facilities, in combination with supply reductions made possible through conservation and demand management, in order to meet forecast demands. Supply Planning in NL is done in a framework that recognizes economic, financial, environmental and social costs, risks, and impacts.

Technical Efficiency:
Efficiency of a system, process, or device in achieving a certain purpose, measured in terms of the physical inputs required to produce a given output. In the context of electricity conservation the relevant input is electric energy.

Technology-Based Potential:
Energy and or capacity/demand savings realized through the implementation of energy-efficiency technologies.

Watt:
The basic unit of measurement of electric power.

Appendix A Background-Section 3: Base Year Electricity Use

Introduction

This appendix provides additional detailed information related to the generation of the Commercial sector Base Year profile. The appendix discusses the following:

- Sub sector descriptions
- Sales data analysis
- Detailed Results
- CEEAM archetype summaries – existing buildings

A.1 Sub Sector Descriptions

Exhibit 95 presents brief descriptions of the Commercial sub sectors. Detailed building archetype profiles for each sub sector are provided in Sections A.4 (Existing buildings) and C.4 (New buildings) of Appendices A and C, respectively.

Exhibit 95 Sub sector Descriptions

Sub Sector	Definition	Examples of Building Types
Large Office	Buildings used for office or public administration, demand greater than 100 kW	Municipal office, government office building, private office buildings
Small Office	Buildings used for office or public administration, demand less than 100 kW	Municipal office, government office building, private office buildings
Food Retail	Retail store that primarily sells food items and has a significant refrigeration load	Supermarket
Large Non-Food Retail	Retail store which primarily sells non-food items, demand greater than 100 kW	"Big box" store, strip mall, enclosed mall unit
Small Non-Food Retail	Retail store which primarily sells non-food items, demand less than 100 kW	Convenience store, independent retailer
Large Accomodation	Large accomodations with common areas, food preparation, and amenities, demand greater than 100 kW	Hotel
Small Accomodation	Small accommodations with very few amenities, demand less than 100 kW	Motel, bed and breakfast
Healthcare	Buildings used for providing multiple accommodations for short- or long-term care residents	Hospital, nursing home, nursing station
Schools	Buildings whose primary function is education. Typically characterized by seasonably variable occupancy.	Elementary or secondary schools
Universities and Colleges	Buildings that make up a campus related to post-secondary education	University campus
Warehouse / Wholesale	Typically metal-clad building with high ceilings and predominantly high-bay lighting	
Restaurant	Full service or quick service restaurant	Family restaurant, franchise restaurant, diner
Large Other Building	Commercial, institutional, manufacturing or light industrial buildings which do not fit the above categories, demand greater than 100 kW	Municipal workshop, prisons, light manufacturing

Exhibit 95 Sub sector Descriptions (cont'd…)

Sub Sector	Definition	Examples of Building Types
Small Other Building	Commercial, institutional, manufacturing or light industrial buildings which do not fit the above categories, demand less than 100 kW	Service garages, religious buildings, theaters, light manufacturing
Other Institutional	Buildings that form Canadian Forces Base Goose Bay	Barracks, mess halls, hangers, warehouses
Non-Building	Structures for which electricity is primarily used by unique equipment	Telephone exchange, microwave repeater station
Street Lighting	Street lighting	N/A
Island Isolated C/I Buildings	Buildings located in isolated regions on the Island of Newfoundland	Restaurants, schools, variety stores, medical clinics, multi-purpose garages and sheds
Labrador Isolated C/I Buildings	Buildings located in isolated regions in Labrador, including Lanse-Aux-Loup	Restaurants, schools, variety stores, medical clinics, multi-purpose garages and sheds

A.2 Sales Data Analysis

This section outlines the methodology for the allocation of the sales data provided by NLH and NLP to the Commercial sub sectors identified above.

Both NLH and NLP provided sales data to ICF. This data included monthly consumption for accounts grouped by sector, sub sector, and rate class. The sales data was aggregated into the sub sector categories defined by ICF, with the distinction between small and large sub sector building types being made at the 100 kW demand level. Because the three diesel regions of Island Isolated, Labrador Isolated, and Lanse-Aux-Loup have relatively few commercial accounts, it was agreed that instead of reporting at the sub sector level, data and results would be reported in the following aggregate categories: Island Isolated C/I Buildings, Labrador Isolated C/I Buildings, and Street Lighting.

Exhibit 96 Sales Data Subsector Assignments

Sub Sector	Description	CDM Potential Subsector Assignment
Accommodations	Other	Small/Large Accommodation
Accommodations	Restaurants	Restaurants
Education	Colleges and Universities	Universities and Colleges
Education	Other	Schools
Health Care	Hospitals	Health Care
Health Care	Other	Health Care
Non-Buildings		Non-Buildings
Office		Small/Large Office
Other Buildings		Small/Large Other Buildings
Other Buildings	DND	Other Institutional
Retail Trade	Food Stores	Food Retail
Retail Trade	Other	Small/Large Non-Food Retail
Wholesalers & Warehouse		Warehouse/Wholesale

Exhibit 96, above, describes how utility sub sectors were mapped to the sub sector definitions given above.

A.3 Detailed Results

This section of the appendix presents the base year electricity consumption for all three regions.

Exhibit 97 Commercial Sector Base Year (2014) Consumption, Island Interconnected, by Sub Sector and End Use (MWh/yr.)*

Sub Sector	Space Heating	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Refrigeration	Secondary Lighting	Domestic Hot Water	Computer Equipment	Food Service Equipment	Other Plug Loads	Outdoor Lighting	Space Cooling	Street Lighting	Computer Servers	Elevator	Block Heaters	Grand Total
Large Office	94,614	53,893	46,186	2,666	1,067	15,973	5,999	24,326	1,067	7,386	4,524	10,209	-	4,319	1,033	-	273,262
Small Office	74,726	39,734	19,864	2,170	868	5,902	5,155	19,802	-	6,012	3,682	7,866	-	3,516	-	-	189,299
Large Non-food Retail	27,391	33,975	27,191	985	5,725	3,596	1,685	1,886	3,817	2,456	3,344	3,168	-	435	-	-	115,655
Small Non-food Retail	39,263	41,215	28,604	1,428	-	4,845	2,577	2,733	-	3,559	4,845	4,863	-	631	-	-	134,563
Food Retail	18,821	19,666	11,213	729	87,439	3,103	3,279	2,199	8,744	2,369	2,473	1,584	-	322	-	-	161,939
Large Accomodation	17,745	6,841	5,480	631	1,892	7,169	14,755	1,104	3,090	1,205	1,070	1,153	-	232	244	-	62,610
Small Accomodation	9,485	3,690	1,397	300	450	2,047	7,022	525	750	574	509	402	-	110	-	-	27,262
Healthcare	54,806	4,604	27,075	1,042	1,562	21,812	8,124	3,645	8,332	7,008	3,534	2,338	-	844	807	-	145,533
Schools	76,730	42,801	8,422	1,053	1,053	9,582	5,337	7,376	1,404	1,486	5,957	267	-	1,293	-	-	162,762
Universities and Colleges	11,328	39,550	35,395	1,908	3,816	4,996	1,193	9,870	2,862	4,804	3,237	1,316	-	702	739	-	121,717
Warehouse/Wholesale	24,251	19,171	4,292	1,310	7,861	3,812	1,958	1,742	-	4,212	2,223	108	-	579	-	-	71,518
Restaurants	11,925	2,352	3,434	256	16,672	7,540	18,743	410	33,431	545	435	989	-	113	-	-	96,846
Labrador Isolated C/I Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Island Isolated C/I Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Large Other Buildings	42,605	28,123	21,288	1,335	16,038	9,791	7,707	6,633	7,918	3,972	3,382	2,667	-	1,116	356	-	152,930
Small Other Buildings	40,739	26,977	17,711	1,293	15,178	8,068	6,768	6,124	7,039	3,876	3,410	2,502	-	1,028	196	-	140,908
Other Institutional	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non-Buildings	-	-	-	199,788	-	-	-	-	-	-	-	-	-	-	-	-	199,788
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	-	34,828	-	-	-	34,828
Grand Total	544,430	362,591	257,551	216,895	159,621	108,235	90,302	88,376	78,454	49,463	42,624	39,433	34,828	15,241	3,375	-	2,091,418

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 98 Commercial Sector Base Year (2014) Consumption, Labrador Interconnected, by Sub Sector and End Use (MW)*

Sub Sector	Space Heating	General Lighting	HVAC Fans & Pumps	Secondary Lighting	Refrigeration	Domestic Hot Water	Food Service Equipment	Other Plug Loads	Miscellaneous Equipment	Computer Equipment	Outdoor Lighting	Street Lighting	Block Heaters	Space Cooling	Computer Servers	Elevator	Grand Total
Large Office	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Small Office	1,793	793	189	118	-	108	-	120	22	395	74	-	22	62	70	-	3,766
Large Non-food Retail	2,699	2,234	1,154	248	410	134	273	176	35	135	239	-	35	56	31	-	7,860
Small Non-food Retail	6,716	4,295	1,163	478	-	258	-	338	68	260	460	-	68	121	60	-	14,283
Food Retail	4,669	1,031	309	133	4,105	205	493	133	21	124	139	-	21	25	5	-	11,414
Large Accomodation	2,803	585	466	687	181	1,572	302	116	30	90	103	-	30	57	22	-	7,044
Small Accomodation	438	98	38	55	12	208	20	15	4	12	14	-	4	9	3	-	929
Healthcare	3,057	654	3,671	3,099	222	1,924	1,184	996	74	518	502	-	222	108	120	57	16,408
Schools	6,374	2,331	933	481	21	363	76	81	29	402	324	-	29	12	70	-	11,527
Universities and Colleges	1,410	631	372	80	61	76	46	77	15	157	52	-	15	25	11	-	3,028
Warehouse/Wholesale	4,074	1,396	461	278	572	178	-	307	48	127	162	-	48	6	42	-	7,698
Restaurants	1,136	212	140	606	1,501	1,776	3,071	54	12	37	39	-	12	18	10	-	8,622
Labrador Isolated C/I Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Island Isolated C/I Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Large Other Buildings	22,842	7,904	6,537	4,889	6,162	5,426	4,743	1,689	229	1,384	1,359	-	358	269	272	50	64,115
Small Other Buildings	16,047	6,188	3,936	2,881	3,513	2,757	2,645	1,147	157	1,099	955	-	238	209	212	31	42,015
Other Institutional	10,017	12,713	8,247	4,559	1,763	2,407	537	2,075	412	1,212	1,406	-	412	219	-	-	45,979
Non-Buildings	-	-	-	-	-	-	-	-	5,068	-	-	-	-	-	-	-	5,068
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	1,756	-	-	-	-	1,756
Grand Total	84,075	41,065	27,616	18,592	18,523	17,392	13,390	7,323	6,224	5,951	5,828	1,756	1,512	1,197	929	138	251,513

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 99 Commercial Sector Base Year (2014) Consumption, Isolated, by Sub Sector and End Use (MW)*

Sub Sector	General Lighting	Refrigeration	Secondary Lighting	HVAC Fans & Pumps	Computer Equipment	Outdoor Lighting	Other Plug Loads	Space Heating	Street Lighting	Food Service Equipment	Block Heaters	Domestic Hot Water	Miscellaneous Equipment	Elevator	Space Cooling	Computer Servers	Grand Total
Labrador Isolated C/I Buildings	6,909	3,416	1,608	1,132	1,051	739	677	580	-	496	305	149	-	-	-	-	17,062
Island Isolated C/I Buildings	649	321	151	106	99	69	64	-	-	47	-	-	-	-	-	-	1,505
Street Lighting	-	-	-	-	-	-	-	-	544	-	-	-	-	-	-	-	544
Grand Total	7,558	3,737	1,759	1,238	1,150	808	740	580	544	542	305	149	-	-	-	-	19,112

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

A.4 CEEAM Archetype Summaries – Existing Buildings

This section includes summary profiles of the twenty four existing building archetypes constructed for this study. Exhibit 100 presents a table of contents for the CEEAM building profiles that follow. A glossary of terms and acronyms used in the building profiles is included at the end of this appendix.

Exhibit 100 Table of Contents - Existing CEEAM Building Profiles

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Large Office	**> 100 kW**		**Island Interconnected**
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.71	W/m².°C	0.12	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.48	W/m².°C	0.09	Btu/hr.ft² .°F	Typical Footprint (m²)	1,239	m²	13,333	ft²
Glazing U value (W/m².°C)	3.97	W/m².°C	0.70	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.40								
Shading Coefficient (SC)	0.58				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	75%				25%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA 22.09%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right:
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | L/s.m² | CFM/ft² | operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.55	L/s.m²	0.70	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²	CFM/ft²
Operation occupied period	50%		
Operation unoccupied period	50%		

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	1,067,682	
Peak Zone Sensible Load	462,384	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	21,510	
Total air circulation or Design air	3.55	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.8	W/m²	1.4	W/ft²

Occ. Period(Hrs./yr.)	3300
Unocc. Period(Hrs./yr.)	5460
Usage During Occupied Period	95%
Usage During Unoccupied Period	20%

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	5.2
	MJ/m².yr	202

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	31.0	W/m²	2.9	W/ft²

Occ. Period(Hrs./yr.)	3400
Unocc. Period(Hrs./yr.)	5360
Usage During Occupied Period	95%
Usage During Unoccupied Period	40%

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	45%	45%			5%		5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²

Floor fraction check: should = 1.00 — 1.00

Occ. Period(Hrs./yr.)	4000
Unocc. Period(Hrs./yr.)	4760
Usage During Occupied Period	0%
Usage During Unoccupied Period	100%

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 16.38 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	262

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.06	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below:
Lunch room/cafeteria/restaurant

Fuel Oil / Propane Fuel Sh[are]: — Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI		All Electric EUI		
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	6.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:
Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.1
	MJ/m².yr	4.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Large Office Baseline | **SIZE:** > 100 kW | **VINTAGE:** | **REGION:** Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	15%						85%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	62.0 W/m²	19.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	417 MJ/m².yr	10.8 kWh/ft².yr
Sizing Factor	1.00	
Electric Fuel Share	85.0%	Fuel Oil / Propane Fuel Sh 15.0%

Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	10.8	15.4	11.5
MJ/m².yr	417	596	444

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	20.0%				80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	14.0 °C	57.2 °F

Peak Cooling Load	84 W/m²	27 Btu/hr.ft²	450 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	109.0 MJ/m².yr	2.8 kWh/ft².yr	
Sizing Factor	1.00		
A/C Saturation (Incidence of A/C)	85.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Sh	

Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	1.2		1.2
MJ/m².yr	45		45

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	10%	90%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.8	0.7
MJ/m².yr	25	30	25.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.6	L/s.m²	0.70	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	6.0	W/m²	0.56	W/ft²
Fan Design Load VAV	6.0	W/m²	0.56	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	75%	25%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.65	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.81	W/m²	0.08	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0053	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.5	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	45.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption	0.4	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.4	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.5
	MJ/m².yr	173.2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: Electricity: **26.5** kWh/ft².yr **1,024.9** MJ/m².yr — Fuel Oil / Propane: **2.4** kWh/ft².yr **92.5** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.2	202.1
ARCHITECTURAL LIGHTING	1.5	59.9
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	4.5	173.2
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	9.2	354.9	2.3	89.5
SPACE COOLING	1.0	38.3		
DOMESTIC HOT WATER	0.6	22.5	0.1	3.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Small Office	**< 100 kW**		**Island Interconnected**
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F		
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F		
Glazing U value (W/m².°C)	3.97	W/m².°C	0.70	Btu/hr.ft² .°F		
Window/Wall Ratio (WIWAR) (%)	0.30					
Shading Coefficient (SC)	0.58					

Typical Building Size	1,859	m²	20,000	ft²
Typical Footprint (m²)	929	m²	10,000	ft²
Footprint Aspect Ratio (L:W)	1			
Percent Conditioned Space	100%			
Percent Conditioned Space Defined as Exterior Zone	45%			
Typical # Stories	2			
Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person

%OA 23.47%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.34	L/s.m²	0.66	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) — L/s.m² — CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	520,257	
Peak Zone Sensible Load	217,608	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	10,123	
Total air circulation or Design air	3.34	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	14.8	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: kWh/ft².yr 4.7; MJ/m².yr 183

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.0	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	45%	45%			5%		5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI: kWh/ft².yr 0.7; MJ/m².yr 27

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 15.57 W/m² — EUI TOTAL kWh/ft².yr 5; MJ/m².yr 210

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.06	
Connected Load (W/m²)	1.9	1.8	0.6	0.8	0.5	1.5
Connected Load (W/ft²)	0.2	0.2	0.05	0.07	0.05	0.14
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.42	16.20
Computer Equipment	EUI	2.36	91.24
Plug Loads	EUI	0.72	27.70

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Sh — Electricity Fuel Share: 100.0%

		kWh/ft².yr	MJ/m².yr
Fuel Oil / Propane EUI	EUI	0.1	5.0
All Electric EUI	EUI		

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI: kWh/ft².yr 0.1; MJ/m².yr 4.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI		
Miscellaneous	EUI	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				Total
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	49.9 W/m²	15.8	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	383 MJ/m².yr	9.9	kWh/ft².yr
Sizing Factor	1.00		

Electric Fuel Share: 90.0% — Fuel Oil / Propane Fuel Sh: 10.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	9.9	383
Fuel Oil / Propane EUI	14.1	547
Market Composite EUI	10.3	399

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	82 W/m²	26 Btu/hr.ft²	461 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	111.0 MJ/m².yr	2.9 kWh/ft².yr	

Sizing Factor: 1.00 — Operation (occ. period): 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 75.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Sh:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.2	48
Fuel Oil / Propane EUI		
Market Composite EUI	1.2	48

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	5%		95%
Blended Efficiency	1.50		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	25
Fuel Oil / Propane EUI	0.4	15
Market Composite EUI	0.6	24.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.66	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	0.50			
Fan Design Load CAV	2.8	W/m²	0.26	W/ft²
Fan Design Load VAV	2.8	W/m²	0.26	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.1	W/m²	0.01	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.61	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	0.5			
Pump Connected Load	0.40	W/m²	0.04	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0052	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.5	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	23.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.0	kWh/m².yr
Condenser Pump Energy Consumption	0.2	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.4
	MJ/m².yr	91.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	22.5 kWh/ft².yr	872.2 MJ/m².yr	Fuel Oil / Propane:	1.4 kWh/ft².yr	55.4 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.7	183.1
ARCHITECTURAL LIGHTING	0.7	27.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	2.4	91.5
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.9	344.3	1.4	54.7
SPACE COOLING	0.9	36.2		
DOMESTIC HOT WATER	0.6	23.8	0.0	0.8
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Food Retail Baseline | **SIZE:** All | **VINTAGE:** | **REGION:** Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.55	W/m².°C	0.10	Btu/hr.ft² .°F	Typical Building Size	2,788 m²	30,000 ft²
Roof U value (W/m².°C)	0.40	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	2,788 m²	30,000 ft²
Glazing U value (W/m².°C)	4.17	W/m².°C	0.73	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1	
					Percent Conditioned Space	100%	
					Percent Conditioned Space Defined as Exterior Zone	45%	
Window/Wall Ratio (WIWAR) (%)	0.06						
Shading Coefficient (SC)	0.69				Typical # Stories	1	
					Floor to Floor Height (m)	4.6 m	15.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA 22.97%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	2.90	L/s.m²	0.57	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based	Dry-Bulb Based		Total
Incidence of Use		100%		100%
Switchover Point	KJ/kg.	18	°C	
	Btu/lbm	64.4	°F	

Summary of Design Parameters

Peak Design Cooling Load	631,563	
Peak Zone Sensible Load	245,685	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	11,429	
Total air circulation or Design air	2.90	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90		
Connected Load	14.5 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	5000		
Unocc. Period(Hrs./yr.)	3760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	20%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	2%	15%	75%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 7.0; MJ/m².yr 270

ARCHITECTURAL LIGHTING (CORRIDORS)

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10		
Connected Load	13.5 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	5000		
Unocc. Period(Hrs./yr.)	3760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			15%	75%	8%	2%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 1.1; MJ/m².yr 43

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00 Lux	27.9	ft-candles
Floor Fraction (HBLFF)			
Connected Load	14.0 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	0%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 14.38 W/m² — EUI TOTAL kWh/ft².yr 8; MJ/m².yr 312

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.43	0.43	0.01	0.01	0.02	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	2.9 W/m²	0.3 W/ft²
Total end-use load (unocc. period)	1.7 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.11	4.42
Computer Equipment	EUI	0.78	30.2
Plug Loads	EUI	0.84	32.5

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	2.6	3.1
MJ/m².yr	100.0	120.0

REFRIGERATION

Provide description below:
Commercial refrigeration display cases

EUI kWh/ft².yr 31.0; MJ/m².yr 1200.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI		
Miscellaneous	EUI	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				Total
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	15%						85%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	36.2	W/m²	11.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	304	MJ/m².yr	7.8	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 85.0% Fuel Oil / Propane Fuel Share 15.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	7.8
	MJ/m².yr	304
Fuel Oil / Propane EUI	kWh/ft².yr	11.2
	MJ/m².yr	434
Market Composite EUI	kWh/ft².yr	8.3
	MJ/m².yr	323

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)				10.0%	90.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	66	W/m²	21	Btu/hr.ft²	570	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	75.2	MJ/m².yr	1.9	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 65.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.9
	MJ/m².yr	33
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.9
	MJ/m².yr	33

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					30%
Eff./COP	65.00				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	2.25		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 45.5

Wetting Use Percentage 90%

All Electric EUI	kWh/ft².yr	1.3
	MJ/m².yr	50
Fuel Oil / Propane EUI	kWh/ft².yr	0.5
	MJ/m².yr	20
Market Composite EUI	kWh/ft².yr	1.2
	MJ/m².yr	47.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.9	L/s.m²	0.57	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	4.5	W/m²	0.42	W/ft²
Fan Design Load VAV	4.5	W/m²	0.42	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.33	W/m²	0.12	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0042	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.6	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	39.7	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	0.6	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.0
	MJ/m².yr	153.9

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	57.4 kWh/ft².yr	2,222.4 MJ/m².yr	Fuel Oil / Propane:	1.7 kWh/ft².yr	67.1 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
GENERAL LIGHTING	7.0	269.9					
ARCHITECTURAL LIGHTING (COR	1.1	42.6	SPACE HEATING	6.7	258.3	1.7	65.1
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.6	21.7		
OTHER PLUG LOADS	0.8	32.5	SERVICE HOT WATER	1.2	45.0	0.1	2.0
HVAC FANS & PUMPS	4.0	153.9	FOOD SERVICE EQUIPMENT	3.1	120.0		
REFRIGERATION	31.0	1,200.0					
MISCELLANEOUS	0.3	10.0					
BLOCK HEATERS							
COMPUTER EQUIPMENT	0.8	30.2					
COMPUTER SERVERS	0.1	4.4					
ELEVATORS							
OUTDOOR LIGHTING	0.9	33.9					

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.55	W/m².°C	0.10	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.40	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	4.17	W/m².°C	0.73	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.75				Typical # Stories	1			
					Floor to Floor Height (m)	5.0	m	16.5	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	12.88%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	2			
Total Air Circulation or Design Air Flow	6.21	L/s.m²	1.22	CFM/ft²
Infiltration Rate		L/s.m²		CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	571,544	
Peak Zone Sensible Load	262,842	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	12,227	
Total air circulation or Design air	6.21	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.5	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	10%	20%	55%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 8.9; MJ/m².yr 345

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.7	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	5%	10%	50%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.9; MJ/m².yr 36

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING Overall LP 21.07 W/m² EUI TOTAL kWh/ft².yr 10; MJ/m².yr 381

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.22	0.22	0.01	0.01	0.02	
Connected Load	0.5 W/m²	0.4 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.1 W/m²	0.2 W/ft²	
Total end-use load (unocc. period)	1.2 W/m²	0.1 W/ft²	
Usage during occupied period	100%		
Usage during unoccupied period	59%		

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT 5

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	1.0
	MJ/m².yr			MJ/m².yr	38.7

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 1.5; MJ/m².yr 58.1

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.3
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Large Non-Food Retail Baseline
SIZE: > 100 kW
VINTAGE:
REGION: Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				Total
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	
System Present (%)	15%						85%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 54.5 W/m² — 17.3 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 327 MJ/m².yr — 8.4 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 85.0% — Fuel Oil / Propane Fuel Share: 15.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	8.4	327
Fuel Oil / Propane EUI	12.1	467
Market Composite EUI	9.0	348

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	10.0%			5.0%	85.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load: 90 W/m² — 29 Btu/hr.ft² — 420 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 106.8 MJ/m².yr — 2.8 kWh/ft².yr

Sizing Factor: 1.00

A/C Saturation (Incidence of A/C): 75.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.1	43
Fuel Oil / Propane EUI		
Market Composite EUI	1.1	43

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.6	23
Market Composite EUI	0.5	19.4

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	6.2	L/s.m²	1.22	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	8.8	W/m²	0.82	W/ft²
Fan Design Load VAV	8.8	W/m²	0.82	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.80	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0057	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	74.4	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	7.1
	MJ/m².yr	275.9

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **30.3** kWh/ft².yr **1,173.7** MJ/m².yr **Fuel Oil / Propane:** **1.9** kWh/ft².yr **72.4** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	8.9	344.8
ARCHITECTURAL LIGHTING	0.9	36.5
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	7.1	275.9
REFRIGERATION	1.5	58.1
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.2	278.0	1.8	70.1
SPACE COOLING	0.8	32.2		
DOMESTIC HOT WATER	0.4	17.1	0.1	2.3
FOOD SERVICE EQUIPMENT	1.0	38.7		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	< 100 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.43	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	4.17	W/m².°C	0.73	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.75				Typical # Stories	1			
					Floor to Floor Height (m)	5.0	m	16.5	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA 18.18%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) — 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² — 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.25			
Total Air Circulation or Design Air Flow	4.40	L/s.m²	0.87	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² — CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	303,354	
Peak Zone Sensible Load	149,003	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	6,932	
Total air circulation or Design air	4.40	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	< 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.5	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	10%	20%	55%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	7.5
	MJ/m².yr	289

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.7	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	5%	10%	50%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.9
	MJ/m².yr	34

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 21.07 W/m²

EUI TOTAL	kWh/ft².yr	8
	MJ/m².yr	323

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.22		0.22		0.01		0.01		0.02			
Connected Load	0.5	W/m²	0.4	W/m²	0.0	W/m²	0.1	W/m²	0.1	W/m²	1.15	W/m²
	0.0	W/ft²	0.0	W/ft²	0.00	W/ft²	0.01	W/ft²	0.01	W/ft²	0.11	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		4660	

Total end-use load (occupied period)	2.1	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT

5

Provide description below:

Fuel Oil / Propane Fuel Sh | | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.3
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	< 100 kW		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Rooftop					
System Present (%)	15%						85%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	53.9	W/m²	17.1	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	324	MJ/m².yr	8.4	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 85.0% Fuel Oil / Propane Fuel Share 15.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	8.4
	MJ/m².yr	324
Fuel Oil / Propane EUI	kWh/ft².yr	11.9
	MJ/m².yr	462
Market Composite EUI	kWh/ft².yr	8.9
	MJ/m².yr	344

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	96	W/m²	30	Btu/hr.ft²	396	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	120.2	MJ/m².yr	3.1	kWh/ft².yr		
Sizing Factor	1.00					
A/C Saturation (Incidence of A/C)	70.0%					

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	1.3
	MJ/m².yr	49
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	1.3
	MJ/m².yr	49

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	5%		95%
Blended Efficiency	1.50		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

All Electric EUI	kWh/ft².yr	0.5
	MJ/m².yr	19
Fuel Oil / Propane EUI	kWh/ft².yr	0.3
	MJ/m².yr	12
Market Composite EUI	kWh/ft².yr	0.5
	MJ/m².yr	18.6

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Non-Food Retail Baseline | **SIZE:** < 100 kW | **VINTAGE:** | **REGION:** Island Interconnected

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.4	L/s.m²	0.87	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	6.2	W/m²	0.58	W/ft²
Fan Design Load VAV	6.2	W/m²	0.58	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.91	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0061	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	52.7	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	5.2
	MJ/m².yr	200.3

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	< 100 kW		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	24.3 kWh/ft².yr	942.4 MJ/m².yr	Fuel Oil / Propane:	1.8 kWh/ft².yr	69.9 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	7.5	288.7
ARCHITECTURAL LIGHTING	0.9	33.9
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	5.2	200.3
REFRIGERATION		
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.1	275.0	1.8	69.3
SPACE COOLING	0.9	34.1		
DOMESTIC HOT WATER	0.5	18.1	0.0	0.6
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	1,239	m²	13,333	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.28								
Shading Coefficient (SC)	0.57				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46	m²/person	495	ft²/person
Occupancy Schedule Occ. Period	50%			
Occupancy Schedule Unocc. Period	80%			
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person

%OA 5.42%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.01	L/s.m²	0.59	CFM/ft²
Infiltration Rate	1.00	L/s.m²	0.20	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	492,851	
Peak Zone Sensible Load	363,672	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	16,918	
Total air circulation or Design air	3.01	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	100	125	150	300				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**125**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	70%	20%	5%	5%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.8
	MJ/m².yr	108

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	23.3	W/m²	2.2	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	40%	10%	35%	10%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.9
	MJ/m².yr	114

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 16.52 W/m²

EUI TOTAL	kWh/ft².yr	6
	MJ/m².yr	222

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.4 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	2.0 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	48%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.45
		MJ/m².yr	17.51
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Sh 2.0% Electricity Fuel Share: 98.0%

Kitchen services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	2.6	EUI	kWh/ft².yr	1.3
	MJ/m².yr	100.0		MJ/m².yr	50.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.8
	MJ/m².yr	30.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.3
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Large Accommodation Baseline | **SIZE:** > 100 kW | **VINTAGE:** | **REGION:** Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane Boilers Stan.	Fuel Oil / Propane Boilers High	Fuel Oil / Propane Packaged Unit	Electric A/A HP	Electric W. S. HP	Electric H/R Chiller	Electric Resistance	Total
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 59.8 W/m² | 19.0 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 313 MJ/m².yr | 8.1 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 90.0% | Fuel Oil / Propane Fuel Share: 10.0% | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	8.1	313
Fuel Oil / Propane EUI	11.5	447
Market Composite EUI	8.4	326

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	30.0%				70.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 33 W/m² | 10 Btu/hr.ft² | 1146 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 66.7 MJ/m².yr | 1.7 kWh/ft².yr

Sizing Factor: 0.85 | Operation (occ. perio 3000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 75.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	24
Fuel Oil / Propane EUI		
Market Composite EUI	0.6	24

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	6.7	260
Fuel Oil / Propane EUI	8.1	315
Market Composite EUI	6.9	265.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: **Large Accommodation** **Baseline**
SIZE: **> 100 kW**
VINTAGE:
REGION: **Island Interconnected**

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.0	L/s.m²	0.59	CFM/ft²
System Static Pressure CAV	338	Pa	1.4	wg
System Static Pressure VAV	338	Pa	1.4	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	2.8	W/m²	0.26	W/ft²
Fan Design Load VAV	2.8	W/m²	0.26	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.78	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0021	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	21.0	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.2
	MJ/m².yr	86.9

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Large Accommodation Baseline
SIZE: > 100 kW
VINTAGE:
REGION: Island Interconnected

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **25.6** kWh/ft².yr **993.0** MJ/m².yr **Fuel Oil / Propane:** **2.0** kWh/ft².yr **78.2** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	2.8	108.5
LOBBY, BALLROOMS, CORRIDORS	2.9	113.7
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	2.2	86.9
REFRIGERATION	0.8	30.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	17.5
COMPUTER SERVERS	0.1	3.7
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.3	281.4	1.2	44.7
SPACE COOLING	0.5	18.3		
DOMESTIC HOT WATER	6.0	234.0	0.8	31.5
FOOD SERVICE EQUIPMENT	1.3	49.0	0.1	2.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Small Accommodation	**< 100 kW**		**Island Interconnected**
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.28								
Shading Coefficient (SC)	0.57				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46	m²/person	495	ft²/person	%OA	5.24%
Occupancy Schedule Occ. Period	50%					
Occupancy Schedule Unocc. Period	80%					
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3)	1	If Fresh Air Control Type = "2" enter % FA. to the right:	15%			
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)		If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation	0.5	L/s.m²	0.10	CFM/ft²
			50%	operation (%)		

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.11	L/s.m²	0.61	CFM/ft²
Infiltration Rate	1.00	L/s.m²	0.20	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	252,853	
Peak Zone Sensible Load	188,263	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	8,758	
Total air circulation or Design air	3.11	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	100	125	150	300	Total
% Distribution	25%	50%	25%		100%
Weighted Average					**125**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	70%	20%	5%	5%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI		
	kWh/ft².yr	3.2
	MJ/m².yr	123

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	23.3	W/m²	2.2	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	40%	10%	35%	10%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI		
	kWh/ft².yr	1.8
	MJ/m².yr	68

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**300**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 15.62 W/m²

EUI TOTAL		
	kWh/ft².yr	5
	MJ/m².yr	191

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.4 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	2.0 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	48%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

	EUI		
Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.45
		MJ/m².yr	17.51
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Kitchen services

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	2.6	kWh/ft².yr	0.6
	MJ/m².yr	100.0	MJ/m².yr	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI		
	kWh/ft².yr	0.4
	MJ/m².yr	15.0

BLOCK HEATERS & MISCELLANEOUS

	EUI		
Block Heaters	EUI	kWh/ft².yr	0.3
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Small Accommodation Baseline
SIZE: < 100 kW
VINTAGE:
REGION: Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	64.7	W/m²	20.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	351	MJ/m².yr	9.1	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 90.0% — Fuel Oil / Propane Fuel Share 10.0% — Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	9.1	351
Fuel Oil / Propane EUI	13.0	502
Market Composite EUI	9.5	366

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	34	W/m²	11	Btu/hr.ft²	1117	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	65.3	MJ/m².yr	1.7	kWh/ft².yr		

Sizing Factor 0.85 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 50.0%

Electric Fuel Share 100.0% — Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.7	27
Fuel Oil / Propane EUI		
Market Composite EUI	0.7	27

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 236.6

Wetting Use Percentage 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	6.7	260
Fuel Oil / Propane EUI	8.1	315
Market Composite EUI	6.9	265.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Small Accommodation Baseline | **SIZE:** < 100 kW | **VINTAGE:** | **REGION:** Island Interconnected

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.1	L/s.m²	0.61	CFM/ft²
System Static Pressure CAV	338	Pa	1.4	wg
System Static Pressure VAV	338	Pa	1.4	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	0.50			
Fan Design Load CAV	1.5	W/m²	0.14	W/ft²
Fan Design Load VAV	1.5	W/m²	0.14	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.80	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	0.5			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0021	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.5					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	10.9	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.2
	MJ/m².yr	46.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	23.5 kWh/ft².yr	908.5 MJ/m².yr	Fuel Oil / Propane:	2.1 kWh/ft².yr	81.7 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	3.2	123.0
LOBBY, BALLROOMS, CORRIDORS	1.8	68.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	1.2	46.5
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	17.5
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.2	316.1	1.3	50.2
SPACE COOLING	0.3	13.4		
DOMESTIC HOT WATER	6.0	234.0	0.8	31.5
FOOD SERVICE EQUIPMENT	0.6	25.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Health Care Baseline | **SIZE:** All | **VINTAGE:** | **REGION:** Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft².°F	Typical Building Size	8,829 m²	95,000 ft²
Roof U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft².°F	Typical Footprint (m²)	1,750 m²	18,830 ft²
Glazing U value (W/m².°C)	3.84 W/m².°C	0.68 Btu/hr.ft².°F	Footprint Aspect Ratio (L:W)	2	
			Percent Conditioned Space	100%	
			Percent Conditioned Space Defined as Exterior Zone	45%	
Window/Wall Ratio (WIWAR) (%)	0.15		Typical # Stories	3	
Shading Coefficient (SC)	0.65		Floor to Floor Height (m)	3.7 m	12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	80%				20%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30 m²/person	323 ft²/person	%OA 34.02%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period	75%		
Fresh Air Requirements or Outside Air	45 L/s.person	95 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	4	
Total Air Circulation or Design Air Flow	4.41 L/s.m²	0.87 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70 L/s.m²	0.14 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	443,312	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H	13.2	ft³/lbm
Design CFM	20,623	
Total air circulation or Design air fl	4.41	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	250 Lux	23.2	ft-candles
Floor Fraction (GLFF)	0.40		
Connected Load	8.8 W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	8760		
Unocc. Period(Hrs./yr.)			
Usage During Occupied Period	40%		
Usage During Unoccupied Period			
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	50	100	200	300				Total
% Distribution			50%	50%				100%
Weighted Average								**250**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	5%	45%	45%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 1.1; MJ/m².yr 44

SECONDARY LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60		
Connected Load	17.0 W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	8760		
Unocc. Period(Hrs./yr.)			
Usage During Occupied Period	65%		
Usage During Unoccupied Period	20%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	600	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	4%	5%	50%	40%		0%	1%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI kWh/ft².yr 5.4; MJ/m².yr 209

TERTIARY LIGHTING

Light Level	250.00 Lux	23.2	ft-candles
Floor Fraction (HBLFF)			
Connected Load	11.9 W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	200	300	500	700				Total
% Distribution	50%	50%						100%
Weighted Average								**250**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)	15%	15%	20%	50%			0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	88	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LPD 13.72 W/m² — EUI TOTAL kWh/ft².yr 7; MJ/m².yr 254

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	40%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

		kWh/ft².yr	MJ/m².yr
Compter Servers	EUI	0.2	8.10
Computer Equipment	EUI	0.9	35.0
Plug Loads	EUI	1.7	67.3

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Commercial food services

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	3.1	2.1
MJ/m².yr	120.0	80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI	0.3	
Miscellaneous	EUI	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)	50%						50%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	36.6	W/m²	11.6	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	1052	MJ/m².yr	27.2	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 50.0% — Fuel Oil / Propane Fuel Sh: 50.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	27.2	38.8	33.0
MJ/m².yr	1052	1503	1278

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)	70.0%				30.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	67	W/m²	21	Btu/hr.ft²	562	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	110.4	MJ/m².yr	2.9	kWh/ft².yr		

Sizing Factor: 1.00 — Operation (occ. perio: 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 60.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	1.0		1.0
MJ/m².yr	37		37

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					40%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	40%	60%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 118.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	3.4	4.1	3.6
MJ/m².yr	130	158	141.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.4	L/s.m²	0.87	CFM/ft²
System Static Pressure CAV	875	Pa	3.5	wg
System Static Pressure VAV	875	Pa	3.5	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	8.7	W/m²	0.81	W/ft²
Fan Design Load VAV	8.7	W/m²	0.81	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.12	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.8	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.09	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.63	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.89	W/m²	0.08	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0043	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.6	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	62.0	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.4	kWh/m².yr
Condenser Pump Energy Consumption	1.1	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	2.0	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	6.7
	MJ/m².yr	260.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	36.1 kWh/ft².yr	1,397.3 MJ/m².yr	Fuel Oil / Propane:	21.0 kWh/ft².yr	814.8 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	1.1	44.2
SECONDARY LIGHTING	5.4	209.4
TERTIARY LIGHTING		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	6.7	260.0
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.9	35.0
COMPUTER SERVERS	0.2	8.1
ELEVATORS	0.2	7.7
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	13.6	526.2	19.4	751.7
SPACE COOLING	0.6	22.4		
DOMESTIC HOT WATER	2.0	78.0	1.6	63.1
FOOD SERVICE EQUIPMENT	2.1	80.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Schools Baseline | **SIZE:** All | **VINTAGE:** | **REGION:** Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	3,717	m²	40,000	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.13								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person	%OA	10.15%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	3	L/s.person	6	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 34%

If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	2.96	L/s.m²	0.58	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.42	L/s.m²	0.08	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	689,051	
Peak Zone Sensible Load	385,006	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	17,910	
Total air circulation or Design air	2.96	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18.8	°C	65.84	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	14.7	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			70%	30%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.1
	MJ/m².yr	122

ARCHITECTURAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	18.0	W/m²	1.7	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	12%	10%	15%	10%	40%	10%	3%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.7
	MJ/m².yr	27

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 15.17 W/m²

EUI TOTAL	kWh/ft².yr	4
	MJ/m².yr	149

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.05	0.05	0.02	0.02	0.01	
Connected Load	0.3 W/m²	0.3 W/m²	0.2 W/m²	0.4 W/m²	0.1 W/m²	0.2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.02 W/ft²	0.04 W/ft²	0.01 W/ft²	0.02 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5760

Total end-use load (occupied period)	1.3 W/m²	0.1 W/ft²
Total end-use load (unocc. period)	0.8 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.54
		MJ/m².yr	21.01
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	8.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.1
	MJ/m².yr	3.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	3

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Schools, Baseline
SIZE: All
VINTAGE:
REGION: Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	25%						75%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 55.8 W/m² | 17.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 291 MJ/m².yr | 7.5 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 75.0% | Fuel Oil / Propane Fuel Share: 25.0% | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	7.5	291
Fuel Oil / Propane EUI	10.7	416
Market Composite EUI	8.3	323

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 54 W/m² | 17 Btu/hr.ft² | 697 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 79.4 MJ/m².yr | 2.0 kWh/ft².yr

Sizing Factor: 1.00 | Operation (occ. perio 4000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 2.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Sh

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.0	38
Fuel Oil / Propane EUI		
Market Composite EUI	1.0	38

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					20%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	20%	80%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.6	23
Market Composite EUI	0.5	19.8

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.0	L/s.m²	0.58	CFM/ft²
System Static Pressure CAV	250	Pa	1.0	wg
System Static Pressure VAV	250	Pa	1.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	1.4	W/m²	0.13	W/ft²
Fan Design Load VAV	1.4	W/m²	0.13	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.09	W/m²	0.10	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0034	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	5.2	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.8	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	2000	hrs./year
Circulating Pump Energy Consumption	0.2	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.6
	MJ/m².yr	24.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	12.0 kWh/ft².yr	463.6 MJ/m².yr	Fuel Oil / Propane:	2.8 kWh/ft².yr	108.7 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	3.1	121.9
ARCHITECTURAL LIGHTING	0.7	27.3
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.1	4.2
HVAC FANS & PUMPS	0.6	24.0
REFRIGERATION	0.1	3.0
MISCELLANEOUS	0.1	3.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	21.0
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.6	218.5	2.7	104.1
SPACE COOLING	0.0	0.8		
DOMESTIC HOT WATER	0.4	15.2	0.1	4.6
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Building Size	6,506 m² / 70,000 ft²
Roof U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Footprint (m²)	3,253 m² / 35,000 ft²
Glazing U value (W/m².°C)	3.58 W/m².°C	0.63 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	50%
Window/Wall Ratio (WIWAR) (%)	0.30			
Shading Coefficient (SC)	0.65		Typical # Stories	2
			Floor to Floor Height (m)	3.7 m / 12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14 m²/person	151 ft²/person	%OA 17.57%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	10 L/s.person	21 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.6	
Total Air Circulation or Design Air Flow	4.06 L/s.m²	0.80 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	752,785	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	35,020	
Total air circulation or Design air	4.06	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90		
Connected Load	14.1 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	90%		
Usage During Unoccupied Period	20%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			60%	35%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	5.4
	MJ/m².yr	207

ARCHITECTURAL LIGHTING CORRIDORS

Light Level	300 Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10		
Connected Load	11.4 W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	50%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	8%	10%	15%	65%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.7
	MJ/m².yr	26

SPECIAL PURPOSE LIGHTING

Light Level	300.00 Lux	27.9	ft-candles
Floor Fraction (HBLFF)			
Connected Load	14.0 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	0%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Floor fraction check: should = 1.00 | 1.00

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 13.79 W/m²

EUI TOTAL	kWh/ft².yr	6
	MJ/m².yr	233

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9 W/m²	0.4 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	55%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	1.34
		MJ/m².yr	51.73
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	0.5	EUI	kWh/ft².yr	0.4
	MJ/m².yr	20.0		MJ/m².yr	15.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: **University/College** **Baseline**
SIZE: **All**
VINTAGE:
REGION: **Island Interconnected**

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	80%						20%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 52.3 W/m² — 16.6 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 297 MJ/m².yr — 7.7 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 20.0% — Fuel Oil / Propane Fuel Share: 80.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	7.7	297
Fuel Oil / Propane EUI	10.9	424
Market Composite EUI	10.3	399

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	50.0%				50.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 80 W/m² — 25 Btu/hr.ft² — 474 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 111.4 MJ/m².yr — 2.9 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 15.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.2	46
Fuel Oil / Propane EUI		
Market Composite EUI	1.2	46

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					75%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	75%		25%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	25
Fuel Oil / Propane EUI	0.8	30
Market Composite EUI	0.7	29.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.1	L/s.m²	0.80	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	6.4	W/m²	0.59	W/ft²
Fan Design Load VAV	6.4	W/m²	0.59	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	90%	10%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.87	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0051	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	45.9	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	1.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	6000	hrs./year
Circulating Pump Energy Consumption	3.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.8
	MJ/m².yr	185.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	16.5 kWh/ft².yr	637.9 MJ/m².yr	Fuel Oil / Propane:	9.3 kWh/ft².yr	362.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.4	207.3
ARCHITECTURAL LIGHTING CORF	0.7	26.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	4.8	185.5
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	1.3	51.7
COMPUTER SERVERS	0.1	3.7
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	1.5	59.4	8.8	339.2
SPACE COOLING	0.2	6.9		
SERVICE HOT WATER	0.2	6.3	0.6	22.8
FOOD SERVICE EQUIPMENT	0.4	15.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Warehouse/Wholesale Baseline | SIZE: All | VINTAGE: | REGION: Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	5,576 m²	60,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	5,576 m²	60,000	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.05							
Shading Coefficient (SC)	0.80				Typical # Stories	1		
					Floor to Floor Height (m)	6.1 m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100 m²/person	1076 ft²/person	%OA	6.56%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	10 L/s.person	21 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1	
Total Air Circulation or Design Air Flow	1.53 L/s.m²	0.30 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70 L/s.m²	0.14 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	509,519	
Peak Zone Sensible Load	387,357	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	18,020	
Total air circulation or Design air	1.53	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All		Island Interconnected
Baseline			

LIGHTING

HIGH BAY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	10.5	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution	50%	50%			100%
Weighted Average					**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20%	10%	60%	10%		100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 3.8; MJ/m².yr 146

OTHER, OFFICE LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	20.9	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	5%	60%	25%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.8; MJ/m².yr 29

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000	Total
% Distribution					
Weighted Average					

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 11.57 W/m² — EUI TOTAL kWh/ft².yr 4.5; MJ/m².yr 175

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.0	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	39%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.11	4.42
Computer Equipment	EUI	0.34	13.30
Plug Loads	EUI	0.83	32.15

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI: EUI kWh/ft².yr; MJ/m².yr

All Electric EUI: EUI kWh/ft².yr; MJ/m².yr

REFRIGERATION

Provide description below:

Process

EUI kWh/ft².yr 1.5; MJ/m².yr 60.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI		
Miscellaneous	EUI	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	25%						75%	100%
Eff./COP	70%	70%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.43	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	40.6	W/m²	12.9	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	247	MJ/m².yr	6.4	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 75.0% — Fuel Oil / Propane Fuel Share: 25.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	6.4	9.1	7.1
MJ/m².yr	247	353	273

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	27	W/m²	8	Btu/hr.ft²	1413	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	39.0	MJ/m².yr	1.0	kWh/ft².yr		

Sizing Factor: 1.00 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 5.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.4		0.4
MJ/m².yr	16		16

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					20%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	20%	80%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.0

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.6	0.5
MJ/m².yr	19	23	19.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	1.5	L/s.m²	0.30	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.0	W/m²	0.09	W/ft²
Fan Design Load VAV	1.0	W/m²	0.09	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.0	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.1	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.54	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.001	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0017	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	50	kPa	17	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.1	W/m²	0.01	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	7.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.4	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.8
	MJ/m².yr	32.8

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:				
Electricity:	14.1 kWh/ft².yr	545.9 MJ/m².yr		
Fuel Oil / Propane:	2.4 kWh/ft².yr	92.7 MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
HIGH BAY LIGHTING	3.8	146.3
OTHER, OFFICE LIGHTING	0.8	29.1
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.8	32.1
HVAC FANS & PUMPS	0.8	32.8
REFRIGERATION	1.5	60.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.3	13.3
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	4.8	185.1	2.3	88.1
SPACE COOLING	0.0	0.8		
DOMESTIC HOT WATER	0.4	14.9	0.1	4.5
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Building Size	929 m² / 10,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	929 m² / 10,000 ft²
Glazing U value (W/m².°C)	3.97 W/m².°C	0.70 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	45%
Window/Wall Ratio (WIWAR) (%)	0.36			
Shading Coefficient (SC)	0.58		Typical # Stories	1
			Floor to Floor Height (m)	3.7 m / 12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	60%							40%	100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	20 m²/person	215 ft²/person	%OA 24.92%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	20 L/s.person	42 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.3	
Total Air Circulation or Design Air Flow	4.01 L/s.m²	0.79 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² — CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters

Peak Design Cooling Load	323,602	
Peak Zone Sensible Load	130,664	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	6,078	
Total air circulation or Design air	4.01	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All		Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.50			
Connected Load	10.7	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.4
	MJ/m².yr	92

ARCHITECTURAL LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.50			
Connected Load	34.4	W/m²	3.2	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	70%	25%					5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	7.6
	MJ/m².yr	294

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 22.57 W/m²

EUI TOTAL	kWh/ft².yr	10
	MJ/m².yr	386

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.16		0.16		0.01				0.03			
Connected Load	0.4	W/m²	0.4	W/m²	0.1	W/m²		W/m²	0.1	W/m²	1.15	W/m²
	0.0	W/ft²	0.0	W/ft²	0.00	W/ft²		W/ft²	0.01	W/ft²	0.11	W/ft²
Diversity Occupied Period	80%		80%		80%		80%		100%		80%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		2500	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		6260	

Total end-use load (occupied period)	1.8	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	65%			

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.41
		MJ/m².yr	16.00
Plug Loads	EUI	kWh/ft².yr	0.55
		MJ/m².yr	21.24

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: 2.0% Electricity Fuel Share: 98.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.1	kWh/ft².yr	34.3
	MJ/m².yr	5.0	MJ/m².yr	1330.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	16.8
	MJ/m².yr	650.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All		Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	63.6	W/m²	20.2	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	517	MJ/m².yr	13.3	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 90.0% Fuel Oil / Propane Fuel Share 10.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	13.3	517
Fuel Oil / Propane EUI	19.1	738
Market Composite EUI	13.9	539

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	102	W/m²	32	Btu/hr.ft²	371	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	126.1	MJ/m².yr	3.3	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 70.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.4	55
Fuel Oil / Propane EUI		
Market Composite EUI	1.4	55

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	5%	95%
Blended Efficiency	1.50	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 700.0

Wetting Use Percentage 90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	19.9	769
Fuel Oil / Propane EUI	12.0	467
Market Composite EUI	19.5	754.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All		Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.0	L/s.m²	0.79	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	6.8	W/m²	0.63	W/ft²
Fan Design Load VAV	6.8	W/m²	0.63	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	60%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.00	W/m²	0.19	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.005	L/s.m²	0.008	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.98	W/m²	0.09	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0065	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	33.6	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption	0.5	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.5
	MJ/m².yr	133.9

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All		Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	97.5 kWh/ft².yr	3,775.8 MJ/m².yr	Fuel Oil / Propane:	2.5 kWh/ft².yr	97.2 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.4	91.7
ARCHITECTURAL LIGHTING	7.6	294.0
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	21.2
HVAC FANS & PUMPS	3.5	133.9
REFRIGERATION	16.8	650.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.4	16.0
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	12.0	464.9	1.9	73.8
SPACE COOLING	1.0	38.5		
DOMESTIC HOT WATER	18.9	730.8	0.6	23.3
FOOD SERVICE EQUIPMENT	33.6	1,303.4	0.0	0.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.24	W/m².°C	0.04	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.40								
Shading Coefficient (SC)	0.58				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	75%				25%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person

%OA 7.43%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.96	L/s.m²	0.78	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) — L/s.m² — CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	190,872	
Peak Zone Sensible Load	128,897	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,996	
Total air circulation or Design air	3.96	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.8	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650		Total
% Distribution	10%	80%	10%		100%
Weighted Average					**550**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	5.2
	MJ/m².yr	202

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	31.0	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	3400			
Unocc. Period(Hrs./yr.)	5360			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500	Total
% Distribution	10%	40%	40%	10%	100%
Weighted Average					**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	45%	45%			5%		5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000	Total
% Distribution					
Weighted Average					

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 16.38 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	262

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.06	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.1	kWh/ft².yr	0.1
	MJ/m².yr	5.0	MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.1
	MJ/m².yr	4.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	64.3	W/m²	20.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	538	MJ/m².yr	13.9	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	13.9
MJ/m².yr	538
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	13.9
MJ/m².yr	538

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)	20.0%				80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	60	W/m²	19	Btu/hr.ft²	629	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	70.3	MJ/m².yr	1.8	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 50.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.7
MJ/m².yr	29
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	29

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI		Fuel Oil / Propane EUI		Market Composite EUI	
kWh/ft².yr	0.6	kWh/ft².yr	0.8	kWh/ft².yr	0.6
MJ/m².yr	25	MJ/m².yr	30	MJ/m².yr	25.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.0	L/s.m²	0.78	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	3.1	W/m²	0.29	W/ft²
Fan Design Load VAV	3.1	W/m²	0.29	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	75%	25%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.18	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.58	W/m²	0.05	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0038	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	21.2	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.8	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.2
	MJ/m².yr	85.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **28.3** kWh/ft².yr **1,094.9** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.2	202.1
ARCHITECTURAL LIGHTING	1.5	59.9
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	2.2	85.1
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	13.9	538.2		
SPACE COOLING	0.4	14.5		
DOMESTIC HOT WATER	0.6	25.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.58				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA 8.06%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right:
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | L/s.m² | CFM/ft² | operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.65	L/s.m²	0.72	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	180,760	
Peak Zone Sensible Load	118,786	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,526	
Total air circulation or Design air	3.65	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	14.8	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.7
	MJ/m².yr	183

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.0	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	45%	45%			5%		5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.7
	MJ/m².yr	27

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 15.57 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	210

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.06	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 51.3 W/m² — 16.3 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 414 MJ/m².yr — 10.7 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	10.7		10.7
MJ/m².yr	414		414

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load: 57 W/m² — 18 Btu/hr.ft² — 664 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 67.3 MJ/m².yr — 1.7 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period): 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 50.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.7		0.7
MJ/m².yr	29		29

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.8	0.6
MJ/m².yr	25	30	25.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Small Office	**< 100 kW**	**Existing**	**Labrador Interconnected**
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.6	L/s.m²	0.72	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	0.50			
Fan Design Load CAV	1.4	W/m²	0.13	W/ft²
Fan Design Load VAV	1.4	W/m²	0.13	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.1	W/m²	0.01	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.12	W/m²	0.10	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	0.5			
Pump Connected Load	0.27	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0036	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	10.8	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	0.9	kWh/m².yr
Condenser Pump Energy Consumption	0.1	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.1
	MJ/m².yr	43.7

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	22.4 kWh/ft².yr	869.4 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.7	183.1
ARCHITECTURAL LIGHTING	0.7	27.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	1.1	43.7
REFRIGERATION		
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	10.7	413.9		
SPACE COOLING	0.4	14.3		
DOMESTIC HOT WATER	0.6	25.0	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.06								
Shading Coefficient (SC)	0.69				Typical # Stories	1			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	37.75%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	30	L/s.person	64	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	2.65	L/s.m²	0.52	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	301,505	
Peak Zone Sensible Load	112,121	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,216	
Total air circulation or Design air	2.65	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Food Retail	**All**	**Existing**	**Labrador Interconnected**
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.5	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	2%	15%	75%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 6.5; MJ/m².yr 251

ARCHITECTURAL LIGHTING (CORRIDORS)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	13.6	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			15%	75%	10%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.8; MJ/m².yr 32

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 14.39 W/m² — EUI TOTAL kWh/ft².yr 7; MJ/m².yr 284

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.43		0.43		0.01		0.01		0.02			
Connected Load	0.8	W/m²	0.7	W/m²	0.0	W/m²	0.1	W/m²	0.1	W/m²	1.5	W/m²
	0.1	W/ft²	0.1	W/ft²	0.00	W/ft²	0.01	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	2.9	W/m²	0.3	W/ft²
Total end-use load (unocc. period)	1.7	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	58%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.03
		MJ/m².yr	1.24
Computer Equipment	EUI	kWh/ft².yr	0.78
		MJ/m².yr	30.2
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.5

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI		All Electric EUI
EUI	kWh/ft².yr	2.6	3.1
	MJ/m².yr	100.0	120.0

REFRIGERATION

Provide description below:

Commercial refrigeration display cases

EUI kWh/ft².yr 25.8; MJ/m².yr 1000.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	35.8	W/m²	11.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	1137	MJ/m².yr	29.4	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share [ ] Oil Fuel Share [ ]

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	29.4
MJ/m².yr	1137

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	29.4
MJ/m².yr	1137

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	95	W/m²	30	Btu/hr.ft²	398	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	54.1	MJ/m².yr	1.4	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 25.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share [ ]

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	65.00				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 45.5

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	1.3
MJ/m².yr	50

Fuel Oil / Propane EUI	
kWh/ft².yr	1.6
MJ/m².yr	61

Market Composite EUI	
kWh/ft².yr	1.3
MJ/m².yr	50.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.6	L/s.m²	0.52	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.9	W/m²	0.18	W/ft²
Fan Design Load VAV	1.9	W/m²	0.18	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.04	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.90	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.005	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0060	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.8	W/m²	0.08	W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	16.9	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.9
	MJ/m².yr	75.2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Food Retail	**All**	**Existing**	**Labrador Interconnected**
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**71.8** kWh/ft².yr	**2,780.1** MJ/m².yr	**Fuel Oil / Propane:**	**0.0** kWh/ft².yr	**0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
GENERAL LIGHTING	6.5	251.1					
ARCHITECTURAL LIGHTING (COR	0.8	32.5	SPACE HEATING	29.4	1,137.3		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.2	6.1		
OTHER PLUG LOADS	0.8	32.5	SERVICE HOT WATER	1.3	50.0	0.0	0.0
HVAC FANS & PUMPS	1.9	75.2	FOOD SERVICE EQUIPMENT	3.1	120.0		
REFRIGERATION	25.8	1,000.0					
MISCELLANEOUS	0.1	5.0					
BLOCK HEATERS	0.1	5.0					
COMPUTER EQUIPMENT	0.8	30.2					
COMPUTER SERVERS	0.0	1.2					
ELEVATORS							
OUTDOOR LIGHTING	0.9	33.9					

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail Baseline	> 100 kW	Existing	Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.75				Typical # Stories	1			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA 9.43%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	18	L/s.person	38	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	2			
Total Air Circulation or Design Air Flow	7.64	L/s.m²	1.50	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)		L/s.m²		CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	301,435	
Peak Zone Sensible Load	161,666	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,521	
Total air circulation or Design air	7.64	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.5	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	10%	20%	55%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	8.2
	MJ/m².yr	317

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.7	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	5%	10%	50%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.9
	MJ/m².yr	35

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 21.07 W/m²

EUI TOTAL	kWh/ft².yr	9
	MJ/m².yr	352

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.22	0.22	0.01	0.01	0.02	
Connected Load	0.5 W/m²	0.4 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.1 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.2 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.1
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.5
		MJ/m².yr	19.1
Plug Loads	EUI	kWh/ft².yr	0.6
		MJ/m².yr	24.9

FOOD SERVICE EQUIPMENT

5

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	1.0
	MJ/m².yr			MJ/m².yr	38.7

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	1.5
	MJ/m².yr	58.1

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	45.5	W/m²	14.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	383	MJ/m².yr	9.9	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share: | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	9.9	383
Fuel Oil / Propane EUI		
Market Composite EUI	9.9	383

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	95	W/m²	30	Btu/hr.ft²	398	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	77.4	MJ/m².yr	2.0	kWh/ft².yr		

Sizing Factor: 1.00

A/C Saturation (Incidence of A/C): 25.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.8	32
Fuel Oil / Propane EUI		
Market Composite EUI	0.8	32

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.6	23
Market Composite EUI	0.5	19.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	7.6	L/s.m²	1.50	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	5.1	W/m²	0.47	W/ft²
Fan Design Load VAV	5.1	W/m²	0.47	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.90	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0060	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	42.7	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.2
	MJ/m².yr	163.5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **28.8** kWh/ft².yr **1,114.2** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	8.2	316.7
ARCHITECTURAL LIGHTING	0.9	35.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	4.2	163.5
REFRIGERATION	1.5	58.1
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	9.9	382.6		
SPACE COOLING	0.2	7.9		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	1.0	38.7		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail Baseline	< 100 kW	Existing	Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.75				Typical # Stories	1			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA 19.11%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	18	L/s.person	38	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right: 34%
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	3.77	L/s.m²	0.74	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.42	L/s.m²	0.08	CFM/ft²

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	299,238	
Peak Zone Sensible Load	159,469	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,418	
Total air circulation or Design air	3.77	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.5	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	10%	20%	55%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	8.2
	MJ/m².yr	317

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	31.7	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	5%	10%	50%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.9
	MJ/m².yr	35

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 21.07 W/m²

EUI TOTAL	kWh/ft².yr	9
	MJ/m².yr	352

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.22		0.22		0.01		0.01		0.02			
Connected Load	0.5	W/m²	0.4	W/m²	0.0	W/m²	0.1	W/m²	0.1	W/m²	1.15	W/m²
	0.0	W/ft²	0.0	W/ft²	0.00	W/ft²	0.01	W/ft²	0.01	W/ft²	0.11	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		4660	

Total end-use load (occupied period)	2.1	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.1
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.5
		MJ/m².yr	19.1
Plug Loads	EUI	kWh/ft².yr	0.6
		MJ/m².yr	24.9

FOOD SERVICE EQUIPMENT

5

Provide description below:

Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Small Non-Food Retail Baseline | **SIZE:** < 100 kW | **VINTAGE:** Existing | **REGION:** Labrador Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	39.0	W/m²	12.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	495	MJ/m².yr	12.8	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% | Fuel Oil / Propane Fuel Share | Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	12.8	495
Fuel Oil / Propane EUI		
Market Composite EUI	12.8	495

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	94	W/m²	30	Btu/hr.ft²	401	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	87.0	MJ/m².yr	2.2	kWh/ft².yr		
Sizing Factor	1.00					
A/C Saturation (Incidence of A/C)	25.0%					

Electric Fuel Share 100.0% | Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.9	36
Fuel Oil / Propane EUI		
Market Composite EUI	0.9	36

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.6	23
Market Composite EUI	0.5	19.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.8	L/s.m²	0.74	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.5	W/m²	0.23	W/ft²
Fan Design Load VAV	2.5	W/m²	0.23	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.89	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0060	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	21.1	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.2
	MJ/m².yr	85.8

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	27.2 kWh/ft².yr	1,053.3 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
GENERAL LIGHTING	8.2	316.7					
ARCHITECTURAL LIGHTING	0.9	35.2	SPACE HEATING	12.8	495.3		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.2	8.9		
OTHER PLUG LOADS	0.6	24.9	DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
HVAC FANS & PUMPS	2.2	85.8	FOOD SERVICE EQUIPMENT				
REFRIGERATION							
MISCELLANEOUS	0.1	5.0					
BLOCK HEATERS	0.1	5.0					
COMPUTER EQUIPMENT	0.5	19.1					
COMPUTER SERVERS	0.1	4.4					
ELEVATORS/ESCALATORS							
OUTDOOR LIGHTING	0.9	33.9					

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Large Accommodation Baseline | **SIZE:** > 100 kW | **VINTAGE:** Existing | **REGION:** Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,394 m²	15,000	ft²
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Footprint (m²)	1,394 m²	15,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.28							
Shading Coefficient (SC)	0.57				Typical # Stories	1		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46 m²/person	495 ft²/person	%OA	5.39%
Occupancy Schedule Occ. Period	50%			
Occupancy Schedule Unocc. Period	80%			
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.3	
Total Air Circulation or Design Air Flow	3.02 L/s.m²	0.60 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70 L/s.m²	0.14 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	196,081	
Peak Zone Sensible Load	147,639	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	6,868	
Total air circulation or Design air	3.02	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125 Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75		
Connected Load	12.7 W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2500		
Unocc. Period(Hrs./yr.)	6260		
Usage During Occupied Period	50%		
Usage During Unoccupied Period	25%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	100	125	150	300				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**125**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	60%	20%	5%	5%		0%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.5
	MJ/m².yr	97

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300 Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25		
Connected Load	23.3 W/m²	2.2	W/ft²
Occ. Period(Hrs./yr.)	3000		
Unocc. Period(Hrs./yr.)	5760		
Usage During Occupied Period	85%		
Usage During Unoccupied Period	50%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	40%	10%	35%	10%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.9
	MJ/m².yr	114

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00 Lux	27.9	ft-candles
Floor Fraction (HBLFF)			
Connected Load	14.0 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	0%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING	Overall LP 15.37 W/m²	EUI TOTAL	kWh/ft².yr	5
			MJ/m².yr	210

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.4 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	50%	50%	50%	50%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.38
		MJ/m².yr	14.80
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Kitchen services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	1.0	EUI	kWh/ft².yr	1.3
	MJ/m².yr	40.0		MJ/m².yr	50.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.8
	MJ/m².yr	30.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Large Accommodation	**> 100 kW**	**Existing**	**Labrador Interconnected**
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	56.8 W/m²	18.0 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	464 MJ/m².yr	12.0 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	12.0
	MJ/m².yr	464
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	12.0
	MJ/m².yr	464

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load	35 W/m²	11 Btu/hr.ft²	1080 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	46.1 MJ/m².yr	1.2 kWh/ft².yr	
Sizing Factor	0.85	Operation (occ. perio	3000 hrs/year Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	50.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.5
	MJ/m².yr	19
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.5
	MJ/m².yr	19

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load)	236.6
Wetting Use Percentage	90%

All Electric EUI	kWh/ft².yr	6.7
	MJ/m².yr	260
Fuel Oil / Propane EUI	kWh/ft².yr	8.1
	MJ/m².yr	315
Market Composite EUI	kWh/ft².yr	6.7
	MJ/m².yr	260.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.0	L/s.m²	0.60	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	2.5	W/m²	0.23	W/ft²
Fan Design Load VAV	2.5	W/m²	0.23	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.70	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0022	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	18.8	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.4	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	2.0
	MJ/m².yr	77.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Large Accommodation	**> 100 kW**	**Existing**	**Labrador Interconnected**
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** 30.1 kWh/ft².yr 1,165.2 MJ/m².yr **Fuel Oil / Propane:** 0.0 kWh/ft².yr 0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	2.5	96.8
LOBBY, BALLROOMS, CORRIDORS	2.9	113.7
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	2.0	77.1
REFRIGERATION	0.8	30.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	14.8
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	12.0	463.6		
SPACE COOLING	0.2	9.4		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	1.3	50.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft² .°F	Typical Building Size	697 m² / 7,500 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	697 m² / 7,500 ft²
Glazing U value (W/m².°C)	3.52 W/m².°C	0.62 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	45%
Window/Wall Ratio (WIWAR) (%)	0.28			
Shading Coefficient (SC)	0.57		Typical # Stories	1
			Floor to Floor Height (m)	3.7 m / 12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46 m²/person	495 ft²/person	%OA 4.53%
Occupancy Schedule Occ. Period	50%		
Occupancy Schedule Unocc. Period	80%		
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² / 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.3	
Total Air Circulation or Design Air Flow	3.60 L/s.m²	0.71 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² / CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	112,083	
Peak Zone Sensible Load	87,862	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	4,087	
Total air circulation or Design air	3.60	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	100	125	150	300				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**125**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	70%	20%	5%	5%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.2
	MJ/m².yr	123

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	23.3	W/m²	2.2	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	40%	10%	35%	10%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	1.8
	MJ/m².yr	68

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 15.62 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	191

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.3		0.3		0.05		0.033		0.02			
Connected Load	0.4	W/m²	0.3	W/m²	0.1	W/m²	0.1	W/m²	0.1	W/m²	1.5	W/m²
	0.0	W/ft²	0.0	W/ft²	0.01	W/ft²	0.01	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	50%		50%		50%		50%		100%		70%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2500		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6260		5760	

Total end-use load (occupied period)	1.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.0	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.38
		MJ/m².yr	14.80
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: Electricity Fuel Share: 100.0%

Kitchen services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	1.0	EUI	kWh/ft².yr	0.6
	MJ/m².yr	40.0		MJ/m².yr	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.4
	MJ/m².yr	15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 65.9 W/m² | 20.9 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 548 MJ/m².yr | 14.1 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share: | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	14.1		14.1
MJ/m².yr	548		548

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 40 W/m² | 13 Btu/hr.ft² | 945 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 51.4 MJ/m².yr | 1.3 kWh/ft².yr

Sizing Factor: 0.85 | Operation (occ. perio 3000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 50.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5		0.5
MJ/m².yr	21		21

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	6.7	8.1	6.7
MJ/m².yr	260	315	260.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.6	L/s.m²	0.71	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	0.50			
Fan Design Load CAV	1.5	W/m²	0.14	W/ft²
Fan Design Load VAV	1.5	W/m²	0.14	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.3	L/s.m²	0.06	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.4	L/s.m²	0.08	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.3	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.80	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	0.5			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0025	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.5					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	11.2	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.9	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.2
	MJ/m².yr	48.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	30.0 kWh/ft².yr	1,162.4 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	3.2	123.0
LOBBY, BALLROOMS, CORRIDORS	1.8	68.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	1.2	48.1
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	14.8
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	14.1	547.9		
SPACE COOLING	0.3	10.6		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.6	25.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Footprint (m²)	2,943	m²	31,667	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.15								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	80%				20%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	9.76%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	3			
Total Air Circulation or Design Air Flow	5.12	L/s.m²	1.01	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	686,735	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H	13.2	ft³/lbm
Design CFM	31,947	
Total air circulation or Design air fl	5.12	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	250	Lux	23.2	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	8.8	W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	50	100	200	300				Total
% Distribution			50%	50%				100%
Weighted Average								**250**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	5%	45%	45%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	1.1
	MJ/m².yr	44

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	17.0	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	300	500	600	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	4%	5%	50%	40%		0%	1%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	5.4
	MJ/m².yr	209

TERTIARY LIGHTING

Light Level	250.00	Lux	23.2	ft-candles
Floor Fraction (HBLFF)				
Connected Load	11.9	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

								Total
Light Level (Lux)	200	300	500	700				Total
% Distribution	50%	50%						100%
Weighted Average								**250**

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)	15%	15%	20%	50%			0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	88	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LPD 13.72 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	254

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	40%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Servers	EUI	kWh/ft².yr	0.2
		MJ/m².yr	8.10
Computer Equipment	EUI	kWh/ft².yr	0.9
		MJ/m².yr	35.0
Plug Loads	EUI	kWh/ft².yr	1.7
		MJ/m².yr	67.3

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: ____ Electricity Fuel Share: 100.0%

Commercial food services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	3.1	EUI	kWh/ft².yr	2.1
	MJ/m².yr	120.0		MJ/m².yr	80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.4
	MJ/m².yr	15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 29.1 W/m² — 9.2 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 229 MJ/m².yr — 5.9 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 90.0% — Fuel Oil / Propane Fuel Share: 10.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	5.9
MJ/m².yr	229

Fuel Oil / Propane EUI	
kWh/ft².yr	8.5
MJ/m².yr	328

Market Composite EUI	
kWh/ft².yr	6.2
MJ/m².yr	239

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	14.0 °C	57.2 °F

Peak Cooling Load: 54 W/m² — 17 Btu/hr.ft² — 704 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 51.5 MJ/m².yr — 1.3 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 35.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	21

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	21

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 118.3

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	3.4
MJ/m².yr	130

Fuel Oil / Propane EUI	
kWh/ft².yr	4.1
MJ/m².yr	158

Market Composite EUI	
kWh/ft².yr	3.4
MJ/m².yr	130.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.1	L/s.m²	1.01	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	8.7	W/m²	0.81	W/ft²
Fan Design Load VAV	8.7	W/m²	0.81	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.11	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.8	W/m²	0.07	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.89	W/m²	0.08	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.71	W/m²	0.07	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0034	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	61.6	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	5.9	kWh/m².yr
Condenser Pump Energy Consumption	0.8	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	6.4
	MJ/m².yr	248.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
Health Care	**All**	**Existing**	**Labrador Interconnected**
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **28.6** kWh/ft².yr **1,108.7** MJ/m².yr **Fuel Oil / Propane:** **0.8** kWh/ft².yr **32.8** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	1.1	44.2
SECONDARY LIGHTING	5.4	209.4
TERTIARY LIGHTING		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	6.4	248.0
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.4	15.0
COMPUTER EQUIPMENT	0.9	35.0
COMPUTER SERVERS	0.2	8.1
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.3	206.5	0.8	32.8
SPACE COOLING	0.2	7.3		
DOMESTIC HOT WATER	3.4	130.0	0.0	0.0
FOOD SERVICE EQUIPMENT	2.1	80.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Schools
SIZE: All
VINTAGE:
REGION: Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717 m²	40,000	ft²
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Footprint (m²)	3,717 m²	40,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	50%		
Window/Wall Ratio (WIWAR) (%)	0.13							
Shading Coefficient (SC)	0.65				Typical # Stories	1		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10 m²/person	108 ft²/person	%OA	18.16%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	6 L/s.person	13 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.3	
Total Air Circulation or Design Air Flow	3.30 L/s.m²	0.65 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.42 L/s.m²	0.08 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	947,110	
Peak Zone Sensible Load	424,335	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	19,740	
Total air circulation or Design air	3.30	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18.8	°C	65.84	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Labrador Interconnected

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	14.7	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			70%	30%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.1
	MJ/m².yr	122

ARCHITECTURAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	16.6	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	10%	15%	10%	30%	20%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	25

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 14.96 W/m²

EUI TOTAL	kWh/ft².yr	4
	MJ/m².yr	147

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.05	0.05	0.02	0.02	0.01	
Connected Load	0.3 W/m²	0.3 W/m²	0.2 W/m²	0.4 W/m²	0.1 W/m²	0.2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.02 W/ft²	0.04 W/ft²	0.01 W/ft²	0.02 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5760

Total end-use load (occupied period)	1.3 W/m²	0.1 W/ft²
Total end-use load (unocc. period)	0.8 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.54
		MJ/m².yr	21.01
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Sh | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	8.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.03
	MJ/m².yr	1.1

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.0
		MJ/m².yr	2
Miscellaneous	EUI	kWh/ft².yr	0.0
		MJ/m².yr	2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Labrador Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	20%						80%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	41.1	W/m²	13.0	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	417	MJ/m².yr	10.8	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 80.0% | Fuel Oil / Propane Fuel Sh 20.0% | Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	10.8	417
Fuel Oil / Propane EUI	15.4	595
Market Composite EUI	11.7	453

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	75	W/m²	24	Btu/hr.ft²	504	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	68.1	MJ/m².yr	1.8	kWh/ft².yr		

Sizing Factor 1.00 | Operation (occ. perio 4000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 2.0%

Electric Fuel Share 100.0% | Fuel Oil / Propane Fuel Sh

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.8	32
Fuel Oil / Propane EUI		
Market Composite EUI	0.8	32

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.6	23
Market Composite EUI	0.5	19.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Labrador Interconnected

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.65	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.2	W/m²	0.20	W/ft²
Fan Design Load VAV	2.2	W/m²	0.20	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.50	W/m²	0.14	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0048	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.6	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	11.8	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	1.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	2000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.3
	MJ/m².yr	48.8

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	All		Labrador Interconnected

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**15.6** kWh/ft².yr	**603.0** MJ/m².yr	**Fuel Oil / F**	**3.1** kWh/ft².yr **119.1** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	3.1	121.9
ARCHITECTURAL LIGHTING	0.6	25.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.1	4.2
HVAC FANS & PUMPS	1.3	48.8
REFRIGERATION	0.0	1.1
MISCELLANEOUS	0.0	1.5
BLOCK HEATERS	0.0	1.5
COMPUTER EQUIPMENT	0.5	21.0
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.6	333.4	3.1	119.1
SPACE COOLING	0.0	0.6		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Building Size	6,506	m²	70,000	ft²
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Footprint (m²)	3,253	m²	35,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14 m²/person	151 ft²/person	%OA	16.85%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	10 L/s.person	21 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.6	
Total Air Circulation or Design Air Flow	4.24 L/s.m²	0.83 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70 L/s.m²	0.14 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	784,929	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	36,515	
Total air circulation or Design air	4.24	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.1	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			60%	35%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 5.4; MJ/m².yr 207

ARCHITECTURAL LIGHTING CORRIDORS

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	11.4	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	8%	10%	15%	65%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.7; MJ/m².yr 26

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	6.6	W/m²	0.6	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 13.79 W/m² — EUI TOTAL kWh/ft².yr 6; MJ/m².yr 233

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9 W/m²	0.4 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	55%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	1.34
		MJ/m².yr	51.73
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: ___ Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI		All Electric EUI
EUI kWh/ft².yr	0.5	EUI kWh/ft².yr	0.4
MJ/m².yr	20.0	MJ/m².yr	15.0

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 49.7 W/m² — 15.8 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 463 MJ/m².yr — 12.0 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	12.0
MJ/m².yr	463
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	12.0
MJ/m².yr	463

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 81 W/m² — 26 Btu/hr.ft² — 466 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 76.4 MJ/m².yr — 2.0 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 25.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.9
MJ/m².yr	33
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	0.9
MJ/m².yr	33

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.8	0.6
MJ/m².yr	25	30	25.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.2	L/s.m²	0.83	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	4.4	W/m²	0.41	W/ft²
Fan Design Load VAV	4.4	W/m²	0.41	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	90%	10%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.62	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0052	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	31.9	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	1.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	6000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.2
	MJ/m².yr	122.1

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:				
Electricity:	25.7 kWh/ft².yr	994.8 MJ/m².yr		
Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.4	207.3
ARCHITECTURAL LIGHTING CORF	0.7	26.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	3.2	122.1
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	1.3	51.7
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	12.0	463.4		
SPACE COOLING	0.2	8.3		
SERVICE HOT WATER	0.6	25.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.4	15.0		

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale Baseline	All	Existing	Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Building Size	1,859 m²	20,000 ft²
Roof U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Footprint (m²)	1,859 m²	20,000 ft²
Glazing U value (W/m².°C)	3.52 W/m².°C	0.62 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1	
			Percent Conditioned Space	100%	
			Percent Conditioned Space Defined as Exterior Zone	45%	
Window/Wall Ratio (WIWAR) (%)	0.05				
Shading Coefficient (SC)	0.80		Typical # Stories	1	
			Floor to Floor Height (m)	6.1 m	20.1 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100 m²/person	1076 ft²/person	%OA 6.49%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	15 L/s.person	32 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right:
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1	
Total Air Circulation or Design Air Flow	2.31 L/s.m²	0.45 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70 L/s.m²	0.14 CFM/ft²

Separate Make-up air unit (100% OA) | | L/s.m² | | CFM/ft²
Operation occupied period | 50%
Operation unoccupied period | 50%

Economizer

	Enthalpy Based		Dry-Bulb Based	Total
Incidence of Use			100%	100%
Switchover Point		KJ/kg.	18 °C	
		Btu/lbm	64.4 °F	

Summary of Design Parameters		
Peak Design Cooling Load	254,531	
Peak Zone Sensible Load	195,583	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	9,099	
Total air circulation or Design air	2.31	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	Existing	Labrador Interconnected
Baseline			

LIGHTING

HIGH BAY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	10.5	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20%	10%	60%	10%		100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.8
	MJ/m².yr	146

OTHER, OFFICE LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	20.9	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	5%	60%	25%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	29

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 11.57 W/m²

EUI TOTAL	kWh/ft².yr	4.5
	MJ/m².yr	175

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	54.55		51		100		200		217			
Density (device/occupant)	0.59		0.59		0.03		0.03		0.06			
Connected Load	0.3	W/m²	0.3	W/m²	0.0	W/m²	0.1	W/m²	0.1	W/m²	2	W/m²
	0.0	W/ft²	0.0	W/ft²	0.00	W/ft²	0.01	W/ft²	0.01	W/ft²	0.19	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		3500	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		5260	

Total end-use load (occupied period)	2.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.0	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	39%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.34
		MJ/m².yr	13.30
Plug Loads	EUI	kWh/ft².yr	0.83
		MJ/m².yr	32.15

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

Process

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	70%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.43	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	48.0	W/m²	15.2	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	427	MJ/m².yr	11.0	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	11.0
	MJ/m².yr	427
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	11.0
	MJ/m².yr	427

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	40	W/m²	13	Btu/hr.ft²	943	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	30.2	MJ/m².yr	0.8	kWh/ft².yr		

Sizing Factor: 1.00 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 5.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.3
	MJ/m².yr	13
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.3
	MJ/m².yr	13

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.0

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.6	0.5
MJ/m².yr	19	23	18.7

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.3	L/s.m²	0.45	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.4	W/m²	0.13	W/ft²
Fan Design Load VAV	1.4	W/m²	0.13	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.80	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0025	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	50	kPa	17	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	11.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.2
	MJ/m².yr	48.3

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **20.8** kWh/ft².yr **806.9** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
HIGH BAY LIGHTING	3.8	146.3
OTHER, OFFICE LIGHTING	0.8	29.1
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.8	32.1
HVAC FANS & PUMPS	1.2	48.3
REFRIGERATION	1.5	60.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.3	13.3
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
SPACE HEATING	11.0	427.0		
SPACE COOLING	0.0	0.6		
DOMESTIC HOT WATER	0.5	18.7	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	Existing	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.36								
Shading Coefficient (SC)	0.58				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	60%							40%	100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	20	m²/person	215	ft²/person	%OA	9.29%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) | 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | L/s.m² | CFM/ft² | operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	4.03	L/s.m²	0.79	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) | L/s.m² | CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	210,389	
Peak Zone Sensible Load	131,371	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	6,111	
Total air circulation or Design air	4.03	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	Existing	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.50			
Connected Load	10.7	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	550	650					Total
% Distribution	100%							100%
Weighted Average								**400**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)			20.0%	80.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI		
	kWh/ft².yr	2.4
	MJ/m².yr	92

ARCHITECTURAL LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.50			
Connected Load	30.7	W/m²	2.9	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution			100%					100%
Weighted Average								**400**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	60%	25%					15%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI		
	kWh/ft².yr	6.8
	MJ/m².yr	262

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 20.72 W/m²

EUI TOTAL		
	kWh/ft².yr	9
	MJ/m².yr	354

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.16	0.16	0.01		0.06	
Connected Load	0.4 W/m²	0.4 W/m²	0.1 W/m²	W/m²	0.1 W/m²	1.15 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	1.8 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.2 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	65%	

	EUI		
Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.41
		MJ/m².yr	16.00
Plug Loads	EUI	kWh/ft².yr	0.60
		MJ/m².yr	23.23

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: ____ Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.1	kWh/ft².yr	34.3
	MJ/m².yr	5.0	MJ/m².yr	1330.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI		
	kWh/ft².yr	16.8
	MJ/m².yr	650.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	Existing	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	58.9 W/m²	18.7 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	492 MJ/m².yr	12.7 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	12.7
	MJ/m².yr	492
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	12.7
	MJ/m².yr	492

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	14.0 °C	57.2 °F

Peak Cooling Load	66 W/m²	21 Btu/hr.ft²	570 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	72.9 MJ/m².yr	1.9 kWh/ft².yr	
Sizing Factor	1.00	Operation (occ. period) 3000 hrs/year	Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	25.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.8
	MJ/m².yr	32
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.8
	MJ/m².yr	32

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 700.0

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	19.9	24.1	19.9
MJ/m².yr	769	933	769.2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	Existing	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.0	L/s.m²	0.79	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	3.2	W/m²	0.30	W/ft²
Fan Design Load VAV	3.2	W/m²	0.30	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	60%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.30	W/m²	0.12	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.64	W/m²	0.06	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0042	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	14.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.8	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.6
	MJ/m².yr	60.4

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	Existing	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **96.4** kWh/ft².yr **3,734.2** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.4	91.7
ARCHITECTURAL LIGHTING	6.8	262.4
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	23.2
HVAC FANS & PUMPS	1.6	60.4
REFRIGERATION	16.8	650.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	16.0
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	12.7	492.0		
SPACE COOLING	0.2	7.9		
DOMESTIC HOT WATER	19.9	769.2	0.0	0.0
FOOD SERVICE EQUIPMENT	34.3	1,330.0		

Terms Used in Building Profile Summaries

Profile Term	Explanation
Building envelope	Defines the thermal characteristics of a building's exterior components
U-value	The rate of heat loss, in Btu per hour per square foot per degree Fahrenheit (BTU/hr. $f^2 \cdot {}^oF$) through walls, roofs and windows. The U-value is the reciprocal of the R-value
Shading coefficient (SC)	Is a measure of the total amount of heat passing through the glazing compared with that through a single clear glass
Window-to-wall ratio	Defines the ratio of window to insulated exterior wall area
General lighting	Defines the lighting types that are used within the main areas of a building, e.g., for a School, the area is classrooms and the lighting type is fluorescent; for a Food Retail store, the main area is the retail floor.
LPD	Lighting power density expressed in terms of W/ft^2
Lux	The amount of visible light per square meter incident on a surface ($lumen/m^2$)
Inc	Incandescent lamps
CFL	Compact fluorescent lamps
T12	T12 fluorescent lamps with magnetic ballasts
T8	T8 fluorescent lamps with electronic ballasts
MH	Metal halide lamps
HPS	High-pressure sodium lamps
HID	High-intensity discharge lighting includes both MH and HPS
T5HO	T5 High Output fluorescent lamps
LED	Light Emitting Diode lamps
Secondary lighting	Defines the lighting types that are used within the secondary areas of a building, e.g., for a School, the secondary areas are corridors, lobbies, foyers, etc.
Outdoor lighting	Defines the outdoor lighting including parking lot and façade
Overall LPD	The total floor weighted LPD that includes general, secondary, and outdoor
Fans	Defines the mix of air handling systems
CAV	Constant air volume
VAV	Variable air volume
Space heating	Defines the mix of heating equipment types found within the stock of buildings
ASHP	Air-source heat pump
WSHP	Water-source heat pump
Resistance	Electric resistance heating equipment including boilers and baseboard heaters
Fuel Oil / Propane	Fossil fuel fired equipment, including space heating, domestic hot water heating, and cooking equipment
Space cooling	Defines the mix of cooling equipment types found within the stock of buildings
Centrifugal	Standard centrifugal chillers with a full load performance of 0.75 kW/ton
Centri HE	High-efficiency centrifugal chillers assumed to have a performance of <0.65 kW/ton
Recip open	Semi-hermetic reciprocating chillers
DX	Direct expansion cooling equipment that use small tonnage hermetic compressors

Appendix B Background-Section 4: Base Year Peak Load

Introduction

Appendix B provides additional detailed information related to each of the major steps employed in the generation of the Commercial sector Base Year peak loads. The discussion is organized as follows:

- Overview of peak load methodology
- Segmentation of commercial sub sectors
- Detailed results

B.1 Overview of Peak Load Profile Methodology

As noted in the main text, development of the electric peak load estimates employs four specific factors as outlined below:

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. This allocation factor can be obtained from either (in decreasing order of priority): (a) monthly consumption statistics from end-use load studies; (b) monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months; or (c) heating or cooling degree days on an appropriate base.
- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.
- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.
- **Per Unit Hourly Factor:** The relationship of load among different hours of the day for each day type (weekday, weekend day, peak day) and for each month reflects the operating hours of the electric equipment or end use within facilities by sub sector. For example, for lighting, this would be affected by time of day, season (affected by daylight), and space type, where applicable. For the Base Year, lighting is treated on an aggregate basis by facility.

The four factors (sets of ratios) defined above provide the basis for converting annual energy to any hourly demand specified including the grouping of hours used in the four peak periods defined in this study. Exhibit 101, below, illustrates how each of the above four factors is applied sequentially to a known annual energy value to produce a peak load value, defined as a specific peak period. In the example, the 36-hour winter peak period is used. The winter peak is defined as follows:

> *The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.*[39]

[39] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

Exhibit 101 Illustrative Application of Annual Energy to Peak Period Value Factors

The Winter Peak demand is computed based on the average demand for the 36-hour period. The NL peak is assumed to occur on the four coldest days in December and January.

The following steps are required:

- **Step 1:** The monthly usage allocation factor for December and January are applied to the annual energy use to calculate December and January energy use.
- **Step 2:** The average weekday in December and January is calculated based on the formula shown below, which adjusts the average day type use to reflect any difference in typical weekend use versus typical weekday use.

$$\frac{1}{(Days\ in\ Month) * \left(\frac{5}{7} + \left(\frac{2}{7} * Weekend\ Ratio\right)\right)}$$

- **Step 3:** The peak day factor is then applied to the average weekday electric energy use to determine the peak day use for the four peak days (as defined by the NL utilities).
- **Step 4:** The average peak over the 9 hours of peak period per day is then calculated based on allocating the peak day use according to the per unit hourly load factor for a peak winter day, using the percentage of use in those hours versus the daily usage for the peak day.

It should be noted that the methodology shown in Exhibit 101 produces aggregate diversified average loads for all customers or end uses in the defined sub sector.

Exhibit 102 provides a specific numeric example for the calculation of Winter Peak Period demand (kW). The example presented in Exhibit 102 is for secondary lighting use in large office buildings, prior to adjustment for fuel share. The example shows how the annual consumption of 10,000 kWh can be converted to a peak demand value for the Winter Peak Period by the calculation of a corresponding hours-use value.

Exhibit 102 Sample Hours-Use Calculation for Office Secondary Lighting

Winter Peak Period =

$$\frac{Annual\ kWh\ \times Mo.Allocation\ (Dec)}{Days\ in\ Month \times \left[\frac{5}{7} + \left(\frac{2}{7} \times Weekend\ Ratio\right)\right]} \times Peak\ Day\ Factor \times Peak\ Hour\ \%\ Daily\ kWh$$

Winter Peak Period =

$$\frac{10{,}000\ [\text{Ann. kWh}] \times\ 14.75\%\ [\text{Mo. Alloc.}]}{62 \times \left[\frac{5}{7} + \left(\frac{2}{7} \times 1.0\ [\text{Dec. Wkend Ratio}]\right)\right]} \times 1.0\ [\text{Peak Day Fact.}]\ \times 0.06410\ [\text{Peak Hr \% Day kWh}]$$

= 1.525 kW

Hours-use Factor =

$$\frac{10{,}000\ [\text{annual kWh}]}{1.525\ [\text{Winter Peak Period}]} = 6{,}557\ [\text{Winter Peak Hours Use}]$$

This means that any applicable Office annual secondary lighting kWh can be converted to average demand in kW during the 36-hour winter peak period by dividing by 6,557 hours**.**

B2 Segmentation of Commercial Buildings

The Commercial sector segmentation used to generate the electric peak load profiles is the same as that used for electric energy use. That is, there is a load profile that corresponds to each combination of sub sector and end use. Exhibit 103 shows the Commercial sub sectors and end uses that were addressed.

Exhibit 103 Commercial Segmentation Used for Electric Peak Load Calculations

Sub sectors (Large Office, Small Office, Large Non-Food Retail, Small Non-Food Retail, Food Retail, Large Accommodation, Small Accommodation, Healthcare, School, Universities and College, Warehouse/Wholesale, Restaurant)

End uses (general lighting, secondary lighting, outdoor lighting, computer equipment, computer servers, other plug load, food service equipment, refrigeration, elevator, miscellaneous equipment, space heating space cooling, HVAC fans & pumps, domestic hot water, block heaters, street lighting)

Exhibit 104 describes the assumptions and data sources for the load profile factors that were used to develop the corresponding hours-use factors. To produce a demand for a combination of sub sector and end use, the corresponding annual energy is divided by the hours-use factor for the peak period for the applicable load shape. For certain end uses that are assumed to have no usage during the winter months (e.g., cooling) the hours-use values are considered infinite (noted by 1E+15), resulting in virtually zero demand when divided into annual energy.

Most of the studies referenced in the exhibit are the same as those used to develop hours-use factors for the CDM Potential Study completed for NL in 2008 and are also the same as those used for studies in other provinces. For most end uses, hours-use factors remain very stable from year to year and across jurisdictions, as long as the peak period of interest is the same. The amount of energy consumed varies from year to year and from place to place, but the shape of the load – when the energy is used – remains very similar.

In this analysis, therefore, the initial estimate of peak demand used the hours-use factors from the 2008 CDM Potential Study. The results were within a few percent of utility measured values. The team then calibrated the model by adjusting the hours-use factors for the weather-sensitive end uses (such as space heating) for all three sectors simultaneously, until the model peak demand output agreed closely with the Utilities' measured peak demand.

Exhibit 104 Commercial End Use Load Shape Parameters

Load Shape #	End Use	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
2001	General lighting – Office	RG&E Office lighting	App. 0.50 RG&E Office lighting	1.00 assumed	Office lighting - RG&E 1991 Study[40]
2002	General lighting – Non-food Retail	RG&E Retail lighting	RG&E Retail lighting	1.00 assumed	RG&E Retail lighting
2003	General lighting – Food Retail	RG&E Grocery lighting	RG&E Grocery lighting	1.00 assumed	RG&E Grocery lighting
2004	General lighting – Accommodation	RG&E Hotel/Motel lighting	RG&E Hotel/Motel lighting	1.00 assumed	RG&E Hotel/Motel lighting
2005	General lighting – Healthcare	RG&E Hospital/Long-term Care lighting	RG&E Hospital/Long-term Care lighting	1.00 assumed	RG&E Hospital/Long-term Care lighting
2006	General lighting – Schools, Universities and Colleges	RG&E College lighting	RG&E College lighting	1.00 assumed	RG&E College lighting
2007	General lighting – Restaurant	RG&E Full-serve Restaurant lighting	RG&E Full-serve Restaurant lighting	1.00 assumed	RG&E Full-serve Restaurant lighting
2008	General lighting – Warehouse	RG&E Warehouse lighting	RG&E Warehouse lighting	1.00 assumed	RG&E Warehouse lighting
2009	General lighting – Small Office and Other Commercial	RG&E Office lighting	RG&E Office lighting (modified)[41]	1.00 assumed	RG&E Office lighting (modified)
2010	General lighting – Small Non-food Retail	RG&E Small Non-food Retail lighting	RG&E Non-food Retail lighting (modified)	1.00 assumed	RG&E Non-food Retail lighting (modified)
2011	Secondary lighting – Office & Education	Architectural lighting model	1.00 assumed	1.00 assumed	Architectural lighting model 6 am-6 pm 100%, 50% evening, 10% overnight
2012	Secondary lighting – Retail & Restaurant	Architectural lighting model	1.00 assumed	1.00 assumed	Architectural lighting model 6 am-10 pm 100%, 50% evening, 10% overnight
2013	Secondary lighting – Health & Warehouse	Architectural lighting model	1.00 assumed	1.00 assumed	Architectural lighting model 6 am-10 pm 100%, 80% evening, 50% overnight
2014	Secondary lighting – all other	Architectural lighting model	1.00 assumed	1.00 assumed	Architectural lighting model 6 am-6 pm 100%, 50% evening, 10% overnight
2015	Refrigeration – Restaurant, Accommodation, Health	RG&E Restaurant refrigeration	RG&E total Restaurant refrigeration	RG&E total Restaurant refrigeration	RG&E total Restaurant refrigeration
2016	Refrigeration – Food Retail	RG&E Grocery refrigeration	RG&E Grocery refrigeration	RG&E Grocery refrigeration	RG&E Grocery refrigeration
2017	Refrigeration – Warehouse / Wholesale	RG&E Warehouse refrigeration	RG&E Warehouse refrigeration	RG&E Warehouse refrigeration	RG&E Warehouse refrigeration
2018	Refrigeration – Schools, Universities and Colleges	RG&E School refrigeration	RG&E School refrigeration	RG&E School refrigeration	RG&E School refrigeration
2019	Refrigeration – all Other Commercial	RG&E total Commercial refrigeration	RG&E total Commercial refrigeration	RG&E total Commercial refrigeration	RG&E total Commercial refrigeration
2020	Streetlighting	Based on dusk-to-dawn lighting model	1.00 assumed	1.00 assumed	Dusk-to-dawn model, average St. John's sunrise/ sunset

[40] Rochester Gas & Electric Company; 1991 DSM Evaluation Report Load Shape working papers.
[41] Modifications for per-unit load shapes for Small Office and Small Non-food Retail reduced overnight loads by 50% after 6 pm (Office) and after 9 pm (Non-food Retail).

Exhibit 104 Commercial End Use Load Shape Parameters (cont'd…)

Load Shape #	End Use	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
2021	Outdoor lighting	Based on outdoor lighting model	1.00 assumed	1.00 assumed	Outdoor lighting model, with RG&E 1991 study factors (0.55 overnight, 0.1 day, 1.0 eve.)
2022	Space heating – Office	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand[42]	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 Study for Office Space Heating
2023	Space heating – Retail Food/Non-Food	10-year average St. John's HDD	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 study for Retail Space heating
2024	Space heating – Accommodation/ Healthcare	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 study for Hospital/Long-term care space heating
2025	Space heating – School / University and College	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 study for School space heating
2026	Space heating – Restaurant	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 study for total Restaurant space heating
2027	Space heating – all Other Commercial	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.00 assumed	10-year average ratio of peak/avg. HDD	RG&E 1991 study for Commercial space heating
2028	Food service equipment – Restaurant	RG&E total Restaurant cooking	RG&E total Restaurant cooking	RG&E total Restaurant cooking	RG&E total Restaurant cooking
2029	Food service equipment – Accommodation / Healthcare	RG&E total Hospital/Long-term Care cooking	RG&E total Hospital/Long-term Care Cooking	RG&E total Hospital/Long-term Care Cooking	RG&E total Hospital/Long-term Care cooking
2030	Food service equipment – Food Retail	RG&E Grocery cooking	RG&E Grocery cooking	RG&E Grocery cooking	RG&E Grocery cooking
2031	Food service equipment – School/University	RG&E School cooking	RG&E School cooking	RG&E School cooking	RG&E School cooking
2032	Food service equipment – all Other Commercial	RG&E School cooking	RG&E School cooking	RG&E School cooking	RG&E School cooking
2033	Domestic hot water (DHW) – Restaurant	RG&E Restaurant water heat	RG&E Restaurant water heat	RG&E Restaurant water heat	RG&E Restaurant water heat
2034	Domestic hot water (DHW) – Accommodation / Health	RG&E total Commercial water heat	RG&E total Commercial water heat	RG&E total Commercial water heat	RG&E total Commercial water heat

[42] Heating degree days on an 18°C base for period 2001 - 2010 for the St. John's weather station.

Exhibit 104 Commercial End Use Load Shape Parameters (cont'd…)

Load Shape #	End Use	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
2035	DHW – Food Retail and Non-Food Retail	RG&E Retail water heat	RG&E Retail water heat	RG&E Retail water heat	RG&E Retail water heat
2036	DHW – School / University	RG&E School water heat	RG&E School water heat	RG&E School water heat	RG&E School water heat
2037	DHW – all Other Commercial	RG&E water heat Commercial	RG&E water heat Commercial	RG&E water heat Commercial	RG&E water heat Commercial
2038	Space cooling – All Commercial	Assumed 100% off winter peak	1.00 various studies	Assumed 100% off winter peak	RG&E 1991 study for Commercial space cooling
2039	Computer, plug load	RG&E Office lighting	RG&E Office lighting	1.00 assumed	RG&E Office lighting
2040	Elevators	NYC subways	NYC subways (0.7881)	1.0 Assumed	NYC subways (6 am-6 pm), arch Office lighting (6 pm –6 am)
2041	Engine Block Heaters	Monthly shape for Labrador assumed similar to SK; then calibrated to actual utility demand	1.00 assumed	Peak Day factor assumed similar to SK	Flat, average 7.9 hrs/day for 90 days[43]

Exhibit 105 shows the distinct hour-use values developed for each combination of peak period, sector, sub sector and end use employed in this study, as generated from the applicable load shape.

The hours-use value represents the divisor to convert annual energy (e.g., MWh) to that peak period demand. For example, dividing the annual electricity consumed for general lighting in offices by the hours-use value for the Annual Peak Hour (i.e. 5,771) will convert annual MWh to demand at the annual system peak hour (6 pm).

[43] Ontario Power Authority – OPA Measures and Assumptions List (prescriptive) as of January 31, 2010; 1,450 watts at 7.9 hours/day x 90 days.

Exhibit 105 Commercial Sector Load Shape Hours-Use Values

Region	Sub-sector	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting
Island	Large Office	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Small Office	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Large Non-food Retail	964	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	2,520	7,139
	Small Non-food Retail	964	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	2,520	7,139
	Food Retail	964	6,393	6,393	7,130	6,393	7,307	6,778	6,393	6,393	6,393	7,139	8,772	6,393	1.E+15	2,520	7,139
	Large Accomodation	964	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	3,386	7,139
	Small Accomodation	964	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	3,386	7,139
	Healthcare	964	7,488	7,488	6,207	7,488	6,152	6,800	7,488	7,488	7,488	7,139	8,490	7,488	1.E+15	3,386	7,139
	Schools	964	6,557	6,557	4,128	6,557	2,657	4,578	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	2,989	7,139
	Universities and Colleges	964	6,557	6,557	4,128	6,557	2,657	6,156	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	2,989	7,139
	Warehouse/Wholesale	964	7,488	7,488	6,207	7,488	2,657	5,387	7,488	7,488	7,488	7,139	7,801	7,488	1.E+15	3,116	7,139
	Restaurants	964	6,393	6,393	6,141	6,393	5,190	7,841	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	3,294	7,139
	Labrador Isolated C/I Buildings	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Island Isolated C/I Buildings	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Large Other Buildings	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Small Other Buildings	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Other Institutional	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Non-Buildings	964	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,137	7,139
	Street Lighting	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139
Labrador	Large Office	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Small Office	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Large Non-food Retail	1,148	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	3,002	7,139
	Small Non-food Retail	1,148	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	3,002	7,139
	Food Retail	1,148	6,393	6,393	7,130	6,393	7,307	6,778	6,393	6,393	6,393	7,139	8,772	6,393	1.E+15	3,002	7,139
	Large Accomodation	1,148	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	4,033	7,139
	Small Accomodation	1,148	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	4,033	7,139
	Healthcare	1,148	7,488	7,488	6,207	7,488	6,152	6,800	7,488	7,488	7,488	7,139	8,490	7,488	1.E+15	4,033	7,139
	Schools	1,148	6,557	6,557	4,128	6,557	2,657	4,578	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	3,561	7,139
	Universities and Colleges	1,148	6,557	6,557	4,128	6,557	2,657	6,156	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	3,561	7,139
	Warehouse/Wholesale	1,148	7,488	7,488	6,207	7,488	2,657	5,387	7,488	7,488	7,488	7,139	7,801	7,488	1.E+15	3,712	7,139
	Restaurants	1,148	6,393	6,393	6,141	6,393	5,190	7,841	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	3,924	7,139
	Labrador Isolated C/I Buildings	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Island Isolated C/I Buildings	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Large Other Buildings	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Small Other Buildings	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Other Institutional	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Non-Buildings	1,148	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	3,736	7,139
	Street Lighting	6,882	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	6,882	7,139

Exhibit 106 Commercial Sector Load Shape Hours-Use Values (cont'd…)

Region	Sub-sector	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting
Isolated	Large Office	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Small Office	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Large Non-food Retail	821	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	2,146	7,139
	Small Non-food Retail	821	6,393	6,393	7,130	6,393	2,657	5,790	6,393	6,393	6,393	7,139	8,453	6,393	1.E+15	2,146	7,139
	Food Retail	821	6,393	6,393	7,130	6,393	7,307	6,778	6,393	6,393	6,393	7,139	8,772	6,393	1.E+15	2,146	7,139
	Large Accomodation	821	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	2,883	7,139
	Small Accomodation	821	6,393	6,393	6,207	6,393	6,152	6,535	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	2,883	7,139
	Healthcare	821	7,488	7,488	6,207	7,488	6,152	6,800	7,488	7,488	7,488	7,139	8,490	7,488	1.E+15	2,883	7,139
	Schools	821	6,557	6,557	4,128	6,557	2,657	4,578	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	2,545	7,139
	Universities and Colleges	821	6,557	6,557	4,128	6,557	2,657	6,156	6,557	6,557	6,557	7,139	9,841	6,557	1.E+15	2,545	7,139
	Warehouse/Wholesale	821	7,488	7,488	6,207	7,488	2,657	5,387	7,488	7,488	7,488	7,139	7,801	7,488	1.E+15	2,653	7,139
	Restaurants	821	6,393	6,393	6,141	6,393	5,190	7,841	6,393	6,393	6,393	7,139	8,490	6,393	1.E+15	2,805	7,139
	Labrador Isolated C/I Buildings	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Island Isolated C/I Buildings	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Large Other Buildings	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Small Other Buildings	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Other Institutional	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Non-Buildings	821	6,557	6,557	6,207	6,557	2,657	5,771	6,557	6,557	6,557	7,139	8,453	6,557	1.E+15	2,671	7,139
	Street Lighting	3,137	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	7,139	3,137	7,139

Since the Utilities do not conduct regular class or end-use load analysis studies, there is no actual total (or sub sector) end-use load profile upon which to calibrate the load profile models developed for this study. The best option for calibrating NL-specific load profile parameters is the weather-sensitive loads, since that is the most area specific.

Since separately metered space heating end-use load data was not available from the Utilities, normal weather for the past 10 years was used to determine monthly allocations, and weekend/weekday ratios were developed from similar studies for another Canadian utility.

For peak day factors, analysis of the past 30 years' average vs. peak weather conditions (in heating degree days) for St. John's was analyzed to determine typical peak day factors for normal weather, which ranged from about 1.4 to 1.5 for winter months. For non weather-sensitive end uses, a factor of 1.0 was assumed, absent specific load study data.

B.3 Detailed Results

The following exhibits shows peak demand by region, sub sector and end use for the peak period identified for this study.

Exhibit 107 Commercial Sector Base Year (2014) Peak Hour Demand, Island Interconnected, by Sub Sector and End Use (MW)*

Sub Sector	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Office	-	4	1	2	0	0	9	7	0	1	1	0	2	4	30	-	62
Small Office	-	3	1	2	-	-	7	3	0	1	1	0	1	3	24	-	45
Large Non-food Retail	-	0	0	1	-	1	6	4	0	0	0	1	1	1	11	-	27
Small Non-food Retail	-	0	0	1	-	-	7	4	0	1	1	-	1	2	16	-	33
Food Retail	-	0	0	1	-	3	3	2	0	0	0	10	0	1	7	-	29
Large Accomodation	-	0	0	6	0	1	1	1	0	0	0	0	1	0	5	-	16
Small Accomodation	-	0	0	3	-	0	1	0	0	0	0	0	0	0	3	-	7
Healthcare	-	0	0	3	0	3	1	4	0	1	0	0	3	1	16	-	33
Schools	-	1	0	2	-	1	9	1	0	0	1	0	1	0	26	-	43
Universities and Colleges	-	2	0	0	0	1	6	5	0	1	0	0	1	0	4	-	22
Warehouse/Wholesale	-	0	0	1	-	-	4	1	0	1	0	1	1	0	8	-	16
Restaurants	-	0	0	7	-	13	0	1	0	0	0	2	1	0	4	-	28
Large Other Buildings	-	1	0	3	0	3	5	3	0	1	0	2	1	1	14	-	35
Small Other Buildings	-	1	0	3	0	3	5	3	0	1	0	2	1	1	13	-	32
Other Institutional	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non-Buildings	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	30
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5
Grand Total	**-**	**13**	**2**	**34**	**1**	**30**	**64**	**39**	**33**	**7**	**6**	**18**	**16**	**15**	**180**	**5**	**463**

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 108 Commercial Sector Base Year (2014) Peak Hour Demand, Labrador Interconnected, by Sub Sector and End Use (MW)*

Sub Sector	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Small Office	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	1
Large Non-food Retail	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	2
Small Non-food Retail	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.0	2.2	-	4
Food Retail	0.0	0.0	0.0	0.1	-	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	3
Large Accomodation	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	2
Small Accomodation	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0
Healthcare	0.1	0.1	0.0	0.7	0.0	0.4	0.1	0.5	0.0	0.1	0.1	0.0	0.4	0.0	0.8	-	3
Schools	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.8	-	3
Universities and Colleges	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	1
Warehouse/Wholesale	0.0	0.0	0.0	0.1	-	-	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	2
Restaurants	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2
Large Other Buildings	0.1	0.2	0.0	2.0	0.0	1.8	1.4	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.1	-	15
Small Other Buildings	0.1	0.2	0.0	1.0	0.0	1.0	1.1	0.6	0.0	0.2	0.1	0.4	0.4	0.1	4.3	-	10
Other Institutional	0.2	0.2	-	0.9	-	0.2	2.2	1.3	0.1	0.3	0.2	0.2	0.7	0.1	2.7	-	9
Non-Buildings	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	1
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0
Grand Total	1	1	0	7	0	5	7	4	1	1	1	2	3	0	23	0	56

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 109 Commercial Sector Base Year (2014) Peak Hour Demand, Isolated, by Sub Sector and End Use (MW)*

Sub Sector	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Labrador Isolated C/I Buildings	0.1	0.2	-	0.1	-	0.2	1.2	0.2	-	0.1	0.1	0.4	0.2	-	0.2	-	3.0
Island Isolated C/I Buildings	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.2
Street Lighting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
Grand Total	**0.1**	**0.2**	**-**	**0.1**	**-**	**0.2**	**1.3**	**0.2**	**-**	**0.1**	**0.1**	**0.4**	**0.3**	**-**	**0.2**	**0.1**	**3.3**

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Appendix C Background-Section 5: Reference Case Electricity Use

Introduction

Appendix C provides additional detailed information related to the construction of the Commercial sector Reference Case. The appendix discusses the following:

- Natural change assumptions
- Expected growth in building stock
- CEEAM archetype summaries – new buildings

C.1 Natural Change Assumptions

For the purposes of this study, “natural” changes to electricity consumption are defined as those changes to electricity usage patterns that occur without incentive or other intervention. Expected natural changes in electricity consumption patterns over the study period take into account four major factors:

- Naturally-occurring improvements in equipment efficiency
- Expected stock penetration by more efficient equipment
- Changes in equipment density, e.g., computers and plug loads, etc.
- Changes in electric share in end uses for which fuel may vary, such as space heating and water heating.

Note that the first two factors will have the effect of reducing electricity consumption, while the third and fourth factor may result in either increased or decreased electricity demand.

Based on the assessment of current trends, the most significant natural changes are expected to involve the following end uses:

- Space cooling
- Lighting
- Computer equipment and other plug loads
- Water heating
- Space heating

Further discussion of these changes follows and, in each case, the discussion identifies the technical change, the major driver(s) and the assumed electricity impact.

Space Cooling

As a result of natural conservation and efficiency gains, it is assumed that new space cooling equipment will provide improved electricity performance compared to existing equipment. Packaged rooftop units are available on the market with energy-efficiency ratios (EER) exceeding 12.0.[44] Similarly, new VFD centrifugal chillers achieve performance efficiencies in the region of 0.35 kW/ton. The combined effects of natural conservation and efficiency gains are estimated to result in a decrease of 5% in space cooling EUI over the length of the study. At the same time, the saturation of cooling equipment in new buildings will increase.

[44] See http://www.energence.com/res/pdf/52W81_energence_58937_0709.pdf for example. Current federal energy-efficiency regulations require a minimum EER of 10.3 for rooftop air conditioning units with a capacity of 5.5 - 11 tons.

As illustrated in Exhibit 110, the net effect of efficiency gains and increased space cooling saturation is expected to reduce energy consumption for space cooling in existing commercial buildings. Increases in overall space cooling energy use through time are expected to be due entirely to the construction of new building stock (Exhibit 111).

Exhibit 110 Reference Case Space Cooling Electricity Use in Existing Buildings by Sub Sector and Milestone Year – Existing Buildings (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	10,209	10,107	10,005	9,903	9,801	9,699
Small Office	7,928	7,849	7,769	7,690	7,611	7,532
Large Non-food Retail	3,224	3,192	3,160	3,128	3,095	3,063
Small Non-food Retail	4,984	4,935	4,885	4,835	4,785	4,735
Food Retail	1,610	1,594	1,577	1,561	1,545	1,529
Large Accomodation	1,210	1,198	1,186	1,174	1,162	1,150
Small Accomodation	411	407	403	399	394	390
Healthcare	2,446	2,397	2,373	2,349	2,325	2,300
Schools	279	277	274	271	268	265
Universities and Colleges	1,341	1,328	1,315	1,301	1,288	1,274
Warehouse/Wholesale	114	113	112	110	109	108
Restaurants	1,007	997	987	977	967	957
Labrador Isolated C/I Buildings	0	0	0	0	0	0
Island Isolated C/I Buildings	0	0	0	0	0	0
Large Other Buildings	2,936	2,906	2,877	2,848	2,818	2,789
Small Other Buildings	2,711	2,672	2,645	2,618	2,591	2,564
Other Institutional	219	217	214	212	210	208
Non-Buildings	0	0	0	0	0	0
Street Lighting	0	0	0	0	0	0
Grand Total	40,630	40,187	39,781	39,375	38,969	38,564

Exhibit 111 Reference Case Space Cooling Electricity Use in New Buildings by Sub Sector and Milestone Year – New Buildings (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	0	356	850	1,527	2,012	2,569
Small Office	0	213	751	1,220	1,555	1,940
Large Non-food Retail	0	101	312	497	635	791
Small Non-food Retail	0	77	323	574	768	985
Food Retail	0	26	105	181	236	299
Large Accomodation	0	28	105	177	229	289
Small Accomodation	0	6	34	64	85	110
Healthcare	0	17	99	188	254	329
Schools	0	23	91	159	211	269
Universities and Colleges	0	91	243	380	491	613
Warehouse/Wholesale	0	5	17	27	35	43
Restaurants	0	19	74	124	159	200
Labrador Isolated C/I Buildings	0	0	0	0	0	0
Island Isolated C/I Buildings	0	0	0	0	0	0
Large Other Buildings	0	80	269	442	570	716
Small Other Buildings	0	1	109	260	378	507
Other Institutional	0	2	4	6	7	9
Non-Buildings	0	0	0	0	0	0
Street Lighting	0	0	0	0	0	0
Grand Total	0	1,046	3,387	5,826	7,626	9,669

Lighting

As a result of natural conservation, it is assumed that the replacement of existing T12 fluorescent lighting and electromagnetic ballasts with new T8 fluorescent lamps and electronic ballasts and even some LED lamps and fixtures will continue. Similarly, CFLs and LED lamps will continue to increase their market share over incandescent lamps, particularly in sub sectors such as Hotel/Motel and Non-food Retail. In addition, LED fixtures designed for outdoor applications will gain market share from MH and HPS fixtures.

The continued growth of CFLs, T8 lighting/electronic ballasts, and LED lamps and fixtures is being driven by:

- Recent improvements in LED lighting efficacy combined with rapidly declining costs
- Increased consumer recognition of the operating cost savings
- Energy regulations that are gradually removing electromagnetic fluorescent ballasts and incandescent lighting products from the marketplace

Overall, the Reference Case assumes that by 2030 the energy intensity of general and secondary lighting in the existing building stock will decrease by 10%, while the energy intensity of outdoor lighting will decrease by 20%.

Exhibit 112 shows the impact of these EUI improvements on indoor lighting[45] energy consumption, while Exhibit 113 shows indoor lighting energy use by sub sector and milestone year in new construction. Exhibit 114 and Exhibit 115 show the energy consumption in existing and new construction for outdoor lighting. Again, all increases in overall lighting energy use through time are expected to be due entirely to the construction of new building stock.

Exhibit 112 Reference Case Indoor Lighting Electricity Use by Sub Sector and Milestone Year – Existing Buildings (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	69,866	68,469	67,072	65,674	64,277	62,880
Small Office	46,547	45,616	44,685	43,754	42,824	41,893
Large Non-food Retail	40,054	39,252	38,451	37,650	36,849	36,048
Small Non-food Retail	50,833	49,816	48,799	47,783	46,766	45,749
Food Retail	23,933	23,454	22,976	22,497	22,018	21,540
Large Accomodation	15,282	14,977	14,671	14,365	14,060	13,754
Small Accomodation	5,890	5,772	5,654	5,536	5,418	5,301
Healthcare	30,169	28,722	28,136	27,550	26,964	26,377
Schools	55,194	54,090	52,987	51,883	50,779	49,675
Universities and Colleges	45,256	44,351	43,446	42,541	41,636	40,731
Warehouse/Wholesale	24,656	24,163	23,670	23,177	22,684	22,191
Restaurants	10,710	10,496	10,281	10,067	9,853	9,639
Labrador Isolated C/I Buildings	8,517	8,246	8,078	7,910	7,741	7,573
Island Isolated C/I Buildings	800	771	756	740	724	708
Large Other Buildings	50,707	49,693	48,679	47,665	46,651	45,636
Small Other Buildings	44,114	43,065	42,186	41,307	40,429	39,550
Other Institutional	17,273	16,927	16,582	16,236	15,891	15,545
Grand Total	539,801	527,882	517,109	506,336	495,563	484,790

[45] Including general and secondary lighting

Exhibit 113 Reference Case Indoor Lighting Electricity Use by Sub Sector and Milestone Year – New Buildings (MWh/yr.)

Sub-Sector	2017	2020	2023	2026	2029
Large Office	1,527	3,646	6,549	8,628	11,017
Small Office	801	2,836	4,608	5,879	7,336
Large Non-food Retail	849	2,623	4,170	5,328	6,645
Small Non-food Retail	570	2,412	4,284	5,743	7,368
Food Retail	296	1,211	2,084	2,715	3,435
Large Accomodation	192	707	1,192	1,548	1,952
Small Accomodation	34	182	336	450	579
Healthcare	137	797	1,516	2,048	2,647
Schools	730	2,857	4,993	6,608	8,429
Universities and Colleges	426	1,140	1,784	2,307	2,880
Warehouse/Wholesale	436	1,414	2,274	2,919	3,649
Restaurants	122	475	795	1,024	1,286
Labrador Isolated C/I Buildings	0	1,144	1,510	1,859	2,209
Island Isolated C/I Buildings	0	125	160	195	230
Large Other Buildings	615	2,044	3,351	4,324	5,424
Small Other Buildings	13	922	2,135	3,095	4,140
Other Institutional	116	233	351	469	589
Grand Total	6,863	24,767	42,091	55,138	69,816

Exhibit 114 Reference Case Outdoor Lighting Electricity Use by Sub Sector and Milestone Year – Existing Buildings (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	4,524	4,343	4,162	3,981	3,800	3,619
Small Office	3,756	3,606	3,455	3,305	3,155	3,005
Large Non-food Retail	3,583	3,440	3,296	3,153	3,010	2,866
Small Non-food Retail	5,305	5,093	4,881	4,669	4,456	4,244
Food Retail	2,612	2,507	2,403	2,298	2,194	2,089
Large Accomodation	1,172	1,125	1,079	1,032	985	938
Small Accomodation	523	502	481	460	439	418
Healthcare	4,036	3,764	3,608	3,451	3,294	3,137
Schools	6,281	6,030	5,779	5,528	5,276	5,025
Universities and Colleges	3,289	3,157	3,026	2,894	2,763	2,631
Warehouse/Wholesale	2,385	2,289	2,194	2,098	2,003	1,908
Restaurants	474	455	436	417	398	379
Labrador Isolated C/I Buildings	739	701	671	642	613	584
Island Isolated C/I Buildings	69	66	63	60	57	55
Large Other Buildings	4,741	4,551	4,362	4,172	3,982	3,793
Small Other Buildings	4,365	4,174	4,000	3,827	3,653	3,479
Other Institutional	1,406	1,350	1,294	1,237	1,181	1,125
Grand Total	49,260	47,154	45,189	43,224	41,260	39,295

Exhibit 115 Reference Case Outdoor Lighting Electricity Use by Sub Sector and Milestone Year – New Buildings (MWh/yr.)

Sub-Sector	2017	2020	2023	2026	2029
Large Office	126	300	539	710	907
Small Office	79	280	456	581	725
Large Non-food Retail	101	311	495	633	789
Small Non-food Retail	68	289	513	688	882
Food Retail	54	219	378	492	623
Large Accomodation	21	78	132	172	217
Small Accomodation	5	26	48	65	83
Healthcare	22	129	246	332	429
Schools	96	377	658	871	1,111
Universities and Colleges	37	99	155	201	251
Warehouse/Wholesale	50	161	259	333	416
Restaurants	8	30	50	65	81
Labrador Isolated C/I Buildings	0	142	188	231	274
Island Isolated C/I Buildings	0	16	20	24	29
Large Other Buildings	71	236	388	500	627
Small Other Buildings	2	114	262	380	508
Other Institutional	12	25	37	50	62
Grand Total	752	2,834	4,825	6,327	8,016

Computer Equipment, Computer Servers and Other Plug Loads

Computer equipment and other plug loads will continue to grow as a result of increased density of computers and peripherals per occupant, increased use of server load, and growth in other peripherals, such as telephone network equipment. Increased penetration of laptops, more efficient server hardware and higher penetration of ENERGY STAR® rated computer equipment and other plug loads is expected to counterbalance the effect of increasing hardware density to some degree.

Overall, the Reference Case assumes that by 2030 the energy intensity of computer equipment and plug loads in the existing building stock will increase by 10%. The impact on electricity use in existing buildings and new buildings is shown in Exhibit 116 and Exhibit 117, below.

Exhibit 116 Computer and Plug Load Energy Use in by Sub Sector and Milestone Year –Existing Buildings (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	36,032	36,752	37,473	38,194	38,914	39,635
Small Office	29,916	30,514	31,112	31,711	32,309	32,907
Large Non-food Retail	5,119	5,222	5,324	5,426	5,529	5,631
Small Non-food Retail	7,580	7,731	7,883	8,035	8,186	8,338
Food Retail	5,152	5,255	5,358	5,461	5,564	5,667
Large Accomodation	2,769	2,824	2,880	2,935	2,990	3,046
Small Accomodation	1,240	1,264	1,289	1,314	1,339	1,364
Healthcare	13,131	13,012	13,267	13,522	13,777	14,032
Schools	10,708	10,922	11,136	11,350	11,564	11,778
Universities and Colleges	15,622	15,935	16,247	16,559	16,872	17,184
Warehouse/Wholesale	7,009	7,149	7,289	7,429	7,569	7,709
Restaurants	1,169	1,193	1,216	1,239	1,263	1,286
Labrador Isolated C/I Buildings	1,728	1,741	1,775	1,809	1,843	1,878
Island Isolated C/I Buildings	162	163	166	169	172	176
Large Other Buildings	15,065	15,366	15,668	15,969	16,270	16,572
Small Other Buildings	13,485	13,700	13,969	14,238	14,506	14,775
Other Institutional	3,287	3,353	3,418	3,484	3,550	3,616
Grand Total	169,173	172,096	175,470	178,845	182,219	185,593

Exhibit 117 Computer and Plug Load Energy Use in by Sub Sector and Milestone Year – New Buildings (MWh/yr.)

Sub-Sector	2017	2020	2023	2026	2029
Large Office	1,002	2,392	4,295	5,659	7,226
Small Office	631	2,234	3,630	4,631	5,779
Large Non-food Retail	144	445	708	904	1,128
Small Non-food Retail	98	413	733	983	1,261
Food Retail	71	290	499	650	822
Large Accomodation	49	180	304	394	497
Small Accomodation	11	60	111	149	191
Healthcare	71	410	779	1,052	1,360
Schools	164	642	1,122	1,485	1,894
Universities and Colleges	176	471	737	953	1,190
Warehouse/Wholesale	146	473	761	977	1,222
Restaurants	19	74	123	159	199
Labrador Isolated C/I Buildings	0	292	386	475	564
Island Isolated C/I Buildings	0	32	41	50	59
Large Other Buildings	230	770	1,263	1,629	2,044
Small Other Buildings	4	331	774	1,122	1,502
Other Institutional	26	53	79	106	133
Grand Total	2,841	9,561	16,344	21,378	27,070

Water Heating

Electricity consumption for water heating is expected to stay constant within the existing building stock. However, it will grow within the new building stock, as electric water heating fuel shares are expected to be higher in new buildings than in existing ones. This is largely driven by an expected increase in electric space heating in the new building stock (see below), and the fact that buildings rarely maintain oil or propane service for water heating alone.

Exhibit 118 illustrates the increased difference in electric water heating penetration between existing and new buildings. This leads to a growth in electricity use for water heating, which will outpace growth in floor area.

Exhibit 118 Electric DHW Share by Sub Sector – Existing and New Buildings (%)

Sub Sector	Island - Existing Buildings	Island - New Buildings	Labrador - Existing Buildings	Labrador - New Buildings
Large Office	90%	100%	100%	100%
Small Office	95%	100%	100%	100%
Large Non-Food Retail	90%	100%	100%	100%
Small Non-Food Retail	95%	100%	100%	100%
Food Retail	90%	100%	100%	100%
Large Accomodation	90%	100%	100%	100%
Small Accomodation	90%	100%	100%	100%
Healthcare	60%	100%	100%	100%
Schools	80%	100%	100%	100%
Universities and Colleges	25%	100%	100%	100%
Warehouse / Wholesale	80%	100%	100%	100%
Restaurant	95%	100%	100%	100%

It should be noted that the electric fuel share and space cooling saturation was not estimated for all sub sectors. Rather, the end use EUIs for the other sub sectors was derived based on a weighted average of the EUIs for specific sub sectors. Section 5.3 includes more details on how this approach was implemented.

Space Heating

In recent years, electric space heating penetrations in new commercial construction have exceeded the historical average, a trend that is presently expected to continue. Similar to the discussion of water heating energy above, electricity consumption for space heating is expected to stay constant within the existing building stock, but to grow rapidly within the new building stock. The penetration of high performance, electrically powered heating equipment is expected to remain low over the study period.

Exhibit 119 illustrates the increased difference in electric space heating penetration between existing and new buildings. This leads to a growth in electricity use for space heating, which will outpace growth in floor area.

Exhibit 119 Electric Space Heating Share by Sub Sector – Existing and New Buildings (%)

Sub Sector	Island - Existing Buildings	Island - New Buildings	Labrador - Existing Buildings	Labrador - New Buildings
Large Office	85%	100%	100%	100%
Small Office	90%	100%	100%	100%
Large Non-Food Retail	85%	100%	100%	100%
Small Non-Food Retail	85%	100%	100%	100%
Food Retail	85%	100%	100%	100%
Large Accomodation	90%	100%	100%	100%
Small Accomodation	90%	100%	100%	100%
Healthcare	50%	100%	100%	100%
Schools	75%	100%	100%	100%
Universities and Colleges	20%	100%	90%	100%
Warehouse / Wholesale	75%	100%	80%	100%
Restaurant	90%	100%	100%	100%

It should be noted that the electric fuel share and space cooling saturation was not estimated for all sub sectors. Rather, the end use EUIs for the other sub sectors was derived based on a weighted average of the EUIs for specific sub sectors. Section 5.3 includes more details on how this approach was implemented.

Overall Impact of Natural Changes

As illustrated in Exhibit 120, the overall impact of the natural changes in energy usage patterns described above are very minimal, as load growth is anticipated by the Utilities in each milestone year. Virtually all growth in electricity use through the study period occurs within the new building stock.

Exhibit 120 Total Energy Use by Sub Sector and Milestone Year – Existing Sub sectors (MWh/yr.)

Sub-Sector	2014	2017	2020	2023	2026	2029
Large Office	273,262	272,302	271,343	270,383	269,423	268,463
Small Office	193,065	192,503	191,941	191,379	190,816	190,254
Large Non-food Retail	123,515	122,641	121,767	120,892	120,018	119,144
Small Non-food Retail	148,847	147,719	146,592	145,465	144,338	143,211
Food Retail	173,352	172,856	172,360	171,864	171,368	170,871
Large Accomodation	69,655	69,346	69,036	68,727	68,418	68,109
Small Accomodation	28,191	28,073	27,955	27,837	27,719	27,601
Healthcare	161,941	157,667	157,155	156,643	156,131	155,619
Schools	174,289	173,145	172,001	170,857	169,714	168,570
Universities and Colleges	124,745	124,007	123,270	122,532	121,794	121,057
Warehouse/Wholesale	79,216	78,766	78,317	77,867	77,418	76,968
Restaurants	105,467	105,248	105,028	104,808	104,588	104,368
Labrador Isolated C/I Buildings	17,062	16,693	16,530	16,366	16,203	16,040
Island Isolated C/I Buildings	1,505	1,466	1,451	1,435	1,420	1,405
Large Other Buildings	217,045	216,113	215,181	214,249	213,318	212,386
Small Other Buildings	182,923	181,429	180,617	179,806	178,995	178,184
Other Institutional	45,979	69,261	85,623	85,285	84,947	84,608
Non-Buildings	204,856	207,490	214,805	221,041	225,350	230,330
Street Lighting	37,127	36,851	36,931	36,999	37,043	37,086
Grand Total	2,362,042	2,373,575	2,387,902	2,384,436	2,379,020	2,374,274

C.2 Expected Growth in Building Stock

The next step in developing the Reference Case involved the development and application of estimated levels of floor space growth in each building sub sector over the study period. The stock growth rates were derived from the sales forecast data provided by the Utilities. The derivation of floor space data in each of the milestone periods applied the following steps:

- As described above for the existing building stock, estimate and apply the expected impact of natural changes within the new building stock over the study period. Efficiency improvements are expected to be more moderate within the new building stock through time. Computer and other plug load growth are expected to be consistent in both existing and new buildings.
- Add floor space at a rate consistent with the utility forecast of electricity consumption growth for each combination of sub sector and milestone year.

A summary of the total new commercial floor space at each milestone period is provided in Exhibit C11.

Exhibit 121 New Commercial Building Floor Space, by Sub Sector and Milestone Year (ft2)

Sub-Sector	2017	2020	2023	2026	2029
Large Office	287,000	686,000	1,231,000	1,622,000	2,071,000
Small Office	181,000	640,000	1,040,000	1,328,000	1,656,000
Large Non-food Retail	115,000	356,000	565,000	722,000	901,000
Small Non-food Retail	78,000	330,000	586,000	785,000	1,007,000
Food Retail	41,000	169,000	291,000	379,000	479,000
Large Accomodation	49,000	179,000	302,000	392,000	495,000
Small Accomodation	11,000	60,000	110,000	148,000	190,000
Healthcare	25,000	144,000	273,000	369,000	477,000
Schools	220,000	860,000	1,503,000	1,989,000	2,537,000
Universities and Colleges	85,000	226,000	354,000	458,000	572,000
Warehouse/Wholesale	113,000	368,000	591,000	759,000	949,000
Restaurants	18,000	68,000	114,000	147,000	185,000
Labrador Isolated C/I Buildings	0	354,000	467,000	575,000	683,000
Island Isolated C/I Buildings	0	39,000	49,000	60,000	71,000
Large Other Buildings	127,000	422,000	693,000	894,000	1,121,000
Small Other Buildings	3,000	190,000	443,000	642,000	859,000
Other Institutional	23,000	45,000	68,000	91,000	115,000
Grand Total	1,374,000	5,136,000	8,682,000	11,361,000	14,370,000

C.3 Results by Region

This section of the appendix presents the reference case electricity consumption for the three regions.

Exhibit 122 - Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Island Interconnected (MWh/yr.)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Office	2014	0	24,326	4,319	5,999	1,033	1,067	53,893	46,186	2,666	7,386	4,524	1,067	15,973	10,209	94,614	0	273,262
	2017	0	25,489	4,526	6,179	1,062	1,096	54,127	47,938	2,740	7,739	4,469	1,096	15,870	10,463	96,854	0	279,648
	2020	0	26,914	4,779	6,427	1,101	1,137	54,868	50,370	2,843	8,172	4,462	1,137	15,850	10,855	99,960	0	288,877
	2023	0	28,686	5,093	6,768	1,156	1,194	56,281	53,700	2,984	8,710	4,520	1,194	15,942	11,430	104,216	0	301,873
	2026	0	30,093	5,343	7,013	1,195	1,234	56,989	56,085	3,085	9,137	4,510	1,234	15,916	11,813	107,265	0	310,912
	2029	0	31,637	5,617	7,293	1,240	1,280	57,962	58,826	3,201	9,606	4,526	1,280	15,935	12,268	110,768	0	321,441
Small Office	2014	0	19,802	3,516	5,155	0	0	39,734	19,864	2,170	6,012	3,682	868	5,902	7,866	74,726	0	189,299
	2017	0	20,624	3,662	5,268	0	0	39,687	20,687	2,217	6,262	3,614	868	5,837	8,000	76,011	0	192,738
	2020	0	22,091	3,922	5,552	0	0	40,774	22,759	2,335	6,708	3,666	868	5,852	8,457	79,243	0	202,226
	2023	0	23,420	4,158	5,799	0	0	41,617	24,563	2,437	7,111	3,692	868	5,850	8,844	82,057	0	210,419
	2026	0	24,483	4,347	5,976	0	0	41,994	25,852	2,510	7,434	3,669	868	5,815	9,099	84,069	0	216,118
	2029	0	25,645	4,553	6,179	0	0	42,544	27,333	2,594	7,787	3,664	868	5,792	9,403	86,379	0	222,741
Large Non-food Retail	2014	0	1,886	435	1,685	0	3,817	33,975	27,191	985	2,456	3,344	5,725	3,596	3,168	27,391	0	115,655
	2017	0	1,980	457	1,740	0	3,930	34,073	27,841	1,015	2,578	3,309	5,895	3,579	3,236	27,913	0	117,546
	2020	0	2,135	493	1,858	0	4,169	35,037	29,214	1,076	2,780	3,384	6,253	3,621	3,415	29,015	0	122,450
	2023	0	2,276	525	1,959	0	4,377	35,788	30,409	1,130	2,963	3,433	6,565	3,649	3,566	29,974	0	126,614
	2026	0	2,390	552	2,036	0	4,532	36,175	31,301	1,170	3,112	3,435	6,797	3,651	3,671	30,690	0	129,511
	2029	0	2,515	581	2,122	0	4,708	36,712	32,317	1,215	3,275	3,456	7,062	3,664	3,795	31,505	0	132,927
Small Non-food Retail	2014	0	2,733	631	2,577	0	0	41,215	28,604	1,428	3,559	4,845	0	4,845	4,863	39,263	0	134,563
	2017	0	2,825	652	2,614	0	0	40,907	28,989	1,447	3,678	4,717	0	4,783	4,890	39,807	0	135,310
	2020	0	2,996	691	2,729	0	0	41,689	30,189	1,508	3,900	4,729	0	4,794	5,077	41,499	0	139,801
	2023	0	3,169	732	2,847	0	0	42,512	31,420	1,570	4,127	4,746	0	4,808	5,270	43,236	0	144,436
	2026	0	3,315	765	2,938	0	0	42,950	32,363	1,618	4,316	4,714	0	4,796	5,406	44,566	0	147,748
	2029	0	3,472	801	3,040	0	0	43,544	33,423	1,671	4,521	4,702	0	4,794	5,565	46,061	0	151,595
Food Retail	2014	0	2,199	322	3,279	0	8,744	19,666	11,213	729	2,369	2,473	87,439	3,103	1,584	18,821	0	161,939
	2017	0	2,274	333	3,332	0	8,871	19,534	11,373	739	2,451	2,427	88,630	3,074	1,594	19,013	0	163,644
	2020	0	2,415	354	3,495	0	9,262	19,944	11,866	772	2,604	2,492	92,300	3,115	1,657	19,604	0	169,881
	2023	0	2,551	374	3,651	0	9,637	20,320	12,337	803	2,753	2,551	95,809	3,152	1,717	20,169	0	175,824
	2026	0	2,661	390	3,763	0	9,906	20,480	12,677	826	2,873	2,565	98,337	3,161	1,756	20,577	0	179,972
	2029	0	2,781	408	3,892	0	10,214	20,719	13,064	851	3,004	2,595	101,222	3,180	1,802	21,041	0	184,773

Exhibit 122 - Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Island Interconnected (MWh/yr.) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Accomodation	2014	0	1,104	232	14,755	244	3,090	6,841	5,480	631	1,205	1,070	1,892	7,169	1,153	17,745	0	62,610
	2017	0	1,146	241	15,076	249	3,120	6,787	5,582	643	1,253	1,048	1,910	7,131	1,170	18,081	0	63,437
	2020	0	1,222	258	15,946	262	3,202	6,876	5,858	676	1,341	1,062	1,960	7,275	1,234	18,994	0	66,167
	2023	0	1,295	275	16,766	274	3,279	6,951	6,118	708	1,426	1,073	2,008	7,402	1,294	19,853	0	68,720
	2026	0	1,354	288	17,364	283	3,336	6,969	6,308	731	1,494	1,069	2,042	7,456	1,335	20,481	0	70,508
	2029	0	1,418	302	18,046	293	3,400	7,009	6,524	757	1,568	1,071	2,082	7,538	1,383	21,196	0	72,586
Small Accomodation	2014	0	525	110	7,022	0	750	3,690	1,397	300	574	509	450	2,047	402	9,485	0	27,262
	2017	0	541	114	7,097	0	757	3,633	1,412	303	591	494	454	2,023	405	9,570	0	27,393
	2020	0	571	120	7,417	0	788	3,633	1,475	315	626	494	473	2,054	428	9,932	0	28,326
	2023	0	602	127	7,752	0	820	3,636	1,541	328	662	496	492	2,088	453	10,313	0	29,310
	2026	0	628	133	7,998	0	844	3,619	1,590	338	691	491	506	2,102	470	10,593	0	30,004
	2029	0	656	139	8,278	0	871	3,609	1,645	348	723	489	523	2,124	491	10,910	0	30,805
Healthcare	2014	0	3,645	844	8,124	807	8,332	4,604	27,075	1,042	7,008	3,534	1,562	21,812	2,338	54,806	0	145,533
	2017	0	3,741	866	8,207	812	8,383	4,544	27,256	1,048	7,192	3,415	1,572	21,480	2,332	55,087	0	145,934
	2020	0	3,919	907	8,598	835	8,624	4,605	28,107	1,078	7,534	3,379	1,617	21,536	2,389	56,406	0	149,535
	2023	0	4,107	950	9,026	861	8,887	4,681	29,036	1,111	7,896	3,352	1,666	21,638	2,454	57,848	0	153,511
	2026	0	4,264	987	9,340	879	9,080	4,712	29,719	1,135	8,199	3,295	1,703	21,597	2,495	58,908	0	156,313
	2029	0	4,433	1,026	9,694	900	9,299	4,759	30,490	1,162	8,522	3,249	1,744	21,607	2,545	60,104	0	159,534
Schools	2014	0	7,376	1,293	5,337	0	1,404	42,801	8,422	1,053	1,486	5,957	1,053	9,582	267	76,730	0	162,762
	2017	0	7,640	1,339	5,443	0	1,427	42,544	8,597	1,070	1,540	5,813	1,070	9,509	287	78,070	0	164,350
	2020	0	8,131	1,425	5,753	0	1,492	43,437	9,108	1,119	1,639	5,852	1,119	9,666	352	81,980	0	171,072
	2023	0	8,622	1,511	6,064	0	1,558	44,340	9,622	1,168	1,738	5,892	1,168	9,825	417	85,912	0	177,836
	2026	0	9,029	1,583	6,299	0	1,607	44,809	10,009	1,205	1,820	5,863	1,205	9,897	465	88,874	0	182,665
	2029	0	9,470	1,660	6,564	0	1,663	45,449	10,446	1,247	1,909	5,861	1,247	10,004	520	92,219	0	188,258
Warehouse/Wholesale	2014	0	1,742	579	1,958	0	0	19,171	4,292	1,310	4,212	2,223	7,861	3,812	108	24,251	0	71,518
	2017	0	1,816	603	2,016	0	0	19,199	4,363	1,339	4,389	2,183	8,034	3,756	112	24,817	0	72,627
	2020	0	1,936	643	2,144	0	0	19,727	4,521	1,403	4,679	2,203	8,419	3,724	122	26,071	0	75,593
	2023	0	2,046	680	2,257	0	0	20,144	4,660	1,460	4,945	2,210	8,757	3,688	131	27,172	0	78,147
	2026	0	2,136	710	2,341	0	0	20,357	4,763	1,501	5,164	2,192	9,009	3,641	137	27,993	0	79,943
	2029	0	2,234	742	2,436	0	0	20,651	4,880	1,549	5,401	2,184	9,295	3,598	145	28,925	0	82,041
Restaurants	2014	0	410	113	18,743	0	33,431	2,352	3,434	256	545	435	16,672	7,540	989	11,925	0	96,846
	2017	0	426	118	19,090	0	34,019	2,345	3,484	261	565	425	16,965	7,471	998	12,259	0	98,426
	2020	0	455	126	20,077	0	35,690	2,411	3,627	274	603	430	17,799	7,552	1,042	13,210	0	103,295
	2023	0	481	133	20,971	0	37,205	2,466	3,757	285	639	432	18,554	7,612	1,081	14,072	0	107,689
	2026	0	503	139	21,605	0	38,280	2,492	3,850	294	667	429	19,090	7,610	1,106	14,684	0	110,749
	2029	0	526	145	22,334	0	39,514	2,529	3,956	303	698	427	19,705	7,630	1,136	15,386	0	114,290

Exhibit 122 - Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Island Interconnected (MWh/yr.) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Other Buildings	2014	0	6,633	1,116	7,707	356	7,918	28,123	21,288	1,335	3,972	3,382	16,038	9,791	2,667	42,605	0	152,930
	2017	0	6,888	1,159	7,884	363	8,062	28,012	21,697	1,360	4,125	3,312	16,320	9,715	2,717	43,401	0	155,014
	2020	0	7,318	1,231	8,314	379	8,409	28,545	22,688	1,420	4,383	3,336	17,005	9,809	2,877	45,329	0	161,045
	2023	0	7,722	1,299	8,706	394	8,726	28,982	23,593	1,475	4,625	3,346	17,630	9,878	3,020	47,088	0	166,485
	2026	0	8,055	1,355	8,994	404	8,959	29,154	24,258	1,515	4,824	3,318	18,089	9,877	3,119	48,380	0	170,301
	2029	0	8,414	1,416	9,322	416	9,224	29,426	25,014	1,561	5,040	3,304	18,612	9,903	3,234	49,851	0	174,736
Small Other Buildings	2014	0	6,124	1,028	6,768	196	7,039	26,977	17,711	1,293	3,876	3,410	15,178	8,068	2,502	40,739	0	140,908
	2017	0	6,216	1,044	6,736	195	7,005	26,309	17,625	1,286	3,934	3,258	15,105	7,868	2,465	40,541	0	139,586
	2020	0	6,480	1,088	6,932	200	7,168	26,329	18,073	1,316	4,101	3,205	15,438	7,834	2,532	41,519	0	142,214
	2023	0	6,812	1,144	7,224	206	7,411	26,622	18,740	1,361	4,312	3,192	15,934	7,861	2,644	42,975	0	146,438
	2026	0	7,094	1,191	7,444	211	7,595	26,712	19,245	1,395	4,490	3,150	16,309	7,842	2,723	44,075	0	149,476
	2029	0	7,393	1,241	7,690	217	7,799	26,874	19,807	1,432	4,680	3,118	16,726	7,839	2,814	45,300	0	152,930
Other Institutional	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Buildings	2014	0	0	0	0	0	0	0	0	199,788	0	0	0	0	0	0	0	199,788
	2017	0	0	0	0	0	0	0	0	202,428	0	0	0	0	0	0	0	202,428
	2020	0	0	0	0	0	0	0	0	209,684	0	0	0	0	0	0	0	209,684
	2023	0	0	0	0	0	0	0	0	215,870	0	0	0	0	0	0	0	215,870
	2026	0	0	0	0	0	0	0	0	220,132	0	0	0	0	0	0	0	220,132
	2029	0	0	0	0	0	0	0	0	225,065	0	0	0	0	0	0	0	225,065
Street Lighting	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,828	34,828
	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,448	34,448
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,448	34,448
	2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,448	34,448
	2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,448	34,448
	2029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,448	34,448
Grand Total	2014	0	88,376	15,241	90,302	3,375	78,454	362,591	257,551	216,895	49,463	42,624	159,621	108,235	39,433	544,430	34,828	2,091,418
	2017	0	91,785	15,837	91,928	3,428	79,565	360,841	262,546	219,826	51,251	41,629	161,780	107,035	40,062	553,168	34,448	2,115,128
	2020	0	97,147	16,790	96,580	3,539	82,892	366,864	274,072	227,786	54,213	41,771	168,321	107,594	41,969	575,210	34,448	2,189,196
	2023	0	102,723	17,780	101,210	3,665	86,092	373,116	286,179	234,689	57,226	41,937	174,644	108,266	43,977	597,963	34,448	2,263,916
	2026	0	107,274	18,585	104,598	3,758	88,412	375,865	295,079	239,480	59,706	41,619	179,242	108,190	45,348	614,744	34,448	2,316,347
	2029	0	112,213	19,459	108,450	3,863	91,054	379,961	305,198	245,013	62,388	41,485	184,476	108,393	46,961	633,796	34,448	2,377,160

Exhibit 123 Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Labrador Interconnected (MWh/yr)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Small Office	2014	22	395	70	108	0	0	793	189	22	120	74	0	118	62	1,793	0	3,766
	2017	22	403	72	108	0	0	777	190	22	122	71	0	115	61	1,794	0	3,757
	2020	22	422	75	111	0	0	781	195	22	128	70	0	114	64	1,867	0	3,871
	2023	23	439	78	114	0	0	781	199	23	133	68	0	113	65	1,931	0	3,968
	2026	23	456	81	116	0	0	781	203	23	139	67	0	112	67	1,992	0	4,062
	2029	24	473	84	119	0	0	781	207	24	144	66	0	111	69	2,053	0	4,154
Large Non-food Retail	2014	35	135	31	134	0	273	2,234	1,154	35	176	239	410	248	56	2,699	0	7,860
	2017	36	139	32	135	0	275	2,205	1,165	36	181	231	413	245	57	2,716	0	7,863
	2020	36	142	33	136	0	277	2,175	1,176	36	185	224	416	241	57	2,733	0	7,867
	2023	36	146	34	137	0	279	2,146	1,187	36	190	216	419	237	58	2,751	0	7,870
	2026	36	150	35	138	0	281	2,117	1,198	36	195	208	421	233	59	2,768	0	7,875
	2029	37	153	35	139	0	283	2,088	1,209	37	200	200	424	229	59	2,786	0	7,879
Small Non-food Retail	2014	68	260	60	258	0	0	4,295	1,163	68	338	460	0	478	121	6,716	0	14,283
	2017	68	266	61	259	0	0	4,227	1,174	68	346	444	0	469	121	6,743	0	14,247
	2020	70	280	65	267	0	0	4,261	1,242	70	364	441	0	468	131	6,923	0	14,581
	2023	72	292	67	275	0	0	4,281	1,303	72	381	435	0	466	139	7,082	0	14,865
	2026	74	305	70	282	0	0	4,299	1,362	74	397	430	0	464	147	7,239	0	15,144
	2029	76	317	73	289	0	0	4,318	1,422	76	413	425	0	461	155	7,395	0	15,422
Food Retail	2014	21	124	5	205	0	493	1,031	309	21	133	139	4,105	133	25	4,669	0	11,414
	2017	21	127	5	206	0	493	1,012	310	21	136	134	4,112	131	25	4,671	0	11,403
	2020	21	130	5	207	0	497	997	316	21	140	130	4,142	129	25	4,680	0	11,441
	2023	21	133	6	208	0	500	982	321	21	144	126	4,168	127	26	4,688	0	11,472
	2026	21	136	6	210	0	503	967	327	21	147	121	4,194	125	26	4,696	0	11,501
	2029	21	140	6	211	0	506	952	332	21	151	117	4,220	123	26	4,704	0	11,530
Large Accomodation	2014	30	90	22	1,572	0	302	585	466	30	116	103	181	687	57	2,803	0	7,044
	2017	30	92	23	1,578	0	303	575	469	30	118	99	182	675	57	2,812	0	7,044
	2020	30	94	23	1,584	0	305	564	472	30	121	95	182	663	57	2,822	0	7,043
	2023	31	96	24	1,589	0	306	554	476	31	124	91	183	651	57	2,831	0	7,042
	2026	31	98	24	1,595	0	307	543	479	31	127	88	183	639	56	2,841	0	7,041
	2029	31	100	25	1,601	0	308	533	482	31	129	84	184	627	56	2,850	0	7,041
Small Accomodation	2014	4	12	3	208	0	20	98	38	4	15	14	12	55	9	438	0	929
	2017	4	12	3	208	0	20	96	38	4	16	13	12	53	8	438	0	927
	2020	4	13	3	214	0	21	96	40	4	16	13	12	53	9	452	0	950
	2023	4	13	3	219	0	21	95	41	4	17	13	13	53	9	464	0	969
	2026	4	14	3	224	0	22	94	41	4	18	12	13	53	9	476	0	988
	2029	4	14	4	229	0	22	93	42	4	18	12	13	53	9	488	0	1,007

Exhibit 123 Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Labrador Interconnected (MWh/yr) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Healthcare	2014	222	518	120	1,924	57	1,184	654	3,671	74	996	502	222	3,099	108	3,057	0	16,408
	2017	171	407	94	1,483	44	913	494	2,829	57	783	372	171	2,341	83	2,356	0	12,598
	2020	171	417	97	1,491	44	917	487	2,851	57	802	358	172	2,305	83	2,368	0	12,621
	2023	172	427	99	1,498	45	922	480	2,872	58	822	345	173	2,268	83	2,379	0	12,642
	2026	172	437	101	1,506	45	927	472	2,893	58	841	331	174	2,231	84	2,391	0	12,662
	2029	172	447	104	1,513	45	931	465	2,914	58	860	318	175	2,194	84	2,403	0	12,683
Schools	2014	29	402	70	363	0	76	2,331	933	29	81	324	21	481	12	6,374	0	11,527
	2017	29	411	72	365	0	77	2,293	937	29	83	313	21	474	12	6,402	0	11,518
	2020	29	424	74	369	0	78	2,270	945	29	85	304	22	470	13	6,471	0	11,583
	2023	29	436	76	373	0	79	2,245	953	29	88	294	23	465	14	6,534	0	11,639
	2026	30	449	79	377	0	79	2,220	961	30	90	285	23	461	14	6,597	0	11,693
	2029	30	461	81	381	0	80	2,195	969	30	93	275	24	456	15	6,659	0	11,748
Universities and Colleges	2014	15	157	11	76	0	46	631	372	15	77	52	61	80	25	1,410	0	3,028
	2017	15	161	11	76	0	46	620	373	15	78	50	61	78	25	1,416	0	3,028
	2020	15	165	12	77	0	46	610	374	15	80	48	61	77	26	1,421	0	3,027
	2023	15	169	12	77	0	46	599	376	15	82	46	62	76	26	1,426	0	3,027
	2026	15	173	12	77	0	46	589	377	15	84	44	62	74	26	1,432	0	3,027
	2029	16	176	13	78	0	47	578	378	16	86	42	62	73	26	1,437	0	3,027
Warehouse/Wholesale	2014	48	127	42	178	0	0	1,396	461	48	307	162	572	278	6	4,074	0	7,698
	2017	48	130	43	179	0	0	1,372	462	48	314	156	574	272	6	4,082	0	7,685
	2020	49	134	45	182	0	0	1,365	467	49	325	152	584	268	6	4,131	0	7,756
	2023	49	139	46	185	0	0	1,356	472	49	336	148	592	263	6	4,175	0	7,816
	2026	50	143	48	188	0	0	1,347	476	50	346	144	600	258	7	4,218	0	7,874
	2029	51	148	49	190	0	0	1,337	481	51	357	140	609	254	7	4,260	0	7,932
Restaurants	2014	12	37	10	1,776	0	3,071	212	140	12	54	39	1,501	606	18	1,136	0	8,622
	2017	12	38	10	1,777	0	3,073	208	140	12	55	38	1,502	594	18	1,137	0	8,612
	2020	12	39	11	1,801	0	3,114	206	141	12	57	37	1,522	587	19	1,150	0	8,707
	2023	12	40	11	1,822	0	3,150	204	143	12	58	35	1,539	580	19	1,161	0	8,787
	2026	12	41	11	1,842	0	3,184	202	144	12	60	34	1,556	573	20	1,172	0	8,865
	2029	12	42	12	1,862	0	3,219	200	145	12	62	33	1,573	565	20	1,183	0	8,941
Large Other Buildings	2014	358	1,384	272	5,426	50	4,743	7,904	6,537	229	1,689	1,359	6,162	4,889	269	22,842	0	64,115
	2017	359	1,418	279	5,447	50	4,762	7,774	6,572	230	1,729	1,311	6,186	4,807	269	22,912	0	64,104
	2020	360	1,451	285	5,469	50	4,780	7,644	6,606	231	1,770	1,262	6,210	4,724	269	22,982	0	64,094
	2023	361	1,484	292	5,490	51	4,799	7,513	6,641	232	1,810	1,213	6,234	4,642	270	23,053	0	64,084
	2026	362	1,517	298	5,512	51	4,818	7,383	6,676	233	1,850	1,164	6,259	4,560	270	23,123	0	64,076
	2029	363	1,550	305	5,533	51	4,837	7,253	6,711	234	1,891	1,116	6,283	4,478	270	23,194	0	64,068

Exhibit 123 Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Labrador Interconnected (MWh/yr) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Small Other Buildings	2014	238	1,099	212	2,757	31	2,645	6,188	3,936	157	1,147	955	3,513	2,881	209	16,047	0	42,015
	2017	238	1,123	217	2,761	31	2,649	6,074	3,945	158	1,172	919	3,519	2,828	208	16,070	0	41,910
	2020	242	1,177	227	2,842	32	2,726	6,108	4,102	162	1,228	909	3,622	2,837	222	16,450	0	42,889
	2023	246	1,226	237	2,912	33	2,793	6,122	4,239	166	1,280	897	3,711	2,838	234	16,781	0	43,715
	2026	250	1,275	247	2,980	34	2,859	6,132	4,372	170	1,331	883	3,798	2,837	246	17,104	0	44,518
	2029	254	1,324	256	3,048	34	2,923	6,141	4,504	174	1,382	869	3,885	2,836	258	17,424	0	45,313
Other Institutional	2014	412	1,212	0	2,407	0	537	12,713	8,247	412	2,075	1,406	1,763	4,559	219	10,017	0	45,979
	2017	415	1,246	0	2,423	0	542	12,550	8,319	415	2,133	1,362	1,775	4,494	218	33,698	0	69,591
	2020	418	1,280	0	2,438	0	547	12,387	8,392	418	2,191	1,318	1,788	4,428	218	50,460	0	86,285
	2023	421	1,314	0	2,454	0	552	12,225	8,466	421	2,250	1,274	1,801	4,362	218	50,522	0	86,281
	2026	425	1,348	0	2,470	0	558	12,063	8,540	425	2,308	1,231	1,814	4,297	217	50,585	0	86,280
	2029	428	1,382	0	2,486	0	563	11,902	8,615	428	2,366	1,187	1,827	4,232	217	50,648	0	86,282
Non-Buildings	2014	0	0	0	0	0	0	0	0	5,068	0	0	0	0	0	0	0	5,068
	2017	0	0	0	0	0	0	0	0	5,063	0	0	0	0	0	0	0	5,063
	2020	0	0	0	0	0	0	0	0	5,121	0	0	0	0	0	0	0	5,121
	2023	0	0	0	0	0	0	0	0	5,171	0	0	0	0	0	0	0	5,171
	2026	0	0	0	0	0	0	0	0	5,218	0	0	0	0	0	0	0	5,218
	2029	0	0	0	0	0	0	0	0	5,264	0	0	0	0	0	0	0	5,264
Street Lighting	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,756	1,756
	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,845	1,845
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,912	1,912
	2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,967	1,967
	2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,998	1,998
	2029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,030	2,030
Grand Total	2014	1,512	5,951	929	17,392	138	13,390	41,065	27,616	6,224	7,323	5,828	18,523	18,592	1,197	84,075	1,756	251,513
	2017	1,467	5,971	923	17,005	125	13,154	40,276	26,922	6,206	7,267	5,511	18,528	17,576	1,171	107,246	1,845	271,194
	2020	1,480	6,167	955	17,188	127	13,309	39,951	27,320	6,279	7,494	5,360	18,733	17,365	1,199	124,911	1,912	289,749
	2023	1,493	6,355	985	17,353	128	13,447	39,583	27,686	6,341	7,714	5,202	18,917	17,142	1,224	125,779	1,967	291,316
	2026	1,506	6,543	1,016	17,516	129	13,584	39,211	28,049	6,401	7,933	5,043	19,098	16,917	1,248	126,634	1,998	292,823
	2029	1,518	6,729	1,046	17,678	130	13,719	38,838	28,411	6,459	8,152	4,884	19,278	16,692	1,272	127,485	2,030	294,321

Exhibit 124 Reference Case Electricity Consumption by Sub sector, End Use and Milestone Year, Isolated (MWh/yr.)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Labrador Isolated C/I Buildings	2014	305	1,051	0	149	0	496	6,909	1,132	0	677	739	3,416	1,608	0	580	0	17,062
	2017	301	1,059	0	148	0	490	6,689	1,118	0	682	701	3,375	1,557	0	573	0	16,693
	2020	351	1,258	0	172	0	573	7,498	1,409	0	810	813	3,931	1,724	0	650	0	19,187
	2023	367	1,335	0	180	0	599	7,663	1,501	0	860	830	4,109	1,756	0	674	0	19,874
	2026	382	1,410	0	187	0	624	7,815	1,590	0	908	844	4,279	1,785	0	698	0	20,521
	2029	397	1,486	0	194	0	650	7,968	1,679	0	956	858	4,449	1,814	0	721	0	21,173
Island Isolated C/I Buildings	2014	0	99	0	0	0	47	649	106	0	64	69	321	151	0	0	0	1,505
	2017	0	99	0	0	0	46	626	105	0	64	66	316	146	0	0	0	1,466
	2020	0	120	0	0	0	55	716	136	0	78	78	377	164	0	0	0	1,725
	2023	0	128	0	0	0	57	732	145	0	82	80	393	168	0	0	0	1,786
	2026	0	135	0	0	0	60	748	154	0	87	82	411	171	0	0	0	1,847
	2029	0	143	0	0	0	62	765	163	0	92	83	428	174	0	0	0	1,910
Street Lighting	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	544	544
	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	557	557
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	571	571
	2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	584	584
	2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	596	596
	2029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	609	609
Grand Total	2014	305	1,150	0	149	0	542	7,558	1,238	0	740	808	3,737	1,759	0	580	544	19,112
	2017	301	1,158	0	148	0	536	7,315	1,223	0	746	766	3,691	1,703	0	573	557	18,716
	2020	351	1,378	0	172	0	627	8,214	1,545	0	887	892	4,308	1,889	0	650	571	21,483
	2023	367	1,463	0	180	0	656	8,396	1,647	0	942	910	4,502	1,924	0	674	584	22,244
	2026	382	1,546	0	187	0	684	8,563	1,744	0	995	925	4,689	1,956	0	698	596	22,965
	2029	397	1,628	0	194	0	712	8,733	1,842	0	1,048	941	4,877	1,988	0	721	609	23,691

C.4 CEEAM Archetype Summaries – New Buildings

This section includes summary profiles of the twelve new building archetypes constructed for this study. **Exhibit 125** presents a table of contents for the CEEAM building profiles that follow. A glossary of terms and acronyms used in the building profiles is included at the end of this appendix.

Exhibit 125 Table of Contents - New CEEAM Building Profiles

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.42	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.60								
Shading Coefficient (SC)	0.58				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA 13.04%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation L/s.m² CFM/ft² operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	6.01	L/s.m²	1.18	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) L/s.m² CFM/ft²

Operation occupied period	50%
Operation unoccupied period	50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	1,586,900	
Peak Zone Sensible Load	678,953	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	31,585	
Total air circulation or Design air	6.01	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.6
	MJ/m².yr	177

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	15.1	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	3400			
Unocc. Period(Hrs./yr.)	5360			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	30%		40%	5%	15%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.8
	MJ/m².yr	29

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 13.13 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	206

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	50	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.26	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: ____ Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.1	kWh/ft².yr	0.10
	MJ/m².yr	5.0	MJ/m².yr	4.00

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.10
	MJ/m².yr	4.00

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.26
		MJ/m².yr	10.00

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load	53.1	W/m²	16.9	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	302	MJ/m².yr	7.8	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	7.8	302
Fuel Oil / Propane EUI		
Market Composite EUI	7.8	302

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	125	W/m²	40	Btu/hr.ft²	302	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	129.0	MJ/m².yr	3.3	kWh/ft².yr		

Sizing Factor: 1.00 — Operation (occ. period): 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 90.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.4	53
Fuel Oil / Propane EUI		
Market Composite EUI	1.4	53

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	24
Fuel Oil / Propane EUI	#DIV/0!	#DIV/0!
Market Composite EUI	#DIV/0!	#DIV/0!

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	6.0	L/s.m²	1.18	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	10.2	W/m²	0.95	W/ft²
Fan Design Load VAV	10.2	W/m²	0.95	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.24	W/m²	0.21	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.007	L/s.m²	0.010	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	1.34	W/m²	0.12	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.005	L/s.m²	0.0079	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.8	W/m²	0.08	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	62.2	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.2	kWh/m².yr
Condenser Pump Energy Consumption	1.7	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	6.1
	MJ/m².yr	236.4

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	25.6 kWh/ft².yr	990.8 MJ/m².yr	Fuel Oil / Propane:	#DIV/0! kWh/ft².yr	#DIV/0! MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.6	176.9
ARCHITECTURAL LIGHTING	0.8	29.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	6.1	236.4
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.8	302.1		
SPACE COOLING	1.2	48.0		
DOMESTIC HOT WATER	0.6	24.2	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.35								
Shading Coefficient (SC)	0.58				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%				50%				150%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA 13.99%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	5.61	L/s.m²	1.10	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m²	CFM/ft²
Operation occupied period	50%	
Operation unoccupied period	50%	

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	770,463	
Peak Zone Sensible Load	316,489	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	14,723	
Total air circulation or Design air	5.61	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.1
	MJ/m².yr	160

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	30%		40%	5%	15%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.3
	MJ/m².yr	11

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 12.92 W/m²

EUI TOTAL	kWh/ft².yr	4
	MJ/m².yr	172

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		50			
Density (device/occupant)	0.9		0.9		0.15		0.1		0.26			
Connected Load	1.9	W/m²	1.8	W/m²	0.6	W/m²	0.8	W/m²	0.5	W/m²	1.5	W/m²
	0.2	W/ft²	0.2	W/ft²	0.05	W/ft²	0.07	W/ft²	0.05	W/ft²	0.14	W/ft²
Diversity Occupied Period	80%		80%		80%		80%		100%		80%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		2500	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		6260	

Total end-use load (occupied period)	5.8	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	3.8	W/m²	0.4	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	66%			

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.26
		MJ/m².yr	10.00

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load	48.9	W/m²	15.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	275	MJ/m².yr	7.1	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share [ ] Oil Fuel Share [ ]

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	7.1
	MJ/m².yr	275
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	7.1
	MJ/m².yr	275

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	121	W/m²	39	Btu/hr.ft²	312	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	122.1	MJ/m².yr	3.2	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share [ ]

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	1.3
	MJ/m².yr	51
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	1.3
	MJ/m².yr	51

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	100.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	55000.00	0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI		Fuel Oil / Propane EUI		Market Composite EUI	
kWh/ft².yr	0.6	kWh/ft².yr	0.0	kWh/ft².yr	0.6
MJ/m².yr	24	MJ/m².yr	0	MJ/m².yr	24.2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.6	L/s.m²	1.10	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	0.50			
Fan Design Load CAV	4.8	W/m²	0.44	W/ft²
Fan Design Load VAV	4.8	W/m²	0.44	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.1	W/m²	0.01	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.17	W/m²	0.20	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.006	L/s.m²	0.009	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	0.5			
Pump Connected Load	0.65	W/m²	0.06	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.005	L/s.m²	0.0077	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.8	W/m²	0.07	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	46.7	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	0.9	kWh/m².yr
Condenser Pump Energy Consumption	0.8	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.6
	MJ/m².yr	176.4

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **22.1** kWh/ft².yr **855.1** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.1	160.2
ARCHITECTURAL LIGHTING	0.3	11.3
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	4.6	176.4
REFRIGERATION		
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.1	275.2		
SPACE COOLING	1.2	45.6		
DOMESTIC HOT WATER	0.6	24.2	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft².°F	Typical Building Size	2,788 m²	30,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft².°F	Typical Footprint (m²)	1,225 m²	13,181 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft².°F	Footprint Aspect Ratio (L:W)	1	
			Percent Conditioned Space	100%	
			Percent Conditioned Space Defined as Exterior Zone	40%	
Window/Wall Ratio (WIWAR) (%)	0.11				
Shading Coefficient (SC)	0.69		Typical # Stories	1	
			Floor to Floor Height (m)	6.0 m	19.7 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45 m²/person	484 ft²/person	%OA	15.81%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	20 L/s.person	42 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor: 3
Total Air Circulation or Design Air Flow: 2.81 L/s.m² | 0.55 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Infiltration Rate: 0.70 L/s.m² | 0.14 CFM/ft²
(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	232,012	
Peak Zone Sensible Load	118,985	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,535	
Total air circulation or Design air	2.81	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	13.2	W/m²	1.2	W/ft²

Occ. Period(Hrs./yr.)	5000
Unocc. Period(Hrs./yr.)	3760
Usage During Occupied Period	100%
Usage During Unoccupied Period	20%

Light Level (Lux)	400	500	600	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	2%	3%		55%	10%	30%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval: years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	6.4
	MJ/m².yr	246

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	12.8	W/m²	1.2	W/ft²

Occ. Period(Hrs./yr.)	5000
Unocc. Period(Hrs./yr.)	3760
Usage During Occupied Period	100%
Usage During Unoccupied Period	50%

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				80%	5%	15%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval: years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	32

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²

Floor fraction check: should = 1.00 | 1.00

Occ. Period(Hrs./yr.)	4000
Unocc. Period(Hrs./yr.)	4760
Usage During Occupied Period	0%
Usage During Unoccupied Period	100%

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)							0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval: years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 13.18 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	278

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.65	0.65	0.01	0.01	0.03	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.0 W/m²	0.1 W/m²	1.5 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.00 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	2.9 W/m²	0.3 W/ft²
Total end-use load (unocc. period)	1.7 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.76
		MJ/m².yr	29.56
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.51

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	2.6	kWh/ft².yr	3.1
	MJ/m².yr	100.0	MJ/m².yr	120.0

REFRIGERATION

Provide description below:
Commercial refrigeration display cases

EUI	kWh/ft².yr	29.0
	MJ/m².yr	1125.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	80%	88%	95%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.25	1.14	1.05	0.31	0.33	0.22	1.00	

Peak Heating Load: 32.0 W/m² — 10.1 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 181 MJ/m².yr — 4.7 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	4.7
MJ/m².yr	181
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	4.7
MJ/m².yr	181

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.2	4.4	3.2	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.31	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load: 24 W/m² — 8 Btu/hr.ft² — 1552 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 77.8 MJ/m².yr — 2.0 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 80.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Sh

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.8
MJ/m².yr	30
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	0.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.55	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 45.5

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	1.3	2.1	1.3
MJ/m².yr	50	83	50.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.8	L/s.m²	0.55	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	4.4	W/m²	0.41	W/ft²
Fan Design Load VAV	4.4	W/m²	0.41	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.49	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.001	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0015	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	38.5	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.9
	MJ/m².yr	151.1

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	53.1 kWh/ft².yr	2,056.5 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
GENERAL LIGHTING	6.4	246.5					
SECONDARY LIGHTING	0.8	31.6	SPACE HEATING	4.7	181.2		
TERTIARY LIGHTING			SPACE COOLING	0.6	24.2		
OTHER PLUG LOADS	0.8	32.5	DOMESTIC HOT WATER	1.3	50.0	0.0	0.0
HVAC FANS & PUMPS	3.9	151.1	FOOD SERVICE EQUIPMENT	3.1	120.0		
REFRIGERATION	29.0	1,125.0					
MISCELLANEOUS	0.3	10.0					
BLOCK HEATERS							
COMPUTER EQUIPMENT	0.8	29.6					
COMPUTER SERVERS	0.1	4.4					
ELEVATORS							
OUTDOOR LIGHTING	1.3	50.4					

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail Baseline	> 100 kW	New	Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA 15.06%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	2			
Total Air Circulation or Design Air Flow	5.31	L/s.m²	1.05	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)		L/s.m²		CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	533,548	
Peak Zone Sensible Load	224,846	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	10,460	
Total air circulation or Design air	5.31	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	15.9	W/m²	1.5	W/ft²

Occ. Period(Hrs./yr.)	4500
Unocc. Period(Hrs./yr.)	4260
Usage During Occupied Period	95%
Usage During Unoccupied Period	15%

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	10%		55%	10%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	6.9
	MJ/m².yr	267

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	16.1	W/m²	1.5	W/ft²

Occ. Period(Hrs./yr.)	4500
Unocc. Period(Hrs./yr.)	4260
Usage During Occupied Period	95%
Usage During Unoccupied Period	50%

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	10%		20%	10%	50%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	0.5
	MJ/m².yr	19

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²

Floor fraction check: should = 1.00 | 1.00

Occ. Period(Hrs./yr.)	4000
Unocc. Period(Hrs./yr.)	4760
Usage During Occupied Period	0%
Usage During Unoccupied Period	100%

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 15.88 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	285

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.22	0.22	0.01	0.01	0.02	
Connected Load	0.5 W/m²	0.4 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.1 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.2 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT

5

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	1.0
	MJ/m².yr			MJ/m².yr	38.7

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	1.5
	MJ/m².yr	58.1

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load	33.1 W/m²	10.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	179 MJ/m².yr	4.6	kWh/ft².yr
Sizing Factor	1.00		

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	4.6	179
Fuel Oil / Propane EUI		
Market Composite EUI	4.6	179

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	84 W/m²	27 Btu/hr.ft²	450 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	115.1 MJ/m².yr	3.0 kWh/ft².yr	
Sizing Factor	1.00		
A/C Saturation (Incidence of A/C)	90.0%		

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.0	38
Fuel Oil / Propane EUI		
Market Composite EUI	1.0	38

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	0.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.55	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Fuel Oil / Propane EUI	0.8	31
Market Composite EUI	0.5	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.3	L/s.m²	1.05	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	7.5	W/m²	0.70	W/ft²
Fan Design Load VAV	7.5	W/m²	0.70	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.68	W/m²	0.16	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0053	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	59.9	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	1.5	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	5.8
	MJ/m².yr	222.8

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:				
Electricity:	24.0 kWh/ft².yr	929.1 MJ/m².yr		
Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	6.9	266.6
ARCHITECTURAL LIGHTING	0.5	18.6
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	5.8	222.8
REFRIGERATION	1.5	58.1
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	4.6	178.8		
SPACE COOLING	0.9	34.1		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	1.0	38.7		

Fuel Specific EUIs for Heating Cooling & DHW

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	17.20%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	4.65	L/s.m²	0.92	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.42	L/s.m²	0.08	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	294,944	
Peak Zone Sensible Load	140,593	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	6,540	
Total air circulation or Design air	4.65	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning: Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95		
Connected Load	18.8 W/m²	1.8	W/ft²
Occ. Period(Hrs./yr.)	3500		
Unocc. Period(Hrs./yr.)	5260		
Usage During Occupied Period	95%		
Usage During Unoccupied Period	15%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	5%		55%	30%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	6.8
	MJ/m².yr	265

ARCHITECTURAL LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05		
Connected Load	16.6 W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	3500		
Unocc. Period(Hrs./yr.)	5260		
Usage During Occupied Period	95%		
Usage During Unoccupied Period	50%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	10%		20%	20%	40%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.5
	MJ/m².yr	18

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level	Lux		ft-candles
Floor Fraction (HBLFF)			
Connected Load	W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	0%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 18.72 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	283

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.22	0.22	0.01	0.01	0.02	
Connected Load	0.5 W/m²	0.4 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.1 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.2 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	59%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT 5

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load	49.8 W/m²	15.8 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	279 MJ/m².yr	7.2 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	7.2		7.2
MJ/m².yr	279		279

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	93 W/m²	29 Btu/hr.ft²	407 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	131.3 MJ/m².yr	3.4 kWh/ft².yr	
Sizing Factor	1.00		
A/C Saturation (Incidence of A/C)	90.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	1.1		1.1
MJ/m².yr	43		43

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	0.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.55	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.8	0.5
MJ/m².yr	19	31	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.6	L/s.m²	0.92	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	6.6	W/m²	0.61	W/ft²
Fan Design Load VAV	6.6	W/m²	0.61	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.86	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0059	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	52.5	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	5.1
	MJ/m².yr	198.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	23.5	kWh/ft².yr	910.3	MJ/m².yr	Fuel Oil / Propane:	0.0	kWh/ft².yr	0.0	MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	6.8	265.0
ARCHITECTURAL LIGHTING	0.5	17.8
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	5.1	198.0
REFRIGERATION		
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.2	279.3		
SPACE COOLING	1.0	38.8		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT				

Fuel Specific EUIs for Heating Cooling & DHW

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717 m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,500 m²	16,140	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.30							
Shading Coefficient (SC)	0.65				Typical # Stories	3		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50	m²/person	538	ft²/person	%OA 9.65%
Occupancy Schedule Occ. Period	50%				
Occupancy Schedule Unocc. Period	80%				
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right: 15%
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.11	L/s.m²	0.61	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) | | L/s.m² | | CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	652,273	
Peak Zone Sensible Load	376,026	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	17,493	
Total air circulation or Design air	3.11	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	8.9	W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution		75%	25%					100%
Weighted Average								**125**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	50%		10%		0%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 1.7; MJ/m².yr 67

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	13.9	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	15%	15%		55%		0%	15%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 2.2; MJ/m².yr 86

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 10.11 W/m² — EUI TOTAL kWh/ft².yr 4; MJ/m².yr 153

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.3 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.9 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	0.9 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	48%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.11
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: 2.0% Electricity Fuel Share: 98.0%

Kitchen services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	1.3	EUI	kWh/ft².yr	0.6
	MJ/m².yr	50.0		MJ/m².yr	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load	50.2 W/m²	15.9 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	273 MJ/m².yr	7.0 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.0
MJ/m².yr	273
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	7.0
MJ/m².yr	273

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load	44 W/m²	14 Btu/hr.ft²	866 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	74.1 MJ/m².yr	1.9 kWh/ft².yr	
Sizing Factor	0.85	Operation (occ. perio	4000 hrs/year Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	80.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.7
MJ/m².yr	28
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	28

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	0.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.55		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

All Electric EUI		Fuel Oil / Propane EUI		Market Composite EUI	
kWh/ft².yr	6.7	kWh/ft².yr	11.1	kWh/ft².yr	6.7
MJ/m².yr	260	MJ/m².yr	430	MJ/m².yr	260.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.1	L/s.m²	0.61	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	1.00			
Fan Design Load CAV	3.0	W/m²	0.28	W/ft²
Fan Design Load VAV	3.0	W/m²	0.28	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.95	W/m²	0.09	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0028	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.4	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	19.7	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	2.1
	MJ/m².yr	82.5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	23.2 kWh/ft².yr	900.0 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	1.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	1.7	67.3
SECONDARY LIGHTING	2.2	85.8
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	2.1	82.5
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.4	16.1
COMPUTER SERVERS	0.1	3.7
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.0	272.6		
SPACE COOLING	0.6	22.7		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.6	24.5	0.0	1.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859 m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,500 m²	16,140	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.30							
Shading Coefficient (SC)	0.65				Typical # Stories	2		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50	m²/person	538	ft²/person
Occupancy Schedule Occ. Period	50%			
Occupancy Schedule Unocc. Period	80%			
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person

%OA 7.63%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.93	L/s.m²	0.77	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) L/s.m² CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	422,031	
Peak Zone Sensible Load	237,866	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	11,066	
Total air circulation or Design air	3.93	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	6.9	W/m²	0.6	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution		75%	25%					100%
Weighted Average								**125**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	20%	30%		50%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	15.7	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	20%	15%		55%		0%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	1.5
	MJ/m².yr	58

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8 Mag		MH	HPS	TOTAL
System Present (%)		0%		T8		100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP	8.25 W/m²	EUI TOTAL	kWh/ft².yr	3
			MJ/m².yr	118

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.3		0.3		0.05		0.033		0.02			
Connected Load	0.3	W/m²	0.3	W/m²	0.1	W/m²	0.1	W/m²	0.1	W/m²	1.5	W/m²
	0.0	W/ft²	0.0	W/ft²	0.01	W/ft²	0.01	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		70%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2500		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6260		5760	

Total end-use load (occupied period)	1.9	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	0.9	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	48%			

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Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.11
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Kitchen services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	1.3	EUI	kWh/ft².yr	0.6
	MJ/m².yr	50.0		MJ/m².yr	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.4
	MJ/m².yr	15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS: Small Accommodation Baseline | **SIZE:** < 100 kW | **VINTAGE:** New | **REGION:** Island Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load: 52.3 W/m² | 16.6 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 295 MJ/m².yr | 7.6 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share: | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.6
MJ/m².yr	295

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	7.6
MJ/m².yr	295

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 57 W/m² | 18 Btu/hr.ft² | 669 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 67.0 MJ/m².yr | 1.7 kWh/ft².yr

Sizing Factor: 0.85 | Operation (occ. perio 4000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 80.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.7
MJ/m².yr	28

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	28

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)	0.00%				
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.55	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Fuel Oil / Propane EUI	
kWh/ft².yr	11.1
MJ/m².yr	430

Market Composite EUI	
kWh/ft².yr	6.7
MJ/m².yr	260.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.9	L/s.m²	0.77	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	0.50			
Fan Design Load CAV	1.9	W/m²	0.17	W/ft²
Fan Design Load VAV	1.9	W/m²	0.17	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.2	W/m²	0.01	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.23	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	0.5			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0036	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.5					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	12.5	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.4	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.3
	MJ/m².yr	51.3

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	22.0 kWh/ft².yr	852.7 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	1.5	59.7
SECONDARY LIGHTING	1.5	58.3
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	1.3	51.3
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.4	16.1
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.6	295.1		
SPACE COOLING	0.6	22.4		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.6	25.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,400	m²	15,064	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.20								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	26.49%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	45	L/s.person	95	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:	15%			
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation	0.5	L/s.m²	0.10	CFM/ft²
	50%	operation (%)		

Sizing Factor	6			
Total Air Circulation or Design Air Flow	5.66	L/s.m²	1.12	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	379,501	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H	13.2	ft³/lbm
Design CFM	17,654	
Total air circulation or Design air fl	5.66	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (PATIENT ROOMS)

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	10.1	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution				100%				100%
Weighted Average								300

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	10%		85%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: 1.3 kWh/ft².yr; 51 MJ/m².yr

SECONDARY LIGHTING (NURSING STATIONS, EXAMINATION ROOMS, LABORATORIES, ICU, RECOVERY)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	13.3	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								500

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)		5%		90%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: 4.2 kWh/ft².yr; 164 MJ/m².yr

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING (CORRIDORS, OTHER)

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)	5%	5%		90%			0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	88	88	65	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LPD 12.02 W/m² — EUI TOTAL: 6 kWh/ft².yr; 215 MJ/m².yr

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	54.55		51		100		200		217			
Density (device/occupant)	0.48		0.48		0.02		0.02		0.04			
Connected Load	0.9	W/m²	0.8	W/m²	0.1	W/m²	0.1	W/m²	0.3	W/m²	3.85	W/m²
	0.1	W/ft²	0.1	W/ft²	0.01	W/ft²	0.01	W/ft²	0.02	W/ft²	0.36	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	5.4	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	40%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

	EUI kWh/ft².yr	EUI MJ/m².yr
Computer Servers	0.21	8.10
Computer Equipment	0.90	35.00
Plug Loads	1.74	67.29

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Commercial food services

	Fuel Oil / Propane EUI	All Electric EUI
kWh/ft².yr	3.1	2.1
MJ/m².yr	120.0	80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI: 0.4 kWh/ft².yr; 15.0 MJ/m².yr

BLOCK HEATERS & MISCELLANEOUS

	EUI kWh/ft².yr	EUI MJ/m².yr
Block Heaters		
Miscellaneous	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	88%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.14	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	39.0	W/m²	12.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	439	MJ/m².yr	11.3	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.3
MJ/m².yr	439
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	11.3
MJ/m².yr	439

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	6.1	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.16	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	36	W/m²	11	Btu/hr.ft²	1065	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	121.3	MJ/m².yr	3.1	kWh/ft².yr		

Sizing Factor 0.65 Operation (occ. perio 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.9
MJ/m².yr	34
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	0.9
MJ/m².yr	34

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	88.000	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 118.3

Wetting Use Percentage 90%

All Electric EUI		Fuel Oil / Propane EUI		Market Composite EUI	
kWh/ft².yr	3.4	kWh/ft².yr	3.4	kWh/ft².yr	3.4
MJ/m².yr	130	MJ/m².yr	131	MJ/m².yr	130.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.7	L/s.m²	1.12	CFM/ft²
System Static Pressure CAV	875	Pa	3.5	wg
System Static Pressure VAV	875	Pa	3.5	wg
Fan Efficiency	55%			
Fan Motor Efficiency	89%			
Sizing Factor	1.00			
Fan Design Load CAV	10.1	W/m²	0.94	W/ft²
Fan Design Load VAV	10.1	W/m²	0.94	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.13	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.9	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.59	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	60%			
Pump Motor Efficiency	88%			
Sizing Factor	1.0			
Pump Connected Load	0.36	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0023	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	60%					
Pump Motor Efficiency	88%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	71.1	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.5	kWh/m².yr
Condenser Pump Energy Consumption	0.4	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	7.3
	MJ/m².yr	282.7

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	34.9	kWh/ft².yr	1,350.6	MJ/m².yr	Fuel Oil / Propane:	0.0	kWh/ft².yr	0.0	MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (PATIENT RO	1.3	51.0
SECONDARY LIGHTING (NURSING	4.2	163.6
TERTIARY LIGHTING (CORRIDORS		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	7.3	282.7
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.9	35.0
COMPUTER SERVERS	0.2	8.1
ELEVATORS	0.2	7.7
OUTDOOR LIGHTING	0.9	34.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	11.3	438.5		
SPACE COOLING	0.7	26.8		
DOMESTIC HOT WATER	3.4	130.0	0.0	0.0
FOOD SERVICE EQUIPMENT	2.1	80.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS: School Baseline | SIZE: All | VINTAGE: New | REGION: Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	2,300	m²	24,748	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.15								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.2	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person	%OA 8.81%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	3	L/s.person	6	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 34%

If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	2.5			
Total Air Circulation or Design Air Flow	3.41	L/s.m²	0.67	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	418,815	
Peak Zone Sensible Load	230,702	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	10,732	
Total air circulation or Design air	3.41	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	19.5	°C	67.1	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.8
	MJ/m².yr	107

SECONDARY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	14.1	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	20%		10%	20%	30%	15%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	21

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP	13.09 W/m²	EUI TOTAL	kWh/ft².yr	3
			MJ/m².yr	129

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.05		0.05		0.02		0.02		0.01			
Connected Load	0.3	W/m²	0.3	W/m²	0.2	W/m²	0.4	W/m²	0.1	W/m²	0.2	W/m²
	0.0	W/ft²	0.0	W/ft²	0.02	W/ft²	0.04	W/ft²	0.01	W/ft²	0.02	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		100%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		5760	

Total end-use load (occupied period)	1.3	W/m²	0.1	W/ft²
Total end-use load (unocc. period)	0.8	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.54
		MJ/m².yr	21.01
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Cafeteria

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	8.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Unknown

EUI	kWh/ft².yr	0.1
	MJ/m².yr	3.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	3

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	73%	83%	75%	2.60	3.10	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.37	1.20	1.33	0.38	0.32	0.22	1.00	

Peak Heating Load	46.7 W/m²	14.8 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	240 MJ/m².yr	6.2 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	6.2		6.2
MJ/m².yr	240		240

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	3	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.33	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	33 W/m²	10 Btu/hr.ft²	1146 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	97.7 MJ/m².yr	2.5 kWh/ft².yr	
Sizing Factor	1.00	Operation (occ. perio	4000 hrs/year Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	10.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	1.1		1.1
MJ/m².yr	41		41

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.5	0.5
MJ/m².yr	19	19	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.4	L/s.m²	0.67	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	1.9	W/m²	0.18	W/ft²
Fan Design Load VAV	1.9	W/m²	0.18	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.66	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.20	W/m²	0.02	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0021	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	7.1	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.9	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	3000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	0.8
	MJ/m².yr	31.3

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **12.4** kWh/ft².yr **478.8** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.8	107.3
SECONDARY LIGHTING	0.6	21.4
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.1	4.2
HVAC FANS & PUMPS	0.8	31.3
REFRIGERATION	0.1	3.0
MISCELLANEOUS	0.1	3.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.5	21.0
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	6.2	239.8		
SPACE COOLING	0.1	4.1		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	6,506	m²	70,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	4,500	m²	48,420	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14	m²/person	151	ft²/person	%OA	14.20%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right: | 34%
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | 0.5 L/s.m² | 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.6			
Total Air Circulation or Design Air Flow	5.03	L/s.m²	0.99	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.40	L/s.m²	0.08	CFM/ft²

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	931,391	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	43,328	
Total air circulation or Design air	5.03	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	**SIZE:**	**VINTAGE:**	**REGION:**
University/College	**All**	**New**	**Island Interconnected**
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	11.9	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

	300	500	700	1000				Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				95%	5%	0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.5
	MJ/m².yr	175

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	8.5	W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)		15%		80%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 11.56 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	195

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	54.55		51		100		200		217			
Density (device/occupant)	0.31		0.31		0.02		0.02		0.01			
Connected Load	1.2	W/m²	1.1	W/m²	0.1	W/m²	0.3	W/m²	0.1	W/m²	1.3	W/m²
	0.1	W/ft²	0.1	W/ft²	0.01	W/ft²	0.03	W/ft²	0.01	W/ft²	0.12	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		100%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		2000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		6760	

Total end-use load (occupied period)	3.9	W/m²	0.4	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	55%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	1.34
		MJ/m².yr	51.73
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

	Fuel Oil / Propane EUI			All Electric EUI	
EUI	kWh/ft².yr	0.5	EUI	kWh/ft².yr	0.4
	MJ/m².yr	20.0		MJ/m².yr	15.0

REFRIGERATION

Provide description below:
Unknown

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	83%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.20	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	37.8 W/m²	12.0 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	192 MJ/m².yr	5.0 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	5.0
	MJ/m².yr	192
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	5.0
	MJ/m².yr	192

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		25.0%			75.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load	105 W/m²	33 Btu/hr.ft²	359 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	128.2 MJ/m².yr	3.3 kWh/ft².yr	

Sizing Factor 1.00 Operation (occ. perio 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 70.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	1.5
	MJ/m².yr	59
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	1.5
	MJ/m².yr	59

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.7	0.6
MJ/m².yr	25	25	25.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.0	L/s.m²	0.99	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	7.9	W/m²	0.73	W/ft²
Fan Design Load VAV	7.9	W/m²	0.73	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.0	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.1	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.11	W/m²	0.20	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.006	L/s.m²	0.008	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.005	L/s.m²	0.0067	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.9	W/m²	0.08	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	37.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.2	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.8	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.6
	MJ/m².yr	141.3

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	19.1 kWh/ft².yr	741.4 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.5	175.5
SECONDARY LIGHTING	0.5	19.6
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	3.6	141.3
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	1.3	51.7
COMPUTER SERVERS	0.1	3.7
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.0	192.0		
SPACE COOLING	1.1	41.6		
DOMESTIC HOT WATER	0.6	25.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.4	15.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,253	m²	35,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	3,253	m²	35,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	40%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA 14.56%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right:
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	1.37	L/s.m²	0.27	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	338,507	
Peak Zone Sensible Load	203,450	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	9,464	
Total air circulation or Design air	1.37	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	9.7	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				15%	50%	35%		100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.7
	MJ/m².yr	142

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	10.1	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	10%		85%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.2
	MJ/m².yr	7

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 9.71 W/m²

EUI TOTAL	kWh/ft².yr	3.9
	MJ/m².yr	149

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	39%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.34
		MJ/m².yr	13.30
Plug Loads	EUI	kWh/ft².yr	0.83
		MJ/m².yr	32.15

FOOD SERVICE EQUIPMENT

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

Large refrigeration storage

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	
		MJ/m².yr	
Miscellaneous	EUI	kWh/ft².yr	0.3
		MJ/m².yr	10

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Hot Water System: Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Electric Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	75%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.33	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	34.0 W/m²	10.8 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	196 MJ/m².yr	5.0 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	5.0		5.0
MJ/m².yr	196		196

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers: Standard	Centrifugal Chillers: HE	Screw Chillers	Reciprocating Chillers: Open	Reciprocating Chillers: DX	Absorption Chillers: W. H.	Absorption Chillers: CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	30 W/m²	10 Btu/hr.ft²	1241 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	43.3 MJ/m².yr	1.1 kWh/ft².yr	
Sizing Factor	1.00	Operation (occ. perio	4000 hrs/year
A/C Saturation (Incidence of A/C)	10.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Note value cannot be less than 2,900 hrs/year)

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5		0.5
MJ/m².yr	18		18

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.90		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 18.2

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.5	0.5
MJ/m².yr	20	20	20.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	1.4	L/s.m²	0.27	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	0.9	W/m²	0.08	W/ft²
Fan Design Load VAV	0.9	W/m²	0.08	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.61	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0019	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	5.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.6
	MJ/m².yr	24.6

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:				
Electricity:	13.6 kWh/ft².yr	527.9 MJ/m².yr		
Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	3.7	142.1
SECONDARY LIGHTING	0.2	7.0
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.8	32.1
HVAC FANS & PUMPS	0.6	24.6
REFRIGERATION	1.5	60.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.3	13.3
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.0	195.5		
SPACE COOLING	0.0	1.8		
DOMESTIC HOT WATER	0.5	20.0	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.36								
Shading Coefficient (SC)	0.58				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	60%							40%	100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	20	m²/person	215	ft²/person	%OA	29.87%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.35	L/s.m²	0.66	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	301,959	
Peak Zone Sensible Load	109,020	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,072	
Total air circulation or Design air	3.35	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Island Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.50			
Connected Load	10.3	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: kWh/ft².yr 2.3; MJ/m².yr 88

ARCHITECTURAL LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.50			
Connected Load	21.2	W/m²	2.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	50%					20%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI: kWh/ft².yr 4.7; MJ/m².yr 181

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 15.75 W/m² — EUI TOTAL kWh/ft².yr 7; MJ/m².yr 269

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.16	0.16	0.01		0.03	
Connected Load (W/m²)	0.4	0.4	0.1		0.1	1.15
Connected Load (W/ft²)	0.0	0.0	0.00		0.01	0.11
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	1.8	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	65%			

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.11	4.42
Computer Equipment	EUI	0.41	16.00
Plug Loads	EUI	0.55	21.24

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: 2.0% Electricity Fuel Share: 98.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	0.1	34.3
MJ/m².yr	5.0	1330.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI: kWh/ft².yr 16.8; MJ/m².yr 650.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI		
Miscellaneous	EUI	0.3	10

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Island Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	59.0 W/m²	18.7 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	742 MJ/m².yr	19.1 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	19.1
MJ/m².yr	742
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	19.1
MJ/m².yr	742

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	95 W/m²	30 Btu/hr.ft²	397 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	107.4 MJ/m².yr	2.8 kWh/ft².yr	

Sizing Factor: 1.00 — Operation (occ. period) 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 90.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.2
MJ/m².yr	47
Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	
Market Composite EUI	
kWh/ft².yr	1.2
MJ/m².yr	47

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 700.0

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	19.9	24.1	19.9
MJ/m².yr	769	933	769.2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Island Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.66	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	5.7	W/m²	0.53	W/ft²
Fan Design Load VAV	5.7	W/m²	0.53	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	60%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.87	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.005	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.92	W/m²	0.09	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0060	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.6	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	28.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption	0.4	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.9
	MJ/m².yr	111.9

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Island Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **102.1** kWh/ft².yr **3,955.9** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.1** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.3	88.3
ARCHITECTURAL LIGHTING	4.7	180.8
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.5	21.2
HVAC FANS & PUMPS	2.9	111.9
REFRIGERATION	16.8	650.0
MISCELLANEOUS	0.3	10.0
BLOCK HEATERS		
COMPUTER EQUIPMENT	0.4	16.0
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	19.1	741.5		
SPACE COOLING	1.1	42.2		
DOMESTIC HOT WATER	19.9	769.2	0.0	0.0
FOOD SERVICE EQUIPMENT	33.6	1,303.4	0.0	0.1

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.42 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Building Size	929 m² / 10,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	465 m² / 5,000 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	45%
Window/Wall Ratio (WIWAR) (%)	0.60			
Shading Coefficient (SC)	0.58		Typical # Stories	2
			Floor to Floor Height (m)	3.7 m / 12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26 m²/person	274 ft²/person	%OA 5.35%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.5	
Total Air Circulation or Design Air Flow	5.50 L/s.m²	1.08 CFM/ft²
Infiltration Rate	0.40 L/s.m²	0.08 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) — L/s.m² — CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	217,193	
Peak Zone Sensible Load	155,218	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,221	
Total air circulation or Design air	5.50	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.6
	MJ/m².yr	177

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	3400			
Unocc. Period(Hrs./yr.)	5360			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	30%		40%	5%	15%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.6
	MJ/m².yr	25

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 12.92 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	202

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	50	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.26	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.1	kWh/ft².yr	0.10
	MJ/m².yr	5.0	MJ/m².yr	4.00

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.10
	MJ/m².yr	4.00

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.13
		MJ/m².yr	5.00
Miscellaneous	EUI	kWh/ft².yr	0.13
		MJ/m².yr	5.00

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office Baseline	> 100 kW	New	Labrador Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load	89.6	W/m²	28.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	801	MJ/m².yr	20.7	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	20.7
	MJ/m².yr	801
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	20.7
	MJ/m².yr	801

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	68	W/m²	22	Btu/hr.ft²	553	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	92.9	MJ/m².yr	2.4	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.9
	MJ/m².yr	36
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.9
	MJ/m².yr	36

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	kWh/ft².yr	0.6
	MJ/m².yr	24
Fuel Oil / Propane EUI	kWh/ft².yr	0.7
	MJ/m².yr	25
Market Composite EUI	kWh/ft².yr	0.6
	MJ/m².yr	24.2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.5	L/s.m²	1.08	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	6.2	W/m²	0.58	W/ft²
Fan Design Load VAV	6.2	W/m²	0.58	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.4	L/s.m²	0.08	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.5	L/s.m²	0.10	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.04	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.23	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.73	W/m²	0.07	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0043	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	37.7	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	3.1	kWh/m².yr
Condenser Pump Energy Consumption	0.7	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.9
	MJ/m².yr	151.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Office	> 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **35.6** kWh/ft².yr **1,379.9** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.6	176.9
ARCHITECTURAL LIGHTING	0.6	25.0
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	3.9	151.0
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	20.7	800.5		
SPACE COOLING	0.8	32.1		
DOMESTIC HOT WATER	0.6	24.2	0.0	0.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.42	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	465	m²	5,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.35								
Shading Coefficient (SC)	0.58				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA	12.79%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) | 1 | If Fresh Air Control Type = "2" enter % FA. to the right:
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air) | If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation | L/s.m² | CFM/ft² | operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	2.30	L/s.m²	0.45	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²	CFM/ft²
Operation occupied period	50%		
Operation unoccupied period	50%		

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	95,876	
Peak Zone Sensible Load	64,888	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	3,019	
Total air circulation or Design air	2.30	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.1
	MJ/m².yr	160

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	30%		40%	5%	15%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.3
	MJ/m².yr	11

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 12.92 W/m²

EUI TOTAL	kWh/ft².yr	4
	MJ/m².yr	172

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	50	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.26	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Servers	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.20
Computer Equipment	EUI	kWh/ft².yr	2.36
		MJ/m².yr	91.24
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	
	MJ/m².yr	

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.13
		MJ/m².yr	5.00
Miscellaneous	EUI	kWh/ft².yr	0.13
		MJ/m².yr	5.00

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load	69.3	W/m²	22.0	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	615	MJ/m².yr	15.9	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	15.9
	MJ/m².yr	615
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	15.9
	MJ/m².yr	615

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	30	W/m²	10	Btu/hr.ft²	1252	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	69.8	MJ/m².yr	1.8	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.7
	MJ/m².yr	26
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.7
	MJ/m².yr	26

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.7	0.6
MJ/m².yr	24	25	24.2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.3	L/s.m²	0.45	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	0.50			
Fan Design Load CAV	1.3	W/m²	0.12	W/ft²
Fan Design Load VAV	1.3	W/m²	0.12	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.4	L/s.m²	0.08	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.5	L/s.m²	0.10	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.54	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	0.5			
Pump Connected Load	0.16	W/m²	0.02	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0019	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	9.7	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.5	kWh/m².yr
Condenser Pump Energy Consumption	0.1	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.1
	MJ/m².yr	42.2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Office	< 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	26.8 kWh/ft².yr	1,039.0 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.1	160.2
ARCHITECTURAL LIGHTING	0.3	11.3
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	1.1	42.2
REFRIGERATION		
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	2.4	91.2
COMPUTER SERVERS	0.4	16.2
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	15.9	615.3		
SPACE COOLING	0.6	23.7		
DOMESTIC HOT WATER	0.6	24.2	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft² .°F	Typical Building Size	929 m² / 10,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	929 m² / 10,000 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	40%
Window/Wall Ratio (WIWAR) (%)	0.11		Typical # Stories	1
Shading Coefficient (SC)	0.69		Floor to Floor Height (m)	6.0 m / 19.7 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45 m²/person	484 ft²/person	%OA	5.55%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	20 L/s.person	42 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² — 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	3	
Total Air Circulation or Design Air Flow	8.00 L/s.m²	1.58 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² — CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	198,673	
Peak Zone Sensible Load	112,922	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,253	
Total air circulation or Design air	8.00	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.0	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)		3%		55%	10%	30%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	5.4
	MJ/m².yr	208

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	12.8	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				80%	5%	15%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	30

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)							0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP	12.07 W/m²	EUI TOTAL	kWh/ft².yr	6
			MJ/m².yr	238

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.65		0.65		0.01		0.01		0.03			
Connected Load	0.8	W/m²	0.7	W/m²	0.0	W/m²	0.0	W/m²	0.1	W/m²	1.5	W/m²
	0.1	W/ft²	0.1	W/ft²	0.00	W/ft²	0.00	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	2.9 W/m²	0.3 W/ft²		
Total end-use load (unocc. period)	1.7 W/m²	0.2 W/ft²		
Usage during occupied period	100%			
Usage during unoccupied period	58%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.76
		MJ/m².yr	29.56
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.51

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	2.6	EUI	kWh/ft².yr	3.1
	MJ/m².yr	100.0		MJ/m².yr	120.0

REFRIGERATION

Provide description below:
Commercial refrigeration display cases

EUI	kWh/ft².yr	25.8
	MJ/m².yr	1000.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	80%	88%	95%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.25	1.14	1.05	0.31	0.33	0.22	1.00	

Peak Heating Load	35.3 W/m²	11.2 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	306 MJ/m².yr	7.9 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	7.9	306
Fuel Oil / Propane EUI		
Market Composite EUI	7.9	306

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.2	4.4	3.2	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.31	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	63 W/m²	20 Btu/hr.ft²	604 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	50.2 MJ/m².yr	1.3 kWh/ft².yr	
Sizing Factor	1.00	Operation (occ. period	4000 hrs/year Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	90.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	22
Fuel Oil / Propane EUI		
Market Composite EUI	0.6	22

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 45.5

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.3	50
Fuel Oil / Propane EUI	1.3	51
Market Composite EUI	1.3	50.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	8.0	L/s.m²	1.58	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	5.8	W/m²	0.54	W/ft²
Fan Design Load VAV	5.8	W/m²	0.54	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.04	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.25	W/m²	0.12	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0040	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	51.1	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	5.1
	MJ/m².yr	198.3

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	53.2 kWh/ft².yr	2,059.5 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.4	207.9
SECONDARY LIGHTING	0.8	30.5
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.8	32.5
HVAC FANS & PUMPS	5.1	198.3
REFRIGERATION	25.8	1,000.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.8	29.6
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	1.3	50.4

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.9	306.4		
SPACE COOLING	0.5	19.6		
DOMESTIC HOT WATER	1.3	50.0	0.0	0.0
FOOD SERVICE EQUIPMENT	3.1	120.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft².°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft².°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft².°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	7.61%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:	34%			
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation	0.5	L/s.m²	0.10	CFM/ft²
	50%	operation (%)		

Sizing Factor	2			
Total Air Circulation or Design Air Flow	7.88	L/s.m²	1.55	CFM/ft²
Infiltration Rate		L/s.m²		CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	284,710	
Peak Zone Sensible Load	166,814	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,760	
Total air circulation or Design air	7.88	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	18.4	W/m²	1.7	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	5%		55%	10%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	8.0
	MJ/m².yr	310

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	20.5	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	8%	10%		20%	60%	0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	24

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 18.53 W/m²

EUI TOTAL	kWh/ft².yr	9
	MJ/m².yr	333

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.22		0.22		0.01		0.01		0.02			
Connected Load	0.5	W/m²	0.4	W/m²	0.0	W/m²	0.1	W/m²	0.1	W/m²	1.15	W/m²
	0.0	W/ft²	0.0	W/ft²	0.00	W/ft²	0.01	W/ft²	0.01	W/ft²	0.11	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		4660	

Total end-use load (occupied period)	2.1	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT

5

Provide description below:

Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	1.0
	MJ/m².yr			MJ/m².yr	38.7

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	1.5
	MJ/m².yr	58.1

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load	42.5	W/m²	13.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	350	MJ/m².yr	9.0	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	9.0
	MJ/m².yr	350
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	9.0
	MJ/m².yr	350

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	90	W/m²	28	Btu/hr.ft²	421	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	84.4	MJ/m².yr	2.2	kWh/ft².yr		
Sizing Factor	1.00					
A/C Saturation (Incidence of A/C)	90.0%					

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.7
	MJ/m².yr	28
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.7
	MJ/m².yr	28

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.5	0.5
MJ/m².yr	19	19	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	7.9	L/s.m²	1.55	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	7.5	W/m²	0.69	W/ft²
Fan Design Load VAV	7.5	W/m²	0.69	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.80	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0057	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	59.3	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	5.7
	MJ/m².yr	221.8

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Non-Food Retail	> 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **29.4** kWh/ft².yr **1,139.1** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	8.0	309.7
ARCHITECTURAL LIGHTING	0.6	23.6
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	5.7	221.8
REFRIGERATION	1.5	58.1
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	9.0	350.5		
SPACE COOLING	0.6	25.2		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	1.0	38.7		

Fuel Specific EUIs for Heating Cooling & DHW

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	11.07%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	5.42	L/s.m²	1.07	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	281,834	
Peak Zone Sensible Load	163,938	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,626	
Total air circulation or Design air	5.42	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	17.6	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

	300	500	700	1000				Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	8%	5%		55%	30%	0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 7.0; MJ/m².yr 272

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	17.1	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	5%	15%		20%	20%	40%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.5; MJ/m².yr 19

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 17.58 W/m² — EUI TOTAL kWh/ft².yr 8; MJ/m².yr 291

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.22	0.22	0.01	0.01	0.02	
Connected Load (W/m²)	0.5	0.4	0.0	0.1	0.1	1.15
Connected Load (W/ft²)	0.0	0.0	0.00	0.01	0.01	0.11
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.1	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.14
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT

5

Provide description below:

Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI: EUI kWh/ft².yr; MJ/m².yr

All Electric EUI: EUI kWh/ft².yr; MJ/m².yr

REFRIGERATION

Provide description below:

EUI kWh/ft².yr; MJ/m².yr

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS: Small Non-Food Retail Baseline | **SIZE:** < 100 kW | **VINTAGE:** New | **REGION:** Labrador Interconnected

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane: Boilers Stan.	Fuel Oil / Propane: Boilers High	Fuel Oil / Propane: Packaged Rooftop	Electric: A/A HP	Electric: W. S. HP	Electric: H/R Chiller	Electric: Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load: 49.8 W/m² | 15.8 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 408 MJ/m².yr | 10.5 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share: | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	10.5		10.5
MJ/m².yr	408		408

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load: 89 W/m² | 28 Btu/hr.ft² | 426 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 81.4 MJ/m².yr | 2.1 kWh/ft².yr

Sizing Factor: 1.00

A/C Saturation (Incidence of A/C): 90.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.7		0.7
MJ/m².yr	27		27

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.5	0.5
MJ/m².yr	19	19	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.4	L/s.m²	1.07	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	5.1	W/m²	0.48	W/ft²
Fan Design Load VAV	5.1	W/m²	0.48	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.78	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0056	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	40.8	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	4.0
	MJ/m².yr	155.2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Non-Food Retail	< 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	25.6 kWh/ft².yr	989.8 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	7.0	271.7
ARCHITECTURAL LIGHTING	0.5	19.1
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	4.0	155.2
REFRIGERATION		
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.5	19.1
COMPUTER SERVERS	0.1	4.4
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

Fuel Specific EUIs for Heating Cooling & DHW

END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
SPACE HEATING	10.5	408.2		
SPACE COOLING	0.6	24.2		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,394	m²	15,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,500	m²	16,140	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50	m²/person	538	ft²/person	%OA	5.22%
Occupancy Schedule Occ. Period	50%					
Occupancy Schedule Unocc. Period	80%					
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	5.75	L/s.m²	1.13	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	444,876	
Peak Zone Sensible Load	260,711	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	12,128	
Total air circulation or Design air	5.75	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	7.3	W/m²	0.7	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300	Total
% Distribution		75%	25%		100%
Weighted Average					**125**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	20%	50%		10%		0%	20%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 1.4; MJ/m².yr 56

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	11.4	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	8%	15%		75%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 1.8; MJ/m².yr 71

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)					Total
% Distribution					
Weighted Average					

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 8.35 W/m² — EUI TOTAL kWh/ft².yr 3; MJ/m².yr 126

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.3 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.9 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	0.9 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	48%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.10	3.68
Computer Equipment	EUI	0.42	16.11
Plug Loads	EUI	0.49	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Kitchen services

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	1.3	1.3
MJ/m².yr	50.0	50.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI	0.1	5
Miscellaneous	EUI	0.1	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load	52.1	W/m²	16.5	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	421	MJ/m².yr	10.9	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	10.9
MJ/m².yr	421

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	10.9
MJ/m².yr	421

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	79	W/m²	25	Btu/hr.ft²	476	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	49.6	MJ/m².yr	1.3	kWh/ft².yr		

Sizing Factor 0.85 Operation (occ. perio 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Fuel Oil / Propane Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	21

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.6
MJ/m².yr	21

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.90		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 236.6

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Fuel Oil / Propane EUI	
kWh/ft².yr	6.8
MJ/m².yr	263

Market Composite EUI	
kWh/ft².yr	6.7
MJ/m².yr	260.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.7	L/s.m²	1.13	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	1.00			
Fan Design Load CAV	5.5	W/m²	0.51	W/ft²
Fan Design Load VAV	5.5	W/m²	0.51	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.73	W/m²	0.16	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0050	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	36.4	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.7
	MJ/m².yr	142.1

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Large Accommodation	> 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	28.5 kWh/ft².yr	1,102.9 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	1.4	55.6
SECONDARY LIGHTING	1.8	70.8
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	3.7	142.1
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	16.1
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	10.9	421.4		
SPACE COOLING	0.4	17.1		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	1.3	50.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	697	m²	7,500	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	697	m²	7,500	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50	m²/person	538	ft²/person	%OA 8.55%
Occupancy Schedule Occ. Period	50%				
Occupancy Schedule Unocc. Period	80%				
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.51	L/s.m²	0.69	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	122,326	
Peak Zone Sensible Load	79,537	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	3,700	
Total air circulation or Design air	3.51	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	7.1	W/m²	0.7	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution		75%	25%					100%
Weighted Average								**125**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	15%	70%		10%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: kWh/ft².yr 1.6; MJ/m².yr 61

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	13.0	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	30%		55%		0%	5%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: kWh/ft².yr 1.2; MJ/m².yr 48

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 7.95 W/m² — EUI TOTAL kWh/ft².yr 3; MJ/m².yr 109

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.3		0.3		0.05		0.033		0.02			
Connected Load	0.3	W/m²	0.3	W/m²	0.1	W/m²	0.1	W/m²	0.1	W/m²	1.5	W/m²
	0.0	W/ft²	0.0	W/ft²	0.01	W/ft²	0.01	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		70%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2500		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6260		5760	

Total end-use load (occupied period)	1.9	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	0.9	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	48%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.42
		MJ/m².yr	16.11
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: Electricity Fuel Share: 100.0%

Kitchen services

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	1.3	0.6
MJ/m².yr	50.0	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI: kWh/ft².yr 0.4; MJ/m².yr 15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load	72.1	W/m²	22.9	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	619	MJ/m².yr	16.0	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% Fuel Oil / Propane Fuel Share: Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	16.0	619
Fuel Oil / Propane EUI		
Market Composite EUI	16.0	619

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	44	W/m²	14	Btu/hr.ft²	866	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	53.7	MJ/m².yr	1.4	kWh/ft².yr		

Sizing Factor: 0.85 Operation (occ. perio 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 80.0%

Electric Fuel Share: 100.0% Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.6	22
Fuel Oil / Propane EUI		
Market Composite EUI	0.6	22

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

	kWh/ft².yr	MJ/m².yr
All Electric EUI	6.7	260
Fuel Oil / Propane EUI	6.8	263
Market Composite EUI	6.7	260.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.5	L/s.m²	0.69	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	0.50			
Fan Design Load CAV	1.7	W/m²	0.16	W/ft²
Fan Design Load VAV	1.7	W/m²	0.16	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.3	L/s.m²	0.06	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.4	L/s.m²	0.08	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	0.5			
Exhaust Fan Connected Load	0.3	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.95	W/m²	0.09	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	0.5			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0028	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.5					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	11.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.3
	MJ/m².yr	49.4

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Small Accommodation	< 100 kW	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **30.0** kWh/ft².yr **1,160.3** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (SUITES)	1.6	60.8
SECONDARY LIGHTING	1.2	48.1
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.5	19.1
HVAC FANS & PUMPS	1.3	49.4
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	16.1
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	16.0	618.6		
SPACE COOLING	0.5	17.5		
DOMESTIC HOT WATER	6.7	260.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.6	25.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	2,943	m²	31,667	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.20								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	13.43%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	35	L/s.person	74	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	5			
Total Air Circulation or Design Air Flow	8.69	L/s.m²	1.71	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	698,518	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H	13.2	ft³/lbm
Design CFM	32,495	
Total air circulation or Design air flo	8.69	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	22	°C	71.6	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING (PATIENT ROOMS)

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	9.4	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution				100%				100%
Weighted Average								**300**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	10%		85%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	1.2
	MJ/m².yr	47

SECONDARY LIGHTING (NURSING STATIONS, EXAMINATION ROOMS, LABORATORIES, ICU, RECOVERY)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	15.2	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	5%		90%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	4.8
	MJ/m².yr	186

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING (CORRIDORS, OTHER)

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)								Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)	5%	5%		90%			0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	88	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LPD 12.84 W/m²

EUI TOTAL	kWh/ft².yr	6
	MJ/m².yr	234

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	54.55		51		100		200		217			
Density (device/occupant)	0.48		0.48		0.02		0.02		0.04			
Connected Load	0.9	W/m²	0.8	W/m²	0.1	W/m²	0.1	W/m²	0.3	W/m²	3.85	W/m²
	0.1	W/ft²	0.1	W/ft²	0.01	W/ft²	0.01	W/ft²	0.02	W/ft²	0.36	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	5.4	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	40%			

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Computer Servers	EUI	kWh/ft².yr	0.21
		MJ/m².yr	8.10
Computer Equipment	EUI	kWh/ft².yr	0.90
		MJ/m².yr	35.00
Plug Loads	EUI	kWh/ft².yr	1.74
		MJ/m².yr	67.29

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Commercial food services

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr	3.1	EUI	kWh/ft².yr	2.1
	MJ/m².yr	120.0		MJ/m².yr	80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.4
	MJ/m².yr	15.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	88%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.14	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	25.2 W/m²	8.0 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	198 MJ/m².yr	5.1 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	5.1		5.1
MJ/m².yr	198		198

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	6.1	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.16	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load	60 W/m²	19 Btu/hr.ft²	629 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	64.6 MJ/m².yr	1.7 kWh/ft².yr	

Sizing Factor: 0.65 — Operation (occ. perio 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 80.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6		0.6
MJ/m².yr	24		24

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	88.000	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 118.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	3.4	3.4	3.4
MJ/m².yr	130	131	130.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	8.7	L/s.m²	1.71	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	55%			
Fan Motor Efficiency	89%			
Sizing Factor	1.00			
Fan Design Load CAV	13.3	W/m²	1.24	W/ft²
Fan Design Load VAV	13.3	W/m²	1.24	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.11	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.8	W/m²	0.07	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.99	W/m²	0.09	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	60%			
Pump Motor Efficiency	88%			
Sizing Factor	1.0			
Pump Connected Load	0.60	W/m²	0.06	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0038	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	60%					
Pump Motor Efficiency	88%					
Sizing Factor	0.8					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	93.3	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	5.7	kWh/m².yr
Condenser Pump Energy Consumption	0.7	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	9.3
	MJ/m².yr	360.1

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **30.9** kWh/ft².yr **1,195.1** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (PATIENT RO	1.2	47.2
SECONDARY LIGHTING (NURSING	4.8	186.3
TERTIARY LIGHTING (CORRIDORS		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	9.3	360.1
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.9	35.0
COMPUTER SERVERS	0.2	8.1
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.9	34.9

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.1	198.3		
SPACE COOLING	0.5	19.0		
DOMESTIC HOT WATER	3.4	130.0	0.0	0.0
FOOD SERVICE EQUIPMENT	2.1	80.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft² .°F	Typical Building Size	3,717 m² / 40,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	3,717 m² / 40,000 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	50%
Window/Wall Ratio (WIWAR) (%)	0.15			
Shading Coefficient (SC)	0.65		Typical # Stories	1
			Floor to Floor Height (m)	3.7 m / 12.2 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10 m²/person	108 ft²/person	%OA 8.74%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	4 L/s.person	8 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² / 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	2	
Total Air Circulation or Design Air Flow	4.58 L/s.m²	0.90 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.42 L/s.m²	0.08 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² / CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based	Total
Incidence of Use			100%	100%
Switchover Point		KJ/kg.	18 °C	
		Btu/lbm	64.4 °F	

Summary of Design Parameters		
Peak Design Cooling Load	764,589	
Peak Zone Sensible Load	387,634	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	18,033	
Total air circulation or Design air	4.58	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	19.5	°C	67.1	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100%		0%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	2.8
	MJ/m².yr	107

SECONDARY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	16.5	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	10%	20%		10%	20%	30%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	25

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)					Total
% Distribution					
Weighted Average					

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 13.46 W/m²

EUI TOTAL	kWh/ft².yr	3
	MJ/m².yr	132

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.05		0.05		0.02		0.02		0.01			
Connected Load	0.3	W/m²	0.3	W/m²	0.2	W/m²	0.4	W/m²	0.1	W/m²	0.2	W/m²
	0.0	W/ft²	0.0	W/ft²	0.02	W/ft²	0.04	W/ft²	0.01	W/ft²	0.02	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		100%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		5760	

Total end-use load (occupied period)	1.3	W/m²	0.1	W/ft²
Total end-use load (unocc. period)	0.8	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

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Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	0.54
		MJ/m².yr	21.01
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Cafeteria

	Fuel Oil / Propane EUI		All Electric EUI	
EUI	kWh/ft².yr	0.2	kWh/ft².yr	0.1
	MJ/m².yr	8.0	MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Unknown

EUI	kWh/ft².yr	0.1
	MJ/m².yr	3.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.0
		MJ/m².yr	2
Miscellaneous	EUI	kWh/ft².yr	0.0
		MJ/m².yr	2

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)							100%	100%
Eff./COP	73%	83%	75%	2.60	3.10	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.37	1.20	1.33	0.38	0.32	0.22	1.00	

Peak Heating Load	42.9 W/m²	13.6 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	313 MJ/m².yr	8.1 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	8.1
	MJ/m².yr	313
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	8.1
	MJ/m².yr	313

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	3	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.33	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load	60 W/m²	19 Btu/hr.ft²	628 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	74.8 MJ/m².yr	1.9 kWh/ft².yr	
Sizing Factor	1.00	Operation (occ. perio 4000 hrs/year	Note value cannot be less than 2,900 hrs/year)
A/C Saturation (Incidence of A/C)	10.0%		
Electric Fuel Share	100.0%	Fuel Oil / Propane Fuel Share	

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	0.9
	MJ/m².yr	34
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	0.9
	MJ/m².yr	34

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.90		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.5	0.5	0.5
MJ/m².yr	19	19	19.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.6	L/s.m²	0.90	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.6	W/m²	0.24	W/ft²
Fan Design Load VAV	2.6	W/m²	0.24	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.21	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.36	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0038	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	9.6	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.8	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	3000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.0
	MJ/m².yr	39.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	14.5 kWh/ft².yr	562.7 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.8	107.3
SECONDARY LIGHTING	0.6	25.1
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.1	4.2
HVAC FANS & PUMPS	1.0	39.0
REFRIGERATION	0.1	3.0
MISCELLANEOUS	0.0	1.5
BLOCK HEATERS	0.0	1.5
COMPUTER EQUIPMENT	0.5	21.0
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.1	312.9		
SPACE COOLING	0.1	3.4		
DOMESTIC HOT WATER	0.5	19.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	6,506	m²	70,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	3,253	m²	35,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14	m²/person	151	ft²/person	%OA	18.38%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.6			
Total Air Circulation or Design Air Flow	3.89	L/s.m²	0.77	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	719,746	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	33,483	
Total air circulation or Design air	3.89	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	11.9	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				95%	4%	1%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 4.5; MJ/m².yr 175

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	9.6	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	15%		80%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI kWh/ft².yr 0.6; MJ/m².yr 22

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)					Total
% Distribution					
Weighted Average					

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 11.65 W/m² — EUI TOTAL kWh/ft².yr 5; MJ/m².yr 197

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9 W/m²	0.4 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	55%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.10
		MJ/m².yr	3.68
Computer Equipment	EUI	kWh/ft².yr	1.34
		MJ/m².yr	51.73
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI: EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

All Electric EUI: EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

REFRIGERATION

Provide description below:

Unknown

EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	83%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.20	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	41.6	W/m²	13.2	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	445	MJ/m².yr	11.5	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	kWh/ft².yr	11.5
	MJ/m².yr	445
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	11.5
	MJ/m².yr	445

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		25.0%			75.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	78	W/m²	25	Btu/hr.ft²	483	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	85.9	MJ/m².yr	2.2	kWh/ft².yr		

Sizing Factor: 1.00 — Operation (occ. perio 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 70.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	kWh/ft².yr	1.0
	MJ/m².yr	39
Fuel Oil / Propane EUI	kWh/ft².yr	
	MJ/m².yr	
Market Composite EUI	kWh/ft².yr	1.0
	MJ/m².yr	39

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.90	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

	All Electric EUI	Fuel Oil / Propane EUI	Market Composite EUI
kWh/ft².yr	0.6	0.7	0.6
MJ/m².yr	25	25	25.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.9	L/s.m²	0.77	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	6.1	W/m²	0.56	W/ft²
Fan Design Load VAV	6.1	W/m²	0.56	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.57	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0050	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	28.6	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.8
	MJ/m².yr	109.8

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	24.5 kWh/ft².yr	947.2 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.5	175.2
SECONDARY LIGHTING	0.6	22.1
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	2.8	109.8
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	1.3	51.7
COMPUTER SERVERS	0.1	3.7
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Fuel Oil / Propane kWh/ft².yr	Fuel Oil / Propane MJ/m².yr
SPACE HEATING	11.5	445.1		
SPACE COOLING	0.7	27.6		
DOMESTIC HOT WATER	0.6	25.0	0.0	0.0
FOOD SERVICE EQUIPMENT	0.4	15.0		

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	40%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA 10.74%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	1.86	L/s.m²	0.37	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) ___ L/s.m² ___ CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	234,761	
Peak Zone Sensible Load	157,585	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	7,331	
Total air circulation or Design air	1.86	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	9.1	W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				15%	15%	70%		100.0%
CU	0.7	0.7	0.6	0.6	0.7	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI	kWh/ft².yr	3.5
	MJ/m².yr	134

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	9.4	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	3%	10%		85%		0%	2%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.2
	MJ/m².yr	7

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 9.13 W/m²

EUI TOTAL	kWh/ft².yr	3.6
	MJ/m².yr	140

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	39%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2")

Computer Servers	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.42
Computer Equipment	EUI	kWh/ft².yr	0.34
		MJ/m².yr	13.30
Plug Loads	EUI	kWh/ft².yr	0.83
		MJ/m².yr	32.15

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: | Electricity Fuel Share: 100.0%

Fuel Oil / Propane EUI			All Electric EUI		
EUI	kWh/ft².yr		EUI	kWh/ft².yr	
	MJ/m².yr			MJ/m².yr	

REFRIGERATION

Provide description below:
Large refrigeration storage

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60.0

BLOCK HEATERS & MISCELLANEOUS

Block Heaters	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5
Miscellaneous	EUI	kWh/ft².yr	0.1
		MJ/m².yr	5

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS: Warehouse/Wholesale Baseline | **SIZE:** All | **VINTAGE:** New | **REGION:** Labrador Interconnected

SPACE HEATING

Heating Plant Type

	Hot Water System: Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Electric Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	75%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.33	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load: 37.3 W/m² | 11.8 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 310 MJ/m².yr | 8.0 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share: | Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	8.0	310
Fuel Oil / Propane EUI		
Market Composite EUI	8.0	310

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers: Standard	HE	Screw Chillers	Reciprocating Chillers: Open	DX	Absorption Chillers: W. H.	CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load: 37 W/m² | 12 Btu/hr.ft² | 1022 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 29.4 MJ/m².yr | 0.8 kWh/ft².yr

Sizing Factor: 1.00 | Operation (occ. perio 4000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 10.0%

Electric Fuel Share: 100.0% | Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenan

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.3	12
Fuel Oil / Propane EUI		
Market Composite EUI	0.3	12

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					0.00%
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share	0%		100%
Blended Efficiency	0.90		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 18.2

Wetting Use Percentage: 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	20
Fuel Oil / Propane EUI	0.5	20
Market Composite EUI	0.5	20.0

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	1.9	L/s.m²	0.37	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.2	W/m²	0.11	W/ft²
Fan Design Load VAV	1.2	W/m²	0.11	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.74	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0023	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	7.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.8
	MJ/m².yr	32.4

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES:	Electricity:	16.5 kWh/ft².yr	641.0 MJ/m².yr	Fuel Oil / Propane:	0.0 kWh/ft².yr	0.0 MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	3.5	133.8
SECONDARY LIGHTING	0.2	6.5
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.8	32.1
HVAC FANS & PUMPS	0.8	32.4
REFRIGERATION	1.5	60.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.3	13.3
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.0	310.2		
SPACE COOLING	0.0	1.2		
DOMESTIC HOT WATER	0.5	20.0	0.0	0.0
FOOD SERVICE EQUIPMENT				

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Labrador Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929 m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929 m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.36							
Shading Coefficient (SC)	0.58				Typical # Stories	1		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	60%							40%	100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	20 m²/person	215 ft²/person	%OA	10.83%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation ____ L/s.m² ____ CFM/ft² ____ operation (%)

Sizing Factor	1.3	
Total Air Circulation or Design Air Flow	3.46 L/s.m²	0.68 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.40 L/s.m²	0.08 CFM/ft²

Separate Make-up air unit (100% OA) ____ L/s.m² ____ CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	191,742	
Peak Zone Sensible Load	112,725	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R	13.2	ft³/lbm
Design CFM	5,244	
Total air circulation or Design air	3.46	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year: ____

Incidence of Annual Room Controls Maintenance ____

Incidence of Annual HVAC Controls Maintenance ____

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Labrador Interconnected
Baseline			

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.50			
Connected Load	10.3	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	400	550	650					Total
% Distribution	100%							100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)				100.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	88	65	95	90	

EUI: 2.3 kWh/ft².yr; 88 MJ/m².yr

ARCHITECTURAL LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.50			
Connected Load	21.2	W/m²	2.0	W/ft²
Occ. Period(Hrs./yr.)	4300			
Unocc. Period(Hrs./yr.)	4460			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

								Total
Light Level (Lux)	200	300	400	500				Total
% Distribution			100%					100%
Weighted Average								**400**

	INC	CFL	T12	T8	HID	T5HO	LED	TOTAL
System Present (%)	30%	50%					20%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.80	0.80	
Efficacy (L/W)	15	50	72	84	65	95	90	

EUI = Load X Hrs. X SF X GLFF

EUI: 4.7 kWh/ft².yr; 181 MJ/m².yr

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

								Total
Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 15.75 W/m² — EUI TOTAL: 7 kWh/ft².yr; 269 MJ/m².yr

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.16	0.16	0.01		0.06	
Connected Load (W/m²)	0.4	0.4	0.1		0.1	1.15
Connected Load (W/ft²)	0.0	0.0	0.00		0.01	0.11
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	1.8	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.2	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	65%			

		kWh/ft².yr	MJ/m².yr
Computer Servers	EUI	0.11	4.42
Computer Equipment	EUI	0.41	16.00
Plug Loads	EUI	0.60	23.23

FOOD SERVICE EQUIPMENT

Provide description below: Fuel Oil / Propane Fuel Share: — Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Fuel Oil / Propane EUI	All Electric EUI
EUI kWh/ft².yr	0.1	34.3
MJ/m².yr	5.0	1330.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI: 16.8 kWh/ft².yr; 650.0 MJ/m².yr

BLOCK HEATERS & MISCELLANEOUS

		kWh/ft².yr	MJ/m².yr
Block Heaters	EUI	0.1	5
Miscellaneous	EUI	0.1	5

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Labrador Interconnected
Baseline			

SPACE HEATING

Heating Plant Type

	Fuel Oil / Propane			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 51.4 W/m² — 16.3 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 427 MJ/m².yr — 11.0 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.0
MJ/m².yr	427

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	11.0
MJ/m².yr	427

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load: 60 W/m² — 19 Btu/hr.ft² — 626 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 65.7 MJ/m².yr — 1.7 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period) 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 90.0%

Electric Fuel Share: 100.0% — Fuel Oil / Propane Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.7
MJ/m².yr	29

Fuel Oil / Propane EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	29

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					0%
Eff./COP	0.65				0.75

	Fossil	Elec. Res.
Fuel Share	0%	100%
Blended Efficiency	0.75	0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 700.0

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	19.9
MJ/m².yr	769

Fuel Oil / Propane EUI	
kWh/ft².yr	24.1
MJ/m².yr	933

Market Composite EUI	
kWh/ft².yr	19.9
MJ/m².yr	769.2

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Labrador Interconnected
Baseline			

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.5	L/s.m²	0.68	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	2.7	W/m²	0.25	W/ft²
Fan Design Load VAV	2.7	W/m²	0.25	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	60%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.19	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.58	W/m²	0.05	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0038	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	12.2	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.8	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.4
	MJ/m².yr	53.0

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Restaurant	All	New	Labrador Interconnected
Baseline			

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **92.8** kWh/ft².yr **3,594.3** MJ/m².yr **Fuel Oil / Propane:** **0.0** kWh/ft².yr **0.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.3	88.3
ARCHITECTURAL LIGHTING	4.7	180.8
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	23.2
HVAC FANS & PUMPS	1.4	53.0
REFRIGERATION	16.8	650.0
MISCELLANEOUS	0.1	5.0
BLOCK HEATERS	0.1	5.0
COMPUTER EQUIPMENT	0.4	16.0
COMPUTER SERVERS	0.1	4.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Fuel Oil / Propane	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	11.0	426.7		
SPACE COOLING	0.7	25.7		
DOMESTIC HOT WATER	19.9	769.2	0.0	0.0
FOOD SERVICE EQUIPMENT	34.3	1,330.0		

Terms Used in Building Profile Summaries

Profile Term	Explanation
Building envelope	Defines the thermal characteristics of a building's exterior components
U-value	The rate of heat loss, in Btu per hour per square foot per degree Fahrenheit (BTU/hr. f^2.°F) through walls, roofs and windows. The U-value is the reciprocal of the R-value
Shading coefficient (SC)	Is a measure of the total amount of heat passing through the glazing compared with that through a single clear glass
Window-to-wall ratio	Defines the ratio of window to insulated exterior wall area
General lighting	Defines the lighting types that are used within the main areas of a building, e.g., for a School, the area is classrooms and the lighting type is fluorescent; for a Food Retail store, the main area is the retail floor.
LPD	Lighting power density expressed in terms of W/ft^2
Lux	The amount of visible light per square meter incident on a surface (lumen/m^2)
Inc	Incandescent lamps
CFL	Compact fluorescent lamps
T12	T12 fluorescent lamps with magnetic ballasts
T8	T8 fluorescent lamps with electronic ballasts
MH	Metal halide lamps
HPS	High-pressure sodium lamps
HID	High-intensity discharge lighting includes both MH and HPS
T5HO	T5 High Output fluorescent lamps
LED	Light Emitting Diode lamps
Secondary lighting	Defines the lighting types that are used within the secondary areas of a building, e.g., for a School, the secondary areas are corridors, lobbies, foyers, etc.
Outdoor lighting	Defines the outdoor lighting including parking lot and façade
Overall LPD	The total floor weighted LPD that includes general, secondary, and outdoor
Fans	Defines the mix of air handling systems
CAV	Constant air volume
VAV	Variable air volume
Space heating	Defines the mix of heating equipment types found within the stock of buildings
ASHP	Air-source heat pump
WSHP	Water-source heat pump
Resistance	Electric resistance heating equipment including boilers and baseboard heaters
Fuel Oil / Propane	Fossil fuel fired equipment, including space heating, domestic hot water heating, and cooking equipment
Space cooling	Defines the mix of cooling equipment types found within the stock of buildings
Centrifugal	Standard centrifugal chillers with a full load performance of 0.75 kW/ton
Centri HE	High-efficiency centrifugal chillers assumed to have a performance of <0.65 kW/ton
Recip open	Semi-hermetic reciprocating chillers
DX	Direct expansion cooling equipment that use small tonnage hermetic compressors

Appendix D Background-Section 6: Reference Case Peak Load

Introduction

The following exhibits show the Reference Case peak load profiles for each region.

Exhibit 126 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Island Interconnected Region (MW)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Office	2014	-	3.7	0.7	2.3	0.2	0.4	9.3	7.0	0.4	1.1	0.6	0.1	2.4	3.8	30.2	-	62.3
	2017	-	3.9	0.7	2.3	0.2	0.4	9.4	7.3	0.4	1.2	0.6	0.1	2.4	3.9	30.9	-	63.8
	2020	-	4.1	0.7	2.4	0.2	0.4	9.5	7.7	0.4	1.2	0.6	0.1	2.4	4.1	31.9	-	65.9
	2023	-	4.4	0.8	2.6	0.2	0.4	9.8	8.2	0.5	1.3	0.6	0.1	2.4	4.3	33.2	-	68.8
	2026	-	4.6	0.8	2.6	0.2	0.5	9.9	8.6	0.5	1.4	0.6	0.1	2.4	4.5	34.2	-	70.8
	2029	-	4.8	0.9	2.7	0.2	0.5	10.0	9.0	0.5	1.5	0.6	0.2	2.4	4.6	35.3	-	73.2
Small Office	2014	-	3.0	0.5	1.9	-	-	6.9	3.0	0.3	0.9	0.5	0.1	0.9	3.0	23.8	-	45.0
	2017	-	3.1	0.6	2.0	-	-	6.9	3.2	0.3	1.0	0.5	0.1	0.9	3.0	24.2	-	45.8
	2020	-	3.4	0.6	2.1	-	-	7.1	3.5	0.4	1.0	0.5	0.1	0.9	3.2	25.3	-	47.9
	2023	-	3.6	0.6	2.2	-	-	7.2	3.7	0.4	1.1	0.5	0.1	0.9	3.3	26.2	-	49.8
	2026	-	3.7	0.7	2.3	-	-	7.3	3.9	0.4	1.1	0.5	0.1	0.9	3.4	26.8	-	51.1
	2029	-	3.9	0.7	2.3	-	-	7.4	4.2	0.4	1.2	0.5	0.1	0.9	3.5	27.5	-	52.6
Large Non-food Retail	2014	-	0.3	0.1	0.6	-	1.4	5.9	4.3	0.2	0.4	0.5	0.7	0.6	1.2	10.9	-	26.9
	2017	-	0.3	0.1	0.7	-	1.5	5.9	4.4	0.2	0.4	0.5	0.7	0.6	1.2	11.1	-	27.3
	2020	-	0.3	0.1	0.7	-	1.6	6.1	4.6	0.2	0.4	0.5	0.7	0.6	1.3	11.5	-	28.5
	2023	-	0.4	0.1	0.7	-	1.6	6.2	4.8	0.2	0.5	0.5	0.8	0.6	1.3	11.9	-	29.5
	2026	-	0.4	0.1	0.8	-	1.7	6.2	4.9	0.2	0.5	0.5	0.8	0.6	1.4	12.2	-	30.2
	2029	-	0.4	0.1	0.8	-	1.8	6.3	5.1	0.2	0.5	0.5	0.8	0.6	1.4	12.5	-	31.0
Small Non-food Retail	2014	-	0.4	0.1	1.0	-	-	7.1	4.5	0.2	0.6	0.7	-	0.8	1.8	15.6	-	32.7
	2017	-	0.4	0.1	1.0	-	-	7.1	4.5	0.2	0.6	0.7	-	0.7	1.8	15.8	-	33.0
	2020	-	0.5	0.1	1.0	-	-	7.2	4.7	0.2	0.6	0.7	-	0.7	1.9	16.5	-	34.2
	2023	-	0.5	0.1	1.1	-	-	7.3	4.9	0.2	0.6	0.7	-	0.8	2.0	17.2	-	35.4
	2026	-	0.5	0.1	1.1	-	-	7.4	5.1	0.3	0.7	0.7	-	0.8	2.0	17.7	-	36.3
	2029	-	0.5	0.1	1.1	-	-	7.5	5.2	0.3	0.7	0.7	-	0.7	2.1	18.3	-	37.3
Food Retail	2014	-	0.3	0.1	1.2	-	3.3	2.9	1.8	0.1	0.4	0.3	10.0	0.5	0.6	7.5	-	28.9
	2017	-	0.4	0.1	1.3	-	3.3	2.9	1.8	0.1	0.4	0.3	10.1	0.5	0.6	7.5	-	29.2
	2020	-	0.4	0.1	1.3	-	3.5	2.9	1.9	0.1	0.4	0.3	10.5	0.5	0.6	7.8	-	30.3
	2023	-	0.4	0.1	1.4	-	3.6	3.0	1.9	0.1	0.4	0.4	10.9	0.5	0.6	8.0	-	31.4
	2026	-	0.4	0.1	1.4	-	3.7	3.0	2.0	0.1	0.4	0.4	11.2	0.5	0.7	8.2	-	32.1
	2029	-	0.4	0.1	1.5	-	3.8	3.1	2.0	0.1	0.5	0.4	11.5	0.5	0.7	8.3	-	32.9

Exhibit 126 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Island Interconnected Region (MW) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Large Accomodation	2014	-	0.2	0.0	5.6	0.0	1.2	1.0	0.9	0.1	0.2	0.1	0.2	1.1	0.4	5.2	-	16.3
	2017	-	0.2	0.0	5.7	0.0	1.2	1.0	0.9	0.1	0.2	0.1	0.2	1.1	0.4	5.3	-	16.6
	2020	-	0.2	0.0	6.0	0.0	1.2	1.1	0.9	0.1	0.2	0.1	0.2	1.1	0.5	5.6	-	17.4
	2023	-	0.2	0.0	6.3	0.0	1.2	1.1	1.0	0.1	0.2	0.2	0.2	1.2	0.5	5.9	-	18.1
	2026	-	0.2	0.0	6.5	0.0	1.3	1.1	1.0	0.1	0.2	0.1	0.2	1.2	0.5	6.0	-	18.6
	2029	-	0.2	0.0	6.8	0.0	1.3	1.1	1.0	0.1	0.2	0.1	0.2	1.2	0.5	6.3	-	19.2
Small Accomodation	2014	-	0.1	0.0	2.6	-	0.3	0.6	0.2	0.0	0.1	0.1	0.1	0.3	0.2	2.8	-	7.3
	2017	-	0.1	0.0	2.7	-	0.3	0.6	0.2	0.0	0.1	0.1	0.1	0.3	0.2	2.8	-	7.4
	2020	-	0.1	0.0	2.8	-	0.3	0.6	0.2	0.0	0.1	0.1	0.1	0.3	0.2	2.9	-	7.7
	2023	-	0.1	0.0	2.9	-	0.3	0.6	0.2	0.1	0.1	0.1	0.1	0.3	0.2	3.0	-	8.0
	2026	-	0.1	0.0	3.0	-	0.3	0.6	0.2	0.1	0.1	0.1	0.1	0.3	0.2	3.1	-	8.2
	2029	-	0.1	0.0	3.1	-	0.3	0.6	0.3	0.1	0.1	0.1	0.1	0.3	0.2	3.2	-	8.4
Healthcare	2014	-	0.5	0.1	3.1	0.1	3.1	0.7	3.6	0.1	0.9	0.5	0.2	2.9	0.9	16.2	-	32.9
	2017	-	0.5	0.1	3.1	0.1	3.2	0.7	3.6	0.1	1.0	0.5	0.2	2.9	0.9	16.3	-	33.1
	2020	-	0.5	0.1	3.2	0.1	3.3	0.7	3.8	0.1	1.0	0.5	0.2	2.9	0.9	16.7	-	33.9
	2023	-	0.5	0.1	3.4	0.1	3.3	0.7	3.9	0.1	1.1	0.5	0.2	2.9	0.9	17.1	-	34.9
	2026	-	0.6	0.1	3.5	0.1	3.4	0.7	4.0	0.2	1.1	0.5	0.2	2.9	0.9	17.4	-	35.6
	2029	-	0.6	0.1	3.7	0.1	3.5	0.7	4.1	0.2	1.1	0.5	0.2	2.9	1.0	17.8	-	36.3
Schools	2014	-	1.1	0.2	2.0	-	0.5	9.3	1.3	0.2	0.2	0.8	0.1	1.5	0.1	25.7	-	43.1
	2017	-	1.2	0.2	2.1	-	0.5	9.3	1.3	0.2	0.2	0.8	0.1	1.5	0.1	26.1	-	43.6
	2020	-	1.2	0.2	2.2	-	0.6	9.5	1.4	0.2	0.2	0.8	0.1	1.5	0.1	27.4	-	45.5
	2023	-	1.3	0.2	2.3	-	0.6	9.7	1.5	0.2	0.3	0.8	0.1	1.5	0.2	28.7	-	47.4
	2026	-	1.4	0.2	2.4	-	0.6	9.8	1.5	0.2	0.3	0.8	0.1	1.5	0.2	29.7	-	48.7
	2029	-	1.4	0.3	2.5	-	0.6	9.9	1.6	0.2	0.3	0.8	0.1	1.5	0.2	30.9	-	50.3
Universities and Colleges	2014	-	1.5	0.1	0.4	0.1	1.1	6.4	5.4	0.3	0.7	0.5	0.4	0.8	0.5	3.8	-	22.0
	2017	-	1.6	0.1	0.5	0.1	1.1	6.4	5.4	0.3	0.8	0.4	0.4	0.8	0.5	3.9	-	22.2
	2020	-	1.6	0.1	0.5	0.1	1.1	6.3	5.5	0.3	0.8	0.4	0.4	0.7	0.6	4.2	-	22.7
	2023	-	1.7	0.1	0.5	0.1	1.1	6.3	5.6	0.3	0.8	0.4	0.4	0.7	0.6	4.4	-	23.1
	2026	-	1.7	0.1	0.6	0.1	1.1	6.2	5.7	0.3	0.8	0.4	0.4	0.7	0.7	4.5	-	23.5
	2029	-	1.8	0.1	0.6	0.1	1.2	6.2	5.7	0.3	0.9	0.4	0.4	0.7	0.7	4.7	-	23.8
Warehouse/Wholesale	2014	-	0.2	0.1	0.7	-	-	3.6	0.6	0.2	0.6	0.3	1.0	0.5	0.0	7.8	-	15.6
	2017	-	0.2	0.1	0.8	-	-	3.6	0.6	0.2	0.6	0.3	1.0	0.5	0.0	8.0	-	15.8
	2020	-	0.3	0.1	0.8	-	-	3.7	0.6	0.2	0.6	0.3	1.1	0.5	0.0	8.4	-	16.5
	2023	-	0.3	0.1	0.9	-	-	3.7	0.6	0.2	0.7	0.3	1.1	0.5	0.0	8.7	-	17.1
	2026	-	0.3	0.1	0.9	-	-	3.8	0.6	0.2	0.7	0.3	1.2	0.5	0.1	9.0	-	17.5
	2029	-	0.3	0.1	0.9	-	-	3.8	0.7	0.2	0.7	0.3	1.2	0.5	0.1	9.3	-	18.0

Exhibit 126 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Island Interconnected Region (MW) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Restaurants	2014	-	0.1	0.0	7.1	-	12.6	0.3	0.5	0.0	0.1	0.1	2.0	1.2	0.4	3.6	-	27.9
	2017	-	0.1	0.0	7.2	-	12.8	0.3	0.5	0.0	0.1	0.1	2.0	1.2	0.4	3.7	-	28.4
	2020	-	0.1	0.0	7.6	-	13.5	0.3	0.6	0.0	0.1	0.1	2.1	1.2	0.4	4.0	-	29.9
	2023	-	0.1	0.0	7.9	-	14.0	0.3	0.6	0.0	0.1	0.1	2.2	1.2	0.4	4.3	-	31.2
	2026	-	0.1	0.0	8.1	-	14.4	0.3	0.6	0.0	0.1	0.1	2.2	1.2	0.4	4.5	-	32.1
	2029	-	0.1	0.0	8.4	-	14.9	0.3	0.6	0.0	0.1	0.1	2.3	1.2	0.4	4.7	-	33.2
Large Other Buildings	2014	-	1.0	0.2	2.9	0.1	3.0	4.9	3.2	0.2	0.6	0.5	1.9	1.5	1.0	13.6	-	34.5
	2017	-	1.1	0.2	3.0	0.1	3.0	4.9	3.3	0.2	0.6	0.5	1.9	1.5	1.0	13.8	-	35.0
	2020	-	1.1	0.2	3.1	0.1	3.2	4.9	3.5	0.2	0.7	0.5	2.0	1.5	1.1	14.5	-	36.5
	2023	-	1.2	0.2	3.3	0.1	3.3	5.0	3.6	0.2	0.7	0.5	2.1	1.5	1.1	15.0	-	37.8
	2026	-	1.2	0.2	3.4	0.1	3.4	5.1	3.7	0.2	0.7	0.5	2.1	1.5	1.2	15.4	-	38.7
	2029	-	1.3	0.2	3.5	0.1	3.5	5.1	3.8	0.2	0.8	0.5	2.2	1.5	1.2	15.9	-	39.8
Small Other Buildings	2014	-	0.9	0.2	2.6	0.0	2.7	4.7	2.7	0.2	0.6	0.5	1.8	1.2	0.9	13.0	-	31.9
	2017	-	0.9	0.2	2.5	0.0	2.6	4.6	2.7	0.2	0.6	0.5	1.8	1.2	0.9	12.9	-	31.7
	2020	-	1.0	0.2	2.6	0.0	2.7	4.6	2.8	0.2	0.6	0.4	1.8	1.2	1.0	13.2	-	32.3
	2023	-	1.0	0.2	2.7	0.0	2.8	4.6	2.9	0.2	0.7	0.4	1.9	1.2	1.0	13.7	-	33.3
	2026	-	1.1	0.2	2.8	0.0	2.9	4.6	2.9	0.2	0.7	0.4	1.9	1.2	1.0	14.1	-	34.1
	2029	-	1.1	0.2	2.9	0.0	2.9	4.7	3.0	0.2	0.7	0.4	2.0	1.2	1.1	14.4	-	34.9
Other Institutional	2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non-Buildings	2014	-	-	-	-	-	-	-	-	30.5	-	-	-	-	-	-	-	30.5
	2017	-	-	-	-	-	-	-	-	30.9	-	-	-	-	-	-	-	30.9
	2020	-	-	-	-	-	-	-	-	32.0	-	-	-	-	-	-	-	32.0
	2023	-	-	-	-	-	-	-	-	32.9	-	-	-	-	-	-	-	32.9
	2026	-	-	-	-	-	-	-	-	33.6	-	-	-	-	-	-	-	33.6
	2029	-	-	-	-	-	-	-	-	34.3	-	-	-	-	-	-	-	34.3
Street Lighting	2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	4.9
	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8
	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8
	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8
	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8
	2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8
Grand Total	2014	0.0	13.4	2.3	34.0	0.5	29.6	63.6	39.0	33.0	7.4	6.0	18.5	16.1	14.9	179.6	4.9	462.7
	2017	0.0	13.9	2.4	34.6	0.5	30.0	63.3	39.7	33.5	7.6	5.8	18.7	16.0	15.1	182.5	4.8	468.5
	2020	0.0	14.7	2.5	36.4	0.5	31.2	64.4	41.5	34.7	8.1	5.9	19.5	16.0	15.8	189.7	4.8	485.9
	2023	0.0	15.6	2.7	38.1	0.5	32.4	65.5	43.3	35.8	8.5	5.9	20.2	16.1	16.6	197.3	4.8	503.4
	2026	0.0	16.3	2.8	39.4	0.6	33.3	66.0	44.7	36.5	8.9	5.8	20.8	16.1	17.1	202.8	4.8	515.9
	2029	0.0	17.0	2.9	40.9	0.6	34.3	66.7	46.2	37.3	9.3	5.8	21.4	16.2	17.7	209.1	4.8	530.3

Exhibit 127 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Labrador Interconnected Region (MW)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Small Office	2014	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.8
	2017	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.8
	2020	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.9
	2023	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.9
	2026	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.9
	2029	0.0	0.1	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5	-	0.9
Large Non-food Retail	2014	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	1.8
	2017	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	1.8
	2020	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	1.8
	2023	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	1.8
	2026	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-	1.8
	2029	0.0	0.0	0.0	0.1	-	0.1	0.4	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.9	-	1.9
Small Non-food Retail	2014	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.0	2.2	-	3.6
	2017	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.0	2.2	-	3.6
	2020	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.0	2.3	-	3.7
	2023	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.1	2.4	-	3.7
	2026	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.1	2.4	-	3.8
	2029	0.0	0.0	0.0	0.1	-	-	0.7	0.2	0.0	0.1	0.1	-	0.1	0.1	2.5	-	3.9
Food Retail	2014	0.0	0.0	0.0	0.1	-	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
	2017	0.0	0.0	0.0	0.1	-	0.2	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
	2020	0.0	0.0	0.0	0.1	-	0.2	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
	2023	0.0	0.0	0.0	0.1	-	0.2	0.1	0.1	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
	2026	0.0	0.0	0.0	0.1	-	0.2	0.1	0.1	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
	2029	0.0	0.0	0.0	0.1	-	0.2	0.1	0.1	0.0	0.0	0.0	0.5	0.0	0.0	1.6	-	2.6
Large Accomodation	2014	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
	2017	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
	2020	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
	2023	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
	2026	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
	2029	0.0	0.0	0.0	0.6	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.7	-	1.8
Small Accomodation	2014	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.2
	2017	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.2
	2020	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.2
	2023	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.2
	2026	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.3
	2029	0.0	0.0	0.0	0.1	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.3
Healthcare	2014	0.1	0.1	0.0	0.7	0.0	0.4	0.1	0.5	0.0	0.1	0.1	0.0	0.4	0.0	0.8	-	3.4
	2017	0.1	0.1	0.0	0.6	0.0	0.3	0.1	0.4	0.0	0.1	0.1	0.0	0.3	0.0	0.6	-	2.6
	2020	0.1	0.1	0.0	0.6	0.0	0.3	0.1	0.4	0.0	0.1	0.1	0.0	0.3	0.0	0.6	-	2.6
	2023	0.1	0.1	0.0	0.6	0.0	0.3	0.1	0.4	0.0	0.1	0.0	0.0	0.3	0.0	0.6	-	2.6
	2026	0.1	0.1	0.0	0.6	0.0	0.3	0.1	0.4	0.0	0.1	0.0	0.0	0.3	0.0	0.6	-	2.6
	2029	0.1	0.1	0.0	0.6	0.0	0.4	0.1	0.4	0.0	0.1	0.0	0.0	0.3	0.0	0.6	-	2.6

Exhibit 127 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Labrador Interconnected Region (MW) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Schools	2014	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.8	-	2.8
	2017	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.8	-	2.8
	2020	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.8	-	2.9
	2023	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.8	-	2.9
	2026	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.9	-	2.9
	2029	0.0	0.1	0.0	0.1	-	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.9	-	2.9
Universities and Colleges	2014	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
	2017	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
	2020	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
	2023	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
	2026	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
	2029	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-	0.7
Warehouse/Wholesale	2014	0.0	0.0	0.0	0.1	-	-	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.7
	2017	0.0	0.0	0.0	0.1	-	-	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.7
	2020	0.0	0.0	0.0	0.1	-	-	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.7
	2023	0.0	0.0	0.0	0.1	-	-	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.7
	2026	0.0	0.0	0.0	0.1	-	-	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.8
	2029	0.0	0.0	0.0	0.1	-	-	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1	-	1.8
Restaurants	2014	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.5
	2017	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.5
	2020	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.5
	2023	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.5
	2026	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.6
	2029	0.0	0.0	0.0	0.7	-	1.2	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.3	-	2.6
Large Other Buildings	2014	0.1	0.2	0.0	2.0	0.0	1.8	1.4	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.1	-	14.8
	2017	0.1	0.2	0.0	2.1	0.0	1.8	1.3	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.1	-	14.8
	2020	0.1	0.2	0.0	2.1	0.0	1.8	1.3	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.2	-	14.8
	2023	0.1	0.2	0.0	2.1	0.0	1.8	1.3	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.2	-	14.8
	2026	0.1	0.2	0.0	2.1	0.0	1.8	1.3	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.2	-	14.8
	2029	0.1	0.2	0.0	2.1	0.0	1.8	1.3	1.0	0.0	0.3	0.2	0.7	0.7	0.1	6.2	-	14.8
Small Other Buildings	2014	0.1	0.2	0.0	1.0	0.0	1.0	1.1	0.6	0.0	0.2	0.1	0.4	0.4	0.1	4.3	-	9.6
	2017	0.1	0.2	0.0	1.0	0.0	1.0	1.1	0.6	0.0	0.2	0.1	0.4	0.4	0.1	4.3	-	9.6
	2020	0.1	0.2	0.0	1.1	0.0	1.0	1.1	0.6	0.0	0.2	0.1	0.4	0.4	0.1	4.4	-	9.8
	2023	0.1	0.2	0.0	1.1	0.0	1.1	1.1	0.6	0.0	0.2	0.1	0.4	0.4	0.1	4.5	-	10.0
	2026	0.1	0.2	0.0	1.1	0.0	1.1	1.1	0.7	0.0	0.2	0.1	0.4	0.4	0.1	4.6	-	10.2
	2029	0.1	0.2	0.0	1.1	0.0	1.1	1.1	0.7	0.0	0.2	0.1	0.5	0.4	0.1	4.7	-	10.4

Exhibit 127 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Labrador Interconnected Region (MW) (cont'd…)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Other Institutional	2014	0.2	0.2	-	0.9	-	0.2	2.2	1.3	0.1	0.3	0.2	0.2	0.7	0.1	2.7	-	9.2
	2017	0.2	0.2	-	0.9	-	0.2	2.2	1.3	0.1	0.3	0.2	0.2	0.7	0.1	9.0	-	15.5
	2020	0.2	0.2	-	0.9	-	0.2	2.1	1.3	0.1	0.3	0.2	0.2	0.7	0.1	13.5	-	20.0
	2023	0.2	0.2	-	0.9	-	0.2	2.1	1.3	0.1	0.3	0.2	0.2	0.7	0.1	13.5	-	20.0
	2026	0.2	0.2	-	0.9	-	0.2	2.1	1.3	0.1	0.4	0.2	0.2	0.7	0.1	13.5	-	20.0
	2029	0.2	0.2	-	0.9	-	0.2	2.1	1.3	0.1	0.4	0.2	0.2	0.6	0.1	13.6	-	20.0
Non-Buildings	2014	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
	2017	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
	2020	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
	2023	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
	2026	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
	2029	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	0.8
Street Lighting	2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.2
	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3
	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3
	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3
	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3
	2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3
Grand Total	2014	0.6	0.9	0.1	6.6	0.0	5.0	7.2	4.1	0.9	1.1	0.8	2.2	2.8	0.5	23.4	0.2	56.4
	2017	0.6	0.9	0.1	6.4	0.0	5.0	7.0	4.1	0.9	1.1	0.8	2.2	2.6	0.4	29.6	0.3	62.0
	2020	0.6	0.9	0.1	6.5	0.0	5.0	7.0	4.1	1.0	1.1	0.8	2.2	2.6	0.5	34.4	0.3	67.0
	2023	0.6	1.0	0.1	6.5	0.0	5.1	6.9	4.2	1.0	1.2	0.7	2.2	2.6	0.5	34.6	0.3	67.4
	2026	0.6	1.0	0.2	6.6	0.0	5.1	6.8	4.2	1.0	1.2	0.7	2.2	2.5	0.5	34.8	0.3	67.8
	2029	0.6	1.0	0.2	6.7	0.0	5.2	6.8	4.3	1.0	1.2	0.7	2.3	2.5	0.5	35.1	0.3	68.2

Exhibit 128 Electric Peak Loads, by Milestone Year, End Use and Sub sector Type, Isolated Region (MW)

Sub-Sector	Year	Block Heaters	Computer Equipment	Computer Servers	Domestic Hot Water	Elevator	Food Service Equipment	General Lighting	HVAC Fans & Pumps	Miscellaneous Equipment	Other Plug Loads	Outdoor Lighting	Refrigeration	Secondary Lighting	Space Cooling	Space Heating	Street Lighting	Grand Total
Labrador Isolated C/I Buildings	2014	0.1	0.2	-	0.1	-	0.2	1.2	0.2	-	0.1	0.1	0.4	0.2	-	0.2	-	3.0
	2017	0.1	0.2	-	0.1	-	0.2	1.2	0.2	-	0.1	0.1	0.4	0.2	-	0.2	-	2.9
	2020	0.1	0.2	-	0.1	-	0.2	1.3	0.2	-	0.1	0.1	0.5	0.3	-	0.2	-	3.3
	2023	0.1	0.2	-	0.1	-	0.2	1.3	0.2	-	0.1	0.1	0.5	0.3	-	0.3	-	3.4
	2026	0.1	0.2	-	0.1	-	0.2	1.4	0.2	-	0.1	0.1	0.5	0.3	-	0.3	-	3.6
	2029	0.1	0.2	-	0.1	-	0.2	1.4	0.3	-	0.1	0.1	0.5	0.3	-	0.3	-	3.7
Island Isolated C/I Buildings	2014	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.2
	2017	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.2
	2020	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.3
	2023	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.3
	2026	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.0	0.0	-	-	-	0.3
	2029	-	0.0	-	-	-	0.0	0.1	0.0	-	0.0	0.0	0.1	0.0	-	-	-	0.3
Street Lighting	2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
	2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
	2026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
	2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
Grand Total	2014	0.1	0.2	-	0.1	-	0.2	1.3	0.2	-	0.1	0.1	0.4	0.3	-	0.2	0.1	3.3
	2017	0.1	0.2	-	0.1	-	0.2	1.3	0.2	-	0.1	0.1	0.4	0.3	-	0.2	0.1	3.2
	2020	0.1	0.2	-	0.1	-	0.2	1.4	0.2	-	0.1	0.1	0.5	0.3	-	0.2	0.1	3.7
	2023	0.1	0.2	-	0.1	-	0.2	1.5	0.3	-	0.1	0.1	0.5	0.3	-	0.3	0.1	3.8
	2026	0.1	0.2	-	0.1	-	0.3	1.5	0.3	-	0.2	0.1	0.6	0.3	-	0.3	0.1	3.9
	2029	0.1	0.2	-	0.1	-	0.3	1.5	0.3	-	0.2	0.1	0.6	0.3	-	0.3	0.1	4.1

Appendix E Background-Section 7: Technology Assessment: Energy Efficiency Measures

Introduction

The following exhibits show the full list of energy efficiency and peak demand measures that were considered for analysis, with comments for the measures not included in this study.

Exhibit 129 Full List of Potential Energy Efficiency Measures for the Commercial Sector

Energy Efficiency Measures	Include	Comments
LIGHTING		General comment: ensure resolution of technology aligns with baseline; need to group
LED Screw-In Lamps	x	
LED High Bay Fixtures	x	MH baseline
LED Tubular Lamps	x	T8 baseline since T12 are being phased out
LED Troffers	x	
LED Outdoor Fixtures	x	To include representative lighting fixture for outdoor applications
LED Exit Signs	x	
LED Downlight Fixture or Retrofit Kit		Potential to be captured by LED Screw-In Lamps measure
Lighting Controls		More descriptive measures included below
High Performance T8 Fixtures	x	T8 baseline since T12 are being phased out
Low Ballast-Factor T8 systems		Removed since this is now the baseline (i.e. T12 being phased out)
T5HO Fixtures	x	For high bay (>16 ft) applications
Occupancy Sensors (Lighting)	x	
Dimming Control (Daylighting)	x	
Lighting Controls (Outdoor)	x	
Billboard lighting		Exclude since this is very specific
CFLs		To exclude since this is a transition technology (i.e. LEDs capture opportunity)
HVAC		
High-Efficiency Air Source Heat Pumps	x	
Ductless Mini-Split Heat Pumps	x	
Ground Source Heat Pumps	x	Institutional sector is presently main market due to long payback
Hotel Occupancy Sensors	x	Consider only for hotels and expand to include lighting. Originally HVAC Occupancy Sensors.
Demand Control Ventilation (DCV)	x	
High Efficiency HVAC Air Filters		Very specific measure beyond resolution of baseline
VFDs on HVAC Motors	x	
Ventilation Heat Recovery	x	
Air Curtains		Included under building envelope category
Radiant Infrared Heaters	x	
High Efficiency Chillers	x	
High Efficiency RTUs	x	
Adjustable Speed Drives		Same as VFDs measure included above
Premium Efficiency Motors	x	
Advanced Building Automation Systems	x	
Building Recommissioning	x	

Exhibit 129 Full List of Potential Energy Efficiency Measures for the Commercial Sector (cont'd…)

Energy Efficiency Measures	Include	Comments
Programmable Thermostats	x	
Demand Control Kitchen Ventilation (DCKV)	x	Specific to sub sectors with commercial kitchens
REFRIGERATION		General Comment: There is a lot of very specific measures that are beyond resolution of baseline
LED Refrigerated Display Case Lighting	x	Moved from Lighting end use
Air Curtains		Included under building envelope category
Variable Speed Drives		Generally not added to existing compressor motors
Cooler Night Covers	x	
Refrigerated Cases with Doors	x	Original measure was focused on adding doors to existing display cases, which is not common
ECM Motors and Evaporator Fan Motor Controllers	x	Included ECM motors as well
Freezer Defrost Controllers	x	
Outside Air Economizers for Walk-In Coolers		Not a mature or commonly implemented measure
Refrigerated Vending Machine Controllers	x	Vending Miser
High Efficiency Compressors	x	Usually not practical as a retrofit
ECM Evaporator Fan Motor		Merged with evaporator fan motor controllers measure
Automatic Door Closers (Walk-In Coolers)	x	
Door Gaskets		Excluded since there is a very wide range of savings
VSD Screw Compressors		Covered by high efficiency compressors measure
Refrigeration Heat Recovery	x	Focus on arenas
Refrigeration Controls	x	To be represented by floating head pressure controls
Refrigeration Free Cooling		Not a mature or commonly implemented measure
CEE-Rated Refrigerators and Freezers	x	May be difficult to get cost data
High efficiency supermarket refrigeration		Covered by other measures
DOMESTIC HOT WATER		
On-Demand Water Heaters	x	To consider only for hotels
High-Efficiency Water Heaters		Not available -- ENERGY STAR electric water heaters are actually HPWHs
Heat Pump Water Heaters	x	
Efficient CIP Systems (Clean In Place)		Excluded since this is an industrial measure
Low-Flow Pre-Rinse Spray Valves	x	To consider only for sub sector with commercial kitchens
Low-Flow Faucet Aerators	x	
Low-Flow Showerheads	x	To consider only for hotels
Drainwater Heat Recovery	x	To consider only for hotels
Tankless Water Heaters		Excluded since this is identical to on-demand water heaters
PROCESS		
Compressed Air - air entraining nozzles		Excluded since this is an industrial measure
APPLIANCES (ENERGY STAR)		
ENERGY STAR Dishwashers	x	To consider only for sub sector with commercial kitchens

Exhibit 129 Full List of Potential Energy Efficiency Measures for the Commercial Sector (cont'd…)

Energy Efficiency Measures	Include	Comments
Hot Food Holding Cabinets		Excluded since this is a very specific application
Commercial Clothes Washers		To be considered by residential sector
High-Efficiency Cooking Equipment	x	Measure added to capture other specific measures
Fryers		Too specific -- general measure added above
Griddles		Too specific -- general measure added above
Steam Cookers		Too specific -- general measure added above
Convection Ovens		Too specific -- general measure added above
High-Efficiency Ice makers		Exclude since there is no incremental cost for ENERGY STAR ice makers
Combination Oven		Too specific -- general measure added above
Induction Ranges		Too specific -- general measure added above
Clothes Dryers		Excluded since there is no ENERGY STAR category for clothes dryer. Better technology (e.g. microwave and heat pumps) is still many years away.
Vending Machines		Excluded since this is covered by VendingMiser measure
BUILDING ENVELOPE		
Roof Insulation	x	
Wall Insulation	x	
ENERGY STAR Windows		Covered below
High Performance Glazing Systems	x	
Door Systems		Too specific and covered by measures immediately above and below
Air Curtains	x	Focus on sub sectors with loading docks and/or doors that are opening and closing often
Skylights		Excluded since this is too specific and not very common
Slab/Floor Insulation		Included in new construction measures
COMPUTER EQUIPMENT (ENERGY STAR)		
ENERGY STAR Computers	x	
ENERGY STAR Office Equipment	x	
Energy-Efficient Server Technologies	x	To consider enterprise servers, since these are more wide-spread throughout building stock
NEW CONSTRUCTION		
New Construction (25% More Efficient)	x	
New Construction (40% More Efficient)	x	
STREET LIGHTING		
Electrodeless Induction Lighting		Considering LED street lighting instead
Dimming Controls		Considering LED street lighting instead
LED Street Lighting	x	Not including controls

Exhibit 130 Full List of Potential Peak Demand Measures for the Commercial Sector

Peak Demand Measures	Include	Comments
HVAC		
Building Automated Controls		Demand impacts covered by EE measures
Electric Thermal Storage	x	
Space Heating Controls	x	To consider utility controlled load switch
Load Shifting (Preheating)		See electric thermal storage measure
VFDs		Demand impacts covered by EE measure
HVAC Fans and Pumps	x	
DOMESTIC HOT WATER		
Electric DHW Controls	x	To consider utility controlled load switch
LIGHTING		
Street Lighting and Parking Lot Lighting Controls		Demand impacts covered by EE measures
Lighting Controls	x	Control of non-critical loads
REFRIGERATION		
Refrigeration Controls	x	Control of non-critical loads
OTHER		
Soft Starters		Industrial measure (i.e. for large motors)
Plug Load Controls		Not relevant to commercial sector
Kitchen and Laundry Load Controls		Demand impacts covered by EE measures
Fuel Switching		Outside of study scope
Curtailment		Outside of study scope

Appendix F Background-Section 8: Economic Potential: Electric Energy Forecast

Introduction

The following three exhibits provide the economic potential energy efficiency results for the island Interconnected, Labrador Interconnected, and Isolated regions, respectively. The three exhibits following those provide the economic potential load reduction results for the Island Interconnected, Labrador Interconnected and Isolated regions respectively. The latter three exhibits do not include the load reduction associated with energy efficiency measures, which were already presented by region in Exhibit 52.

Exhibit 131 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year, Island Interconnected (MWh/yr.)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Refrigeration	Domestic Hot Water	Computer Equipment	Secondary Lighting	Outdoor Lighting	Street Lighting	Space Cooling	Other Plug Loads	Food Service Equipment	Computer Servers	TOTAL
Large Office	2017	35,396	21,111	14,702	112	2,009	7,233	4,890	1,856	-	2,385	2,000	-	643	**92,337**
	2020	40,728	20,671	15,130	118	2,047	9,231	4,640	2,251	-	2,430	2,048	-	1,093	**100,389**
	2023	47,060	20,538	15,984	132	2,129	9,532	4,441	2,669	-	2,563	2,101	-	1,114	**108,262**
	2026	51,318	25,502	16,999	148	2,227	9,797	4,260	2,988	-	2,728	2,149	-	1,135	**119,251**
	2029	58,110	25,654	18,382	170	2,363	10,076	4,119	2,902	-	2,967	2,199	-	1,156	**128,099**
Small Office	2017	43,695	15,509	6,925	-	1,486	5,876	1,806	1,509	-	2,370	211	-	523	**79,910**
	2020	44,071	15,207	7,141	-	1,618	7,533	1,710	1,830	-	2,393	226	-	889	**82,619**
	2023	45,395	15,168	7,670	-	1,794	7,766	1,634	2,175	-	2,497	240	-	907	**85,245**
	2026	45,364	18,334	8,223	-	1,973	7,974	1,560	2,432	-	2,606	251	-	924	**89,642**
	2029	47,874	19,050	8,975	-	2,145	8,191	1,497	2,357	-	2,767	263	-	941	**94,060**
Large Non-food Retail	2017	9,064	16,499	9,307	2,188	453	561	1,346	1,372	-	936	774	-	-	**42,500**
	2020	10,503	16,111	9,430	2,213	466	721	1,282	1,667	-	942	789	-	-	**44,124**
	2023	12,172	15,965	9,764	2,294	496	744	1,236	1,988	-	981	804	-	-	**46,444**
	2026	13,875	15,841	10,122	2,380	529	765	1,192	2,230	-	1,024	819	-	-	**48,778**
	2029	15,705	15,864	10,614	2,502	573	787	1,158	2,174	-	1,087	835	-	-	**51,299**
Small Non-food Retail	2017	16,763	14,887	7,117	-	690	809	1,812	1,984	-	1,078	-	-	-	**45,139**
	2020	17,976	14,504	7,281	-	705	1,034	1,723	2,405	-	1,090	-	-	-	**46,719**
	2023	19,461	14,304	7,585	-	734	1,066	1,648	2,843	-	1,130	-	-	-	**48,770**
	2026	20,405	17,157	7,962	-	769	1,094	1,579	3,176	-	1,185	-	-	-	**53,328**
	2029	22,336	17,218	8,479	-	818	1,124	1,523	3,070	-	1,267	-	-	-	**55,836**
Food Retail	2017	6,396	9,878	3,832	32,765	855	651	927	1,014	-	466	746	163	-	**57,693**
	2020	7,290	9,650	3,872	32,955	872	833	894	1,232	-	467	761	326	-	**59,151**
	2023	8,394	9,545	3,992	33,738	915	857	878	1,472	-	480	776	488	-	**61,536**
	2026	9,494	9,451	4,122	34,589	961	880	864	1,654	-	494	790	543	-	**63,843**
	2029	10,667	9,433	4,303	35,824	1,024	903	860	1,618	-	517	805	543	-	**66,497**
Large Accomodation	2017	8,938	4,578	1,930	360	6,323	327	2,200	438	-	342	356	58	-	**25,850**
	2020	9,283	4,444	1,954	363	6,725	419	2,096	531	-	344	363	58	-	**26,579**
	2023	9,799	4,344	2,022	374	7,268	432	2,036	632	-	358	370	58	-	**27,692**
	2026	10,331	4,245	2,096	386	7,828	443	1,981	707	-	373	377	58	-	**28,824**
	2029	10,955	4,167	2,199	403	8,478	456	1,954	686	-	397	384	58	-	**30,135**
Small Accomodation	2017	4,595	2,328	331	0	3,245	155	627	208	-	89	169	-	-	**11,749**
	2020	4,707	2,251	338	2	3,443	198	596	252	-	90	173	-	-	**12,050**
	2023	4,896	2,185	355	7	3,696	204	577	298	-	96	176	-	-	**12,491**
	2026	5,095	2,121	375	13	3,959	209	560	333	-	103	179	-	-	**12,946**
	2029	5,336	2,064	401	20	4,258	215	550	321	-	113	183	-	-	**13,461**
Healthcare	2017	36,357	1,653	13,606	162	2,216	1,076	3,668	1,446	-	685	136	155	126	**61,285**
	2020	36,898	1,616	13,706	168	2,427	1,372	3,533	1,747	-	683	139	310	213	**62,811**
	2023	37,698	1,598	13,914	179	2,688	1,410	3,461	2,056	-	691	141	465	218	**64,521**
	2026	38,491	1,800	14,172	193	2,972	1,444	3,418	2,286	-	705	144	517	222	**66,364**
	2029	39,517	1,856	14,532	212	3,248	1,480	3,429	2,192	-	728	147	517	226	**68,083**

Exhibit 131 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year, Island Interconnected (MWh/yr.) (cont'd…)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Refrigeration	Domestic Hot Water	Computer Equipment	Secondary Lighting	Outdoor Lighting	Street Lighting	Space Cooling	Other Plug Loads	Food Service Equipment	Computer Servers	TOTAL
Schools	2017	42,862	16,399	2,197	110	2,092	2,184	2,885	2,440	-	60	291	-	-	**71,520**
	2020	43,806	16,176	2,234	115	2,124	2,796	2,752	2,954	-	66	297	-	-	**73,319**
	2023	45,191	16,074	2,307	123	2,177	2,883	2,647	3,480	-	76	302	-	-	**75,262**
	2026	46,690	16,023	2,395	133	2,240	2,961	2,555	3,871	-	89	308	-	-	**77,266**
	2029	48,389	16,166	2,520	147	2,325	3,043	2,636	3,718	-	106	314	-	-	**79,363**
Universities and Colleges	2017	2,543	19,772	16,991	774	461	2,919	1,381	1,325	-	390	940	-	105	**47,602**
	2020	2,909	19,335	17,037	777	471	3,711	1,319	1,596	-	400	959	-	178	**48,693**
	2023	3,555	18,937	17,113	784	486	3,798	1,262	1,867	-	419	977	-	181	**49,379**
	2026	4,380	18,677	17,315	808	524	3,883	1,221	2,073	-	475	996	-	185	**50,537**
	2029	5,381	18,416	17,514	832	561	3,968	1,182	1,972	-	530	1,014	-	188	**51,559**
Warehouse/Wholesale	2017	8,606	11,033	658	852	526	517	423	911	-	16	-	-	-	**23,543**
	2020	10,286	10,757	677	862	533	662	392	1,098	-	17	-	-	-	**25,284**
	2023	12,266	10,620	720	930	560	682	370	1,300	-	19	-	-	-	**27,467**
	2026	14,067	10,669	759	989	584	700	347	1,445	-	21	-	-	-	**29,581**
	2029	15,992	10,567	808	1,071	616	719	489	1,387	-	24	-	-	-	**31,673**
Restaurants	2017	6,203	971	815	1,675	6,327	122	3,637	178	-	218	-	623	-	**20,767**
	2020	6,567	955	835	1,770	6,457	156	3,484	217	-	222	-	1,245	-	**21,907**
	2023	7,121	950	868	1,946	6,683	161	3,351	256	-	230	-	1,868	-	**23,433**
	2026	7,840	949	908	2,157	6,950	165	3,224	286	-	241	-	2,075	-	**24,796**
	2029	8,530	957	962	2,451	7,315	169	3,116	277	-	258	-	2,075	-	**26,109**
Large Other Buildings	2017	17,479	12,612	7,954	338	3,232	1,966	2,796	1,386	-	786	1,172	-	-	**49,721**
	2020	19,417	12,323	8,060	410	3,271	2,515	2,663	1,678	-	794	1,195	-	-	**52,326**
	2023	21,647	12,101	8,224	521	3,336	2,589	2,548	1,976	-	813	1,218	-	-	**54,974**
	2026	24,822	12,093	8,604	783	3,494	2,657	2,493	2,222	-	872	1,241	-	-	**59,281**
	2029	27,617	12,087	8,985	1,044	3,652	2,726	2,440	2,149	-	932	1,264	-	-	**62,897**
Small Other Buildings	2017	17,883	8,799	4,372	-	1,648	1,795	2,288	1,387	-	547	-	-	-	**38,719**
	2020	18,884	8,508	4,417	30	1,666	2,287	2,165	1,671	-	546	-	-	-	**40,174**
	2023	20,163	8,294	4,521	104	1,710	2,351	2,060	1,962	-	557	-	-	-	**41,722**
	2026	21,613	9,848	4,750	270	2,235	2,411	1,989	2,192	-	593	-	-	-	**45,901**
	2029	23,378	9,778	5,003	455	2,439	2,472	1,927	2,104	-	635	-	-	-	**48,192**
Street Lighting	2017	-	-	-	-	-	-	-	-	17,083	-	-	-	-	**17,083**
	2020	-	-	-	-	-	-	-	-	16,530	-	-	-	-	**16,530**
	2023	-	-	-	-	-	-	-	-	15,941	-	-	-	-	**15,941**
	2026	-	-	-	-	-	-	-	-	15,311	-	-	-	-	**15,311**
	2029	-	-	-	-	-	-	-	-	14,638	-	-	-	-	**14,638**
Grand Total	2017	256,779	156,029	90,735	39,336	31,564	26,192	30,686	17,455	17,083	10,367	6,796	998	1,397	**685,417**
	2020	273,325	152,508	92,111	39,782	32,827	33,467	29,250	21,127	16,530	10,483	6,950	1,938	2,373	**712,673**
	2023	294,817	150,623	95,040	41,131	34,672	34,476	28,149	24,974	15,941	10,911	7,105	2,879	2,419	**743,138**
	2026	313,786	162,711	98,802	42,849	37,244	35,383	27,243	27,896	15,311	11,510	7,255	3,192	2,464	**785,647**
	2029	339,787	163,279	103,678	45,132	39,815	36,329	26,880	26,929	14,638	12,328	7,406	3,192	2,510	**821,902**

Exhibit 132 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year, Labrador Interconnected (MWh/yr.)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Domestic Hot Water	Outdoor Lighting	Secondary Lighting	Computer Equipment	Refrigeration	Other Plug Loads	Space Cooling	Food Service Equipment	Computer Servers	TOTAL
Small Office	2017	380	130	45	29	30	36	119	-	4	14	-	11	**798**
	2020	437	187	45	29	37	34	153	-	4	14	-	18	**958**
	2023	456	186	45	36	43	33	156	-	5	14	-	19	**992**
	2026	479	185	46	39	47	31	160	-	5	14	-	19	**1,025**
	2029	506	186	47	41	45	29	164	-	5	15	-	19	**1,056**
Large Non-food Retail	2017	639	705	289	36	99	65	41	69	56	12	-	-	**2,011**
	2020	802	706	290	36	119	62	52	87	57	12	-	-	**2,223**
	2023	970	688	293	37	138	58	53	111	58	12	-	-	**2,419**
	2026	1,351	672	296	37	152	55	54	112	59	13	-	-	**2,800**
	2029	1,501	656	300	37	144	53	55	112	60	13	-	-	**2,931**
Small Non-food Retail	2017	1,507	1,186	291	70	190	125	79	-	-	27	-	-	**3,474**
	2020	2,254	1,375	297	70	229	119	100	-	-	27	-	-	**4,472**
	2023	2,387	1,400	306	71	268	113	103	-	-	28	-	-	**4,678**
	2026	2,679	1,391	320	73	297	109	106	-	-	30	-	-	**5,005**
	2029	3,704	1,381	338	75	284	105	108	-	-	32	-	-	**6,027**
Food Retail	2017	1,773	312	77	54	58	24	37	737	42	6	-	-	**3,120**
	2020	2,245	378	106	54	69	30	48	918	43	7	19	-	**3,918**
	2023	2,455	369	107	54	81	36	49	1,192	44	7	28	-	**4,423**
	2026	2,671	361	108	55	89	35	50	1,194	45	7	32	-	**4,646**
	2029	2,891	354	109	55	84	34	51	1,198	46	7	32	-	**4,860**
Large Accomodation	2017	816	356	121	665	42	196	27	0	34	13	-	-	**2,270**
	2020	868	343	121	730	51	185	34	0	35	12	-	-	**2,380**
	2023	923	349	123	770	59	174	35	15	36	12	-	-	**2,497**
	2026	978	336	124	804	65	164	36	15	36	12	-	-	**2,572**
	2029	1,570	324	126	838	61	154	36	15	37	12	-	-	**3,173**
Small Accomodation	2017	129	60	9	92	6	16	4	0	5	2	-	-	**321**
	2020	132	58	9	102	7	15	5	0	5	2	-	-	**334**
	2023	137	58	9	108	8	14	5	0	5	2	-	-	**345**
	2026	237	56	10	113	9	13	5	0	5	2	-	-	**450**
	2029	243	55	10	120	8	13	5	0	5	2	-	-	**460**
Healthcare	2017	334	17	916	371	160	181	121	-	15	7	18	14	**2,153**
	2020	870	107	1,240	431	192	174	153	0	15	18	35	24	**3,259**
	2023	1,036	105	1,245	469	223	168	156	0	16	18	53	24	**3,513**
	2026	1,196	102	1,252	500	246	162	160	0	16	18	58	25	**3,735**
	2029	1,350	130	1,261	522	232	158	163	1	16	18	58	25	**3,933**

Exhibit 132 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year, Labrador Interconnected (MWh/yr.) (cont'd…)

Subsector	Milestone Years	Space Heating	General Lighting	HVAC Fans & Pumps	Domestic Hot Water	Outdoor Lighting	Secondary Lighting	Computer Equipment	Refrigeration	Other Plug Loads	Space Cooling	Food Service Equipment	Computer Servers	TOTAL
Schools	2017	1,463	359	220	139	134	40	122	-	16	3	-	-	**2,496**
	2020	1,535	354	220	139	161	38	155	0	16	3	-	-	**2,621**
	2023	2,132	413	219	144	188	83	158	0	17	3	-	-	**3,357**
	2026	2,206	839	242	145	207	78	161	0	17	3	-	-	**3,898**
	2029	2,283	828	242	146	196	74	165	0	17	3	-	-	**3,955**
Universities and Colleges	2017	379	225	152	29	21	10	48	0	15	6	-	2	**886**
	2020	499	241	153	29	26	10	60	0	15	6	-	3	**1,041**
	2023	669	236	154	30	30	10	62	7	16	6	-	3	**1,220**
	2026	738	231	154	30	33	9	63	7	16	6	-	3	**1,289**
	2029	809	227	155	30	31	9	64	7	16	6	-	3	**1,356**
Warehouse/Wholesale	2017	886	205	69	48	67	20	38	-	-	1	-	-	**1,334**
	2020	1,162	655	70	48	80	18	49	1	-	1	-	-	**2,084**
	2023	1,446	639	74	49	94	25	50	56	-	1	-	-	**2,433**
	2026	2,292	625	76	49	103	23	51	57	-	1	-	-	**3,278**
	2029	2,584	612	78	50	98	22	52	59	-	1	-	-	**3,557**
Restaurants	2017	190	42	33	366	16	294	11	35	-	4	59	-	**1,050**
	2020	505	57	33	368	19	281	14	37	-	4	118	-	**1,436**
	2023	526	56	34	612	23	268	15	126	-	4	177	-	**1,841**
	2026	597	56	34	619	25	256	15	131	-	4	197	-	**1,934**
	2029	731	55	35	629	24	244	15	138	-	5	197	-	**2,071**
Large Other Buildings	2017	5,808	1,595	1,856	1,330	562	990	419	1	500	59	-	-	**13,119**
	2020	7,843	1,900	1,877	1,853	674	938	532	3	510	59	-	-	**16,189**
	2023	10,863	2,307	1,886	1,857	785	887	543	8	520	58	-	-	**19,714**
	2026	12,039	2,247	1,898	1,862	862	839	553	13	530	58	-	-	**20,902**
	2029	13,660	2,189	1,913	1,869	814	792	564	21	539	58	-	-	**22,419**
Small Other Buildings	2017	3,604	1,249	976	625	394	583	332	0	-	46	-	-	**7,810**
	2020	3,881	1,479	997	631	475	556	425	8	-	47	-	-	**8,499**
	2023	5,790	1,831	1,019	641	556	534	435	21	-	48	-	-	**10,875**
	2026	8,295	1,808	1,050	656	615	515	446	40	-	50	-	-	**13,476**
	2029	9,032	1,794	1,090	947	586	501	457	65	-	53	-	-	**14,527**
Other Institutional	2017	9,842	-	1,179	546	547	22	258	-	-	19	-	-	**12,412**
	2020	17,828	-	1,208	546	631	19	350	-	-	18	-	-	**20,600**
	2023	23,123	29	1,239	550	716	24	357	4	-	18	-	-	**26,061**
	2026	28,089	2,627	2,411	554	798	27	364	7	-	47	-	-	**34,924**
	2029	30,009	2,600	2,439	559	847	32	371	11	-	47	-	-	**36,916**
Grand Total	2017	27,750	6,441	6,232	4,398	2,327	2,602	1,655	842	687	218	76	27	**53,255**
	2020	40,861	7,841	6,665	5,067	2,770	2,478	2,130	1,054	700	230	172	45	**70,014**
	2023	52,913	8,667	6,754	5,429	3,212	2,425	2,177	1,540	714	232	258	46	**84,367**
	2026	63,845	11,537	8,022	5,537	3,548	2,317	2,223	1,577	728	265	286	47	**99,933**
	2029	70,873	11,391	8,143	5,918	3,453	2,220	2,270	1,627	741	272	286	48	**107,242**

Exhibit 133 Total Economic Potential Electricity Savings by End Use, Sub sector and Milestone Year, Isolated (MWh/yr.)

Subsector	Milestone Years	General Lighting	Refrigeration	Outdoor Lighting	Secondary Lighting	Computer Equipment	HVAC Fans & Pumps	Other Plug Loads	Domestic Hot Water	TOTAL
Labrador Isolated C/I Buildings	2017	2,812	647	542	431	306	277	157	49	**5,223**
	2020	2,864	1,034	529	428	405	310	160	53	**5,783**
	2023	2,895	1,427	516	423	418	343	164	56	**6,241**
	2026	2,951	1,610	507	425	431	384	167	59	**6,534**
	2029	3,013	1,702	502	434	443	436	170	64	**6,763**
Island Isolated C/I Buildings	2017	263	61	51	42	29	26	15	-	**486**
	2020	270	98	50	42	38	30	15	-	**542**
	2023	274	135	49	42	39	33	15	-	**587**
	2026	280	153	48	42	41	37	16	-	**616**
	2029	287	162	48	43	42	42	16	-	**641**
Grand Total	2017	3,075	708	593	473	334	303	172	49	**5,709**
	2020	3,134	1,131	579	470	443	340	176	53	**6,325**
	2023	3,169	1,562	565	465	457	375	179	56	**6,828**
	2026	3,231	1,763	555	468	471	421	182	59	**7,150**
	2029	3,300	1,864	549	477	485	478	186	64	**7,403**

Exhibit 134 Economic Potential Load Reduction by End Use, Sub sector and Milestone Year, Island Interconnected (MW)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Large Office	2017	0	0	0	1	0	1
	2020	0	3	0	1	2	5
	2023	0	3	0	1	2	5
	2026	0	3	0	1	2	5
	2029	0	3	0	1	2	5
Small Office	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Large Non-food Retail	2017	0	0	0	0	0	0
	2020	0	2	0	0	1	2
	2023	0	2	0	0	1	2
	2026	0	2	0	0	1	2
	2029	0	2	0	0	1	2
Small Non-food Retail	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Food Retail	2017	0	0	0	0	0	0
	2020	0	1	1	0	0	2
	2023	0	1	1	0	0	2
	2026	0	1	1	0	0	2
	2029	0	1	1	0	0	2
Large Accomodation	2017	0	0	0	0	0	0
	2020	2	0	0	0	1	3
	2023	2	0	0	0	1	4
	2026	2	0	0	0	1	4
	2029	2	0	0	0	1	4
Small Accomodation	2017	0	0	0	0	0	0
	2020	1	0	0	0	0	1
	2023	1	0	0	0	0	1
	2026	1	0	0	0	0	1
	2029	1	0	0	0	0	1

Exhibit 134 Economic Potential Load Reduction by End Use, Sub sector and Milestone Year, Island Interconnected (MW) (cont'd…)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Healthcare	2017	0	0	0	0	0	0
	2020	1	1	0	0	1	4
	2023	2	1	0	0	1	4
	2026	2	1	0	0	1	4
	2029	2	1	0	0	1	4
Schools	2017	0	0	0	0	0	0
	2020	0	1	0	0	1	2
	2023	0	1	0	0	1	2
	2026	0	1	0	0	1	2
	2029	0	1	0	0	1	2
Universities and Colleges	2017	0	0	0	0	0	0
	2020	0	1	0	0	0	2
	2023	0	1	0	0	0	2
	2026	0	2	0	0	0	2
	2029	0	2	0	0	0	2
Warehouse/Wholesale	2017	0	0	0	0	0	0
	2020	0	0	0	0	1	1
	2023	0	0	0	0	0	1
	2026	0	0	0	0	0	1
	2029	0	0	0	0	0	1
Restaurants	2020	3	0	0	0	0	4
	2023	3	0	0	0	0	4
	2026	4	0	0	0	0	4
	2029	4	0	0	0	0	4
Large Other Buildings	2017	0	0	0	0	0	0
	2020	1	1	0	0	1	3
	2023	1	1	0	0	1	4
	2026	1	1	0	0	1	4
	2029	1	1	0	0	1	4
Small Other Buildings	2017	0	0	0	0	0	0
	2020	1	0	0	0	1	2
	2023	1	0	0	0	1	2
	2026	1	0	0	0	1	2
	2029	1	0	0	0	1	2
Grand Total	2017	0	0	0	3	0	3
	2020	10	9	1	3	11	34
	2023	11	10	1	3	11	35
	2026	11	10	1	3	11	36
	2029	11	10	1	3	11	36

Exhibit 135 Economic Potential Load Reduction by End Use, Sub sector and Milestone Year, Labrador Interconnected (MW)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Small Office	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Large Non-food Retail	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Small Non-food Retail	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Food Retail	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Large Accomodation	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Small Accomodation	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Healthcare	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Schools	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0

Exhibit 135 Economic Potential Load Reduction by End Use, Sub sector and Milestone Year, Labrador Interconnected (MW) (cont'd…)

Sub sector	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Refrigeration	Secondary Lighting	Space Heating	Grand Total
Universities and Colleges	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Warehouse/Wholesale	2017	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Restaurants	2020	0	0	0	0	0	0
	2023	0	0	0	0	0	0
	2026	0	0	0	0	0	0
	2029	0	0	0	0	0	0
Large Other Buildings	2017	0	0	0	0	0	0
	2020	1	0	0	0	0	2
	2023	1	0	0	0	0	2
	2026	1	0	0	0	0	2
	2029	1	0	0	0	0	2
Small Other Buildings	2017	0	0	0	0	0	0
	2020	1	0	0	0	0	1
	2023	1	0	0	0	0	1
	2026	1	0	0	0	0	1
	2029	1	0	0	0	0	1
Other Institutional	2017	0	0	0	0	0	0
	2020	0	1	0	0	1	2
	2023	0	1	0	0	1	1
	2026	0	0	0	0	1	1
	2029	0	0	0	0	1	1
Grand Total	2017	0	0	0	1	0	1
	2020	2	1	0	1	2	7
	2023	2	1	0	1	2	6
	2026	2	1	0	1	2	6
	2029	2	1	0	1	2	6

Exhibit 136 Economic Potential Load Reduction by End Use, Sub sector and Milestone Year, Isolated (MW)

Building Category	Milestone Year	Domestic Hot Water	HVAC Fans & Pumps	Secondary Lighting	Space Heating	Grand Total
Labrador Isolated C/I Buildings	2017	0.0	0.0	0.1	0.0	0.1
	2020	0.0	0.0	0.1	0.0	0.1
	2023	0.0	0.0	0.1	0.0	0.1
	2026	0.0	0.0	0.1	0.0	0.1
	2029	0.0	0.0	0.1	0.0	0.1
Island Isolated C/I Buildings	2017	0.0	0.0	0.0	0.0	0.0
	2020	0.0	0.0	0.0	0.0	0.0
	2023	0.0	0.0	0.0	0.0	0.0
	2026	0.0	0.0	0.0	0.0	0.0
	2029	0.0	0.0	0.0	0.0	0.0
Grand Total	2017	0.0	0.0	0.1	0.0	0.1
	2020	0.0	0.0	0.1	0.0	0.1
	2023	0.0	0.0	0.1	0.0	0.2
	2026	0.0	0.0	0.1	0.0	0.2
	2029	0.0	0.0	0.1	0.0	0.2

Appendix G Background-Section 10: Achievable Workshop Action Profile Slides

Opportunities for Today's Workshop

	Primary End Use	Percent of 2029 Economic Potential Savings
LED Tubes	Lighting	3%
High-Efficiency Air Source Heat Pumps	Space Heating	15%
Evaporator Fan Upgrades	Refrigeration	1%
VFDs on HVAC Motors	HVAC Fans and Pumps	3%
Advanced BAS	Multiple	4%
High Performance New Construction	Multiple	7%
PC Power Management	Computer Equipment	1%
Glazing	Space Heating	3%
Electric Thermal Storage Systems	Space Heating - Demand	0%

Commercial Opportunity 1:

LED Tubes

Solid state lighting using light emitting diodes as a source of illumination.

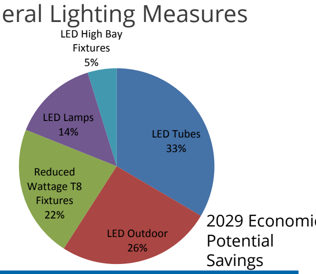
Relamping existing T8 fixtures with LED tubes that can operate using the existing ballast.

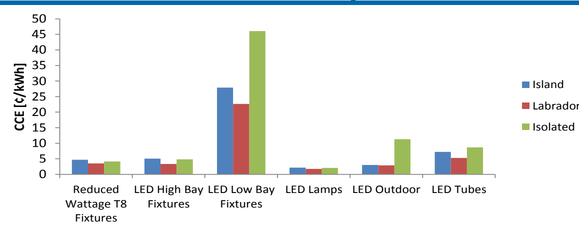
Commercial Opportunity 1:

LED Tubes

Comparison with Other General Lighting Measures

	Economic Potential Savings (MWh)	Passes Economic Test in Regions
Reduced Wattage T8 Fixtures	20,938	All
LED High Bay Fixtures	4,567	All
LED Low Bay Fixtures	0	None
LED Lamps	13,501	All
LED Outdoor	24,443	All
LED Tubes	31,915	All





Commercial Opportunity 1:

LED Tubes

Assumptions

Focus Building Type	Office
Focus Region	Island
Typical Application:	
Cost	$23.81
Useful Life	11.8 years
Savings:	
General lighting	31%

Commercial Opportunity 1:

LED Tubes

Economic Indicators

Simple Payback (L. Office - Island)	5.0 years
Average CCE (¢/kWh):	
Island	7.23
Labrador	5.30
Isolated	8.65
Basis	Incremental
Eligibility Timeline	At replacement
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 230
Principal region	Island

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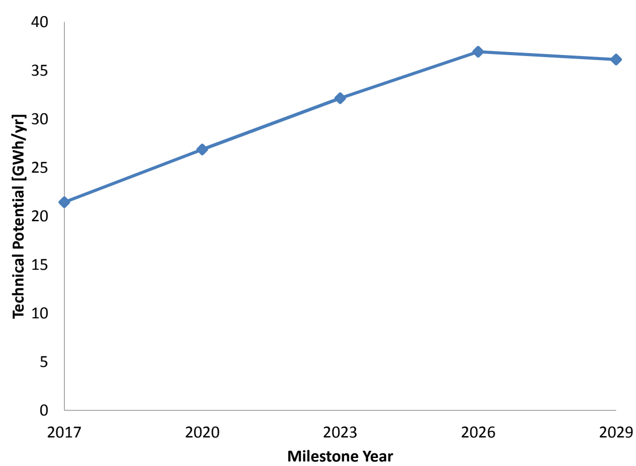
Commercial Opportunity 1:

LED Tubes

Technical Potential Growth



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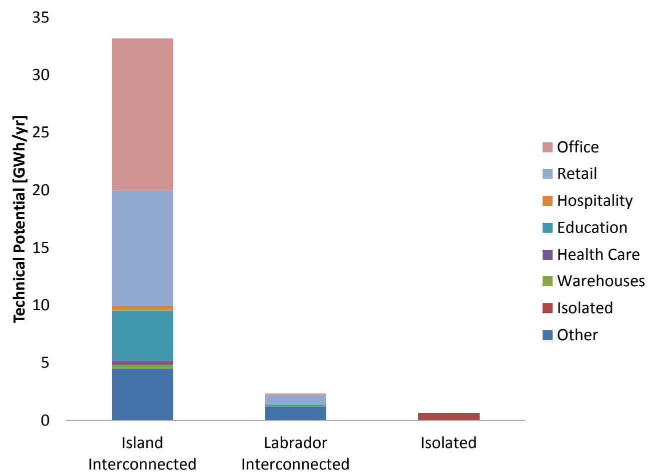
Commercial Opportunity 1:

LED Tubes

2029 Technical Potential Breakdown



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Commercial Opportunity 2:

Air Source Heat Pumps

Cold climate air source heat pumps (ASHPs) utilise the vapour compression cycle to transfer heat from the outside air to the interior during the heating season.

Replace RTUs equipped with electric resistance heat with models equipped with CEE qualified ASHPs.

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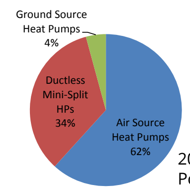
Commercial Opportunity 2:

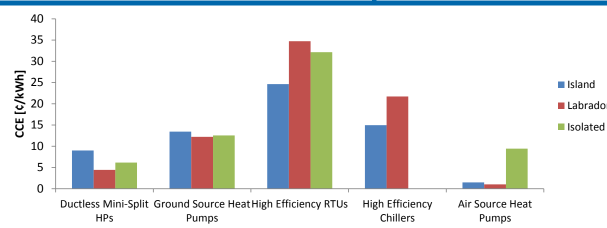
Air Source Heat Pumps

Comparison with Other Space Heating Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Ductless Mini-Split HPs	78,928	All
Ground Source Heat Pumps	9,816	Isolated
High Efficiency RTUs	0	None
High Efficiency Chillers	0	None
Air Source Heat Pumps	143,163	All



2029 Economic Potential Savings



Commercial Opportunity 2:

Air Source Heat Pumps

Assumptions

Focus Building Type	L. Office
Focus Region	Island
Typical Application:	
Cost	$1,500
Useful Life	15 years
Savings:	
Space heating	45%

Commercial Opportunity 2:

Air Source Heat Pumps

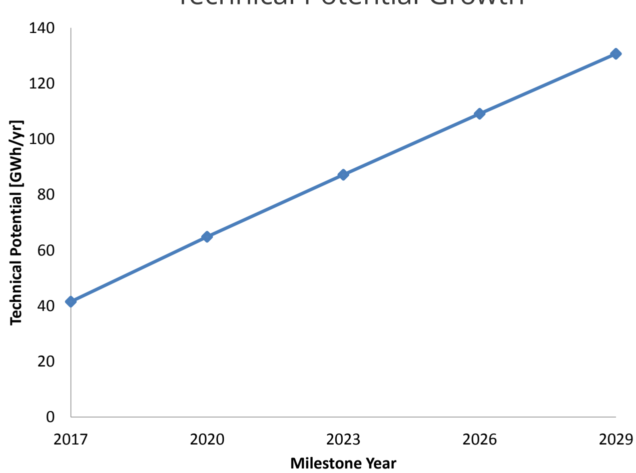
Economic Indicators

Simple Payback (L. Office - Island)	0.8 years
Average CCE (¢/kWh):	
Island	1.47
Labrador	1.02
Isolated	9.41
Basis	Incremental
Eligibility Timeline	At replacement
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 240
Principal region	Island

Commercial Opportunity 2:

Air Source Heat Pumps

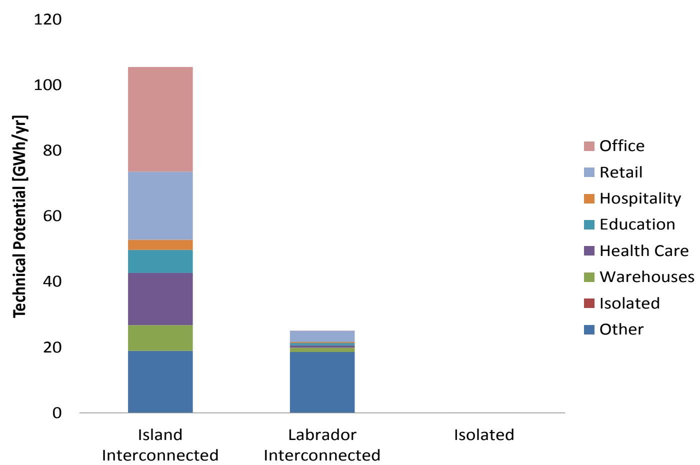
Technical Potential Growth



Commercial Opportunity 2:

Air Source Heat Pumps

2029 Technical Potential Breakdown



Commercial Opportunity 3:

Evaporator Fan Upgrades

Electrically commutated motors (ECMs) are more efficient than shaded pole evaporator fan motors and emit less waste heat.

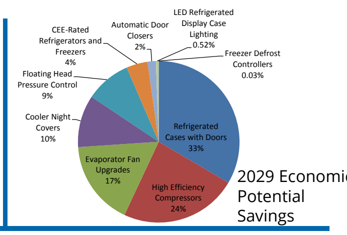
Replace existing evaporator fan motors for walk in coolers with ECMs.

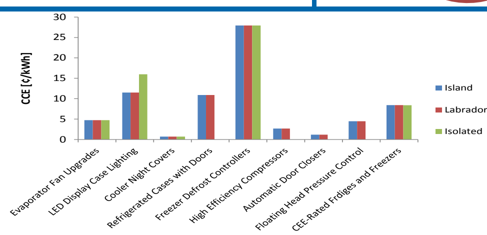
Commercial Opportunity 3:

Evaporator Fan Upgrades

Comparison with Other Refrigeration Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
LED Refrigerated Display Case Lighting	207	Island, Isolated
Cooler Night Covers	4,188	All
Refrigerated Cases with Doors	13416	Island
Freezer Defrost Controllers	14	Isolated
High Efficiency Compressors	9431	Island, Labrador
Automatic Door Closers	667	Island, Labrador
Floating Head Pressure Control	3660	Island, Labrador
CEE-Rated Refrigerators and Freezers	1,714	Island, Labrador
Evaporator Fan Upgrades	6804	All





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Commercial Opportunity 3:

Evaporater Fan Upgrades

Assumptions

Focus Building Type	Food Retail
Focus Region	Island
Typical Application:	
Cost	$460
Useful Life	16 years
Savings:	
Refrigeration	6%

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Commercial Opportunity 3:

Evaporator Fan Upgrades

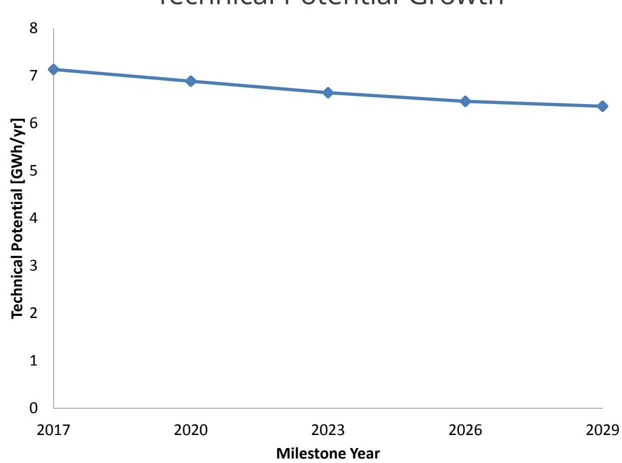
Economic Indicators

Simple Payback (Food Retail - Island)	4.7 years
Average CCE (¢/kWh):	
Island	4.73
Labrador	4.73
Isolated	4.73
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
Floor Area / # of Facilities by 2029	3,400,000 ft^2 / 540
Principal region	Island

Commercial Opportunity 3:

Evaporator Fan Upgrades

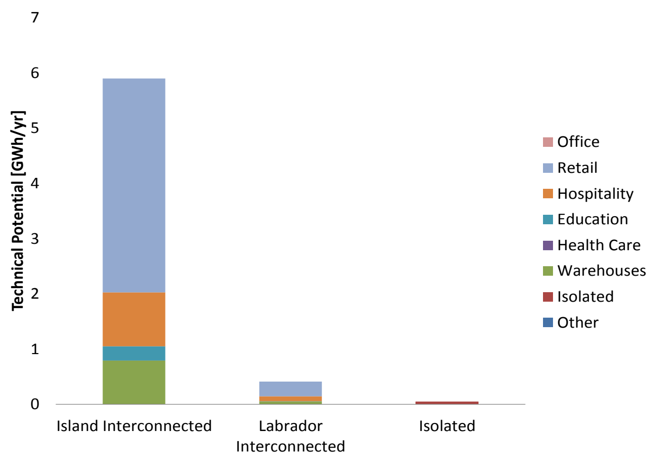
Technical Potential Growth



Commercial Opportunity 3:

Evaporator Fan Upgrades

2029 Technical Potential Breakdown



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Commercial Opportunity 4:

VFDs on HVAC Motors

Variable frequency drives (VFDs) allow induction motor driven loads such as fans and pumps to operate at varying speed in response to changing load requirements.

Variable flow air systems and variable volume pumping systems are ideal candidates for retrofit.

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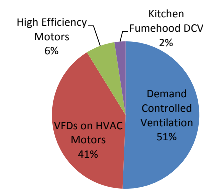
Commercial Opportunity 4:

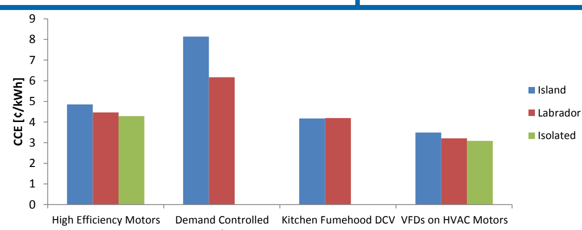
VFDs on HVAC Motors

Comparison with Other HVAC Fans & Pumps Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
High Efficiency Motors	3,795	All
Demand Controlled Ventilation	30,243	Island, Labrador
Kitchen Fumehood DCV	1,453	Island, Labrador
VFDs on HVAC Motors	24,205	All



2029 Economic Potential Savings



Commercial Opportunity 4:

VFDs on HVAC Motors

Assumptions

Focus Building Type	L. Office
Focus Region	Island
Typical Application:	
Cost	$4,820
Useful Life	15 years
Savings:	
HVAC fans & pumps	11%

Commercial Opportunity 4:

VFDs on HVAC Motors

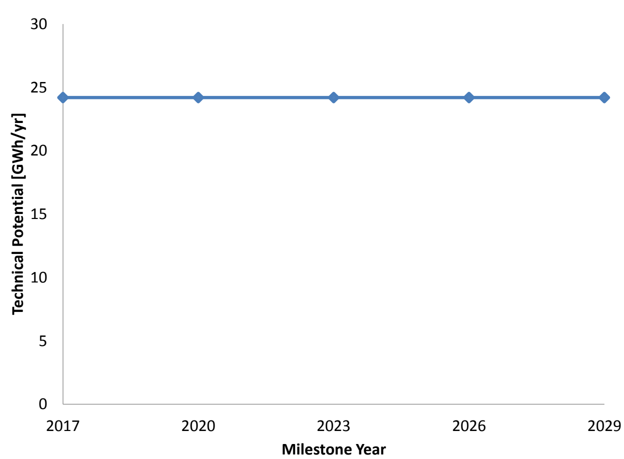
Economic Indicators

Simple Payback (L. Office - Island)	3.2 years
Average CCE (¢/kWh):	
Island	3.49
Labrador	3.21
Isolated	3.09
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 70
Principal region	Island

Commercial Opportunity 4:

VFDs on HVAC Motors

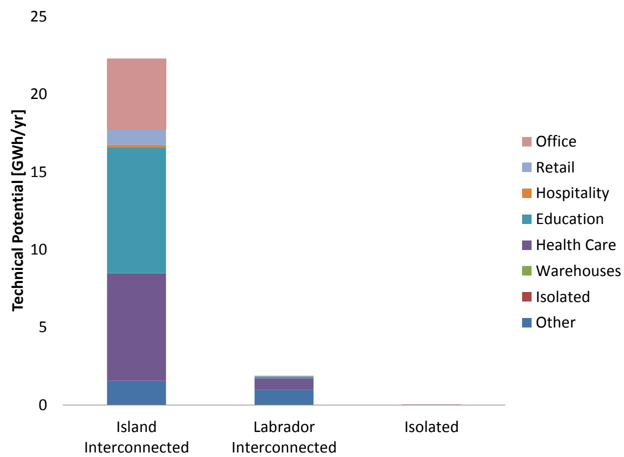
Technical Potential Growth



Commercial Opportunity 4:

VFDs on HVAC Motors

2029 Technical Potential Breakdown



Commercial Opportunity 5:

Advanced Building Automation

Advanced Building Automation Systems (BAS) incorporate diagnostic tools and self tuning controls into existing BAS functions, and expand control to additional systems such as lighting and VAV boxes.

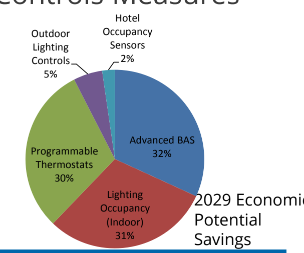
Most applicable to large, complex facilities such as office buildings, hotels, and healthcare.

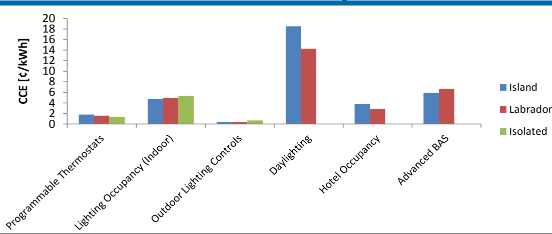
Commercial Opportunity 5:

Advanced Building Automation

Comparison with Other Controls Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Programmable Thermostats	37,948	All
Lighting Occupancy (Indoor)	37,999	All
Outdoor Lighting Controls	6,570	All
Daylighting Controls	0	None
Hotel Occupancy Sensors	2,864	Island, Labrador
Advanced BAS	39,870	Island, Labrador





Commercial Opportunity 5:

Advanced Building Automation

Assumptions

Focus Building Type	L. Office
Focus Region	Island
Typical Application:	
Cost	$0.90/ft²
Useful Life	15 years
Savings:	
Space heating, space cooling, general lighting, and HVAC fans & pumps	10%

Commercial Opportunity 5:

Advanced Building Automation

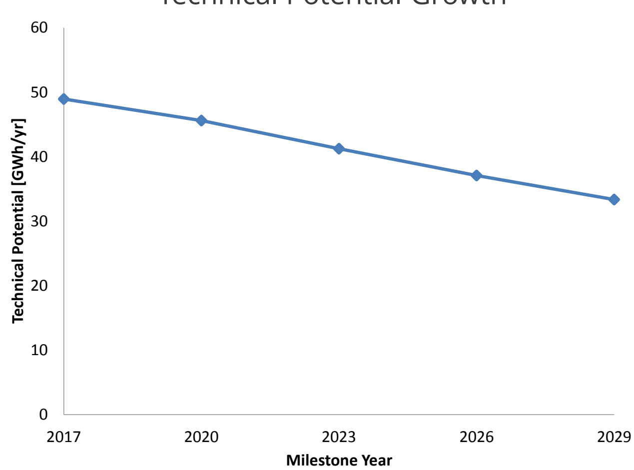
Economic Indicators

Simple Payback (L. Office - Island)	3.8 years
Average CCE (¢/kWh):	
Island	5.90
Labrador	6.64
Isolated	N/A
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 250
Principal region	Island

Commercial Opportunity 5:

Advanced Building Automation

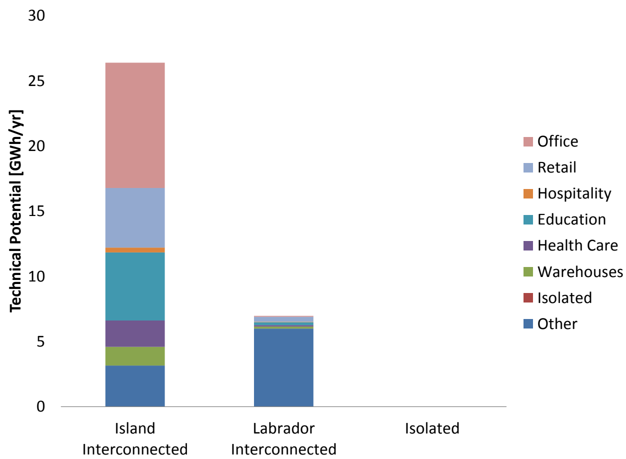
Technical Potential Growth



Commercial Opportunity 5:

Advanced Building Automation

2029 Technical Potential Breakdown



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Commercial Opportunity 6:

High-Performance New Construction

Constructing a new building using an integrated design approach to lower overall energy use.

Two measures are considered: 25% and 40% better than baseline (code) construction.

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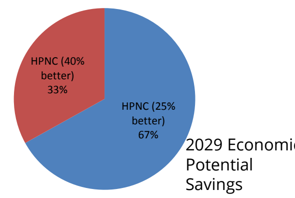
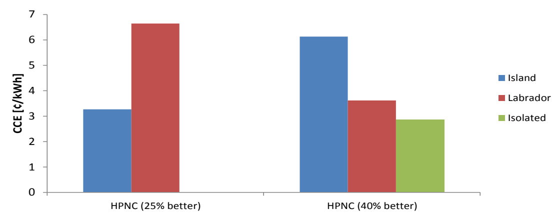
Commercial Opportunity 6:
High-Performance New Construction
Comparison with Other New Construction Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
HPNC (25% better)	47,934	All
HPNC (40% better)	23,674	Island, Labrador





Commercial Opportunity 6:
High-Performance New Construction
Assumptions

Focus Building Type	Office
Focus Region	Island
Typical Application:	
Cost	$23.81
Useful Life	11.8 years
Savings:	
General lighting	31%

Commercial Opportunity 6:

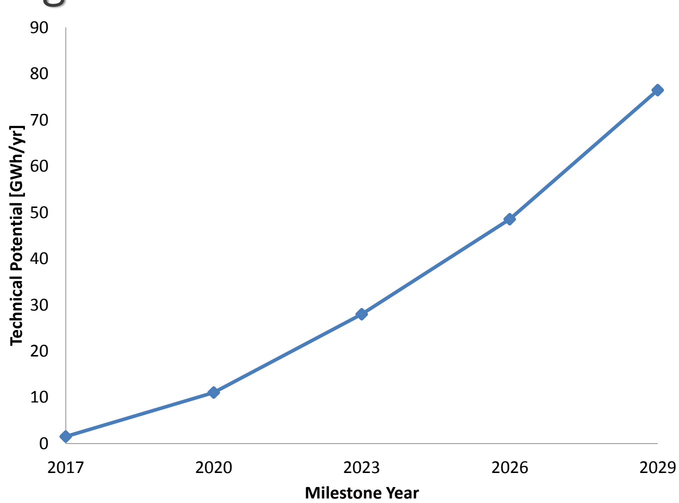
High-Performance New Construction

Economic Indicators

Simple Payback (L. Office - Island)	5.0 years
Average CCE (¢/kWh):	
Island	7.23
Labrador	5.30
Isolated	8.65
Basis	Incremental
Eligibility Timeline	At replacement
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 230
Principal region	Island

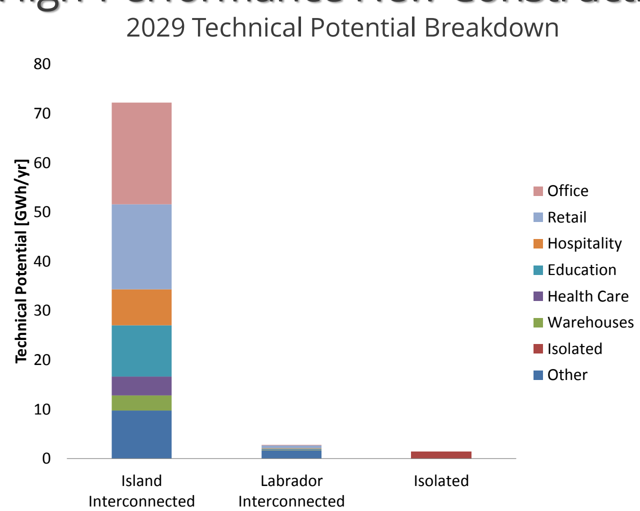
Commercial Opportunity 6:

High Performance New Construction



Commercial Opportunity 6:

High-Performance New Construction



Commercial Opportunity 7:

PC Power Management

Personal computers (PCs) have integrated power management systems that can shut off components when the PC is not in use but quickly return it to an active state when required.

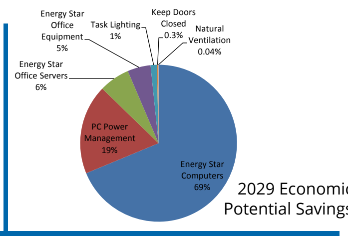
This measure involves fully utilising existing power management systems on PCs.

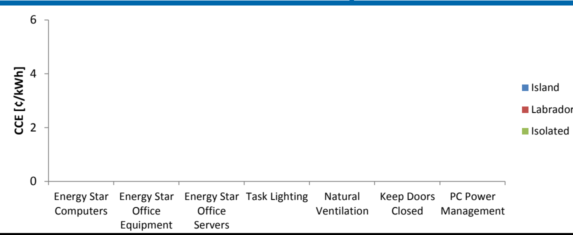
Commercial Opportunity 7:

PC Power Management

Comparison with Other Behavioural Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Energy Star Computers	27,803	All
Energy Star Office Equipment	1,933	All
Energy Star Office Servers	2,558	All
Task Lighting	524	All
Natural Ventilation	18	All
Keep Doors Closed	124	All
PC Power Management	7,482	All





Commercial Opportunity 7:

PC Power Management

Assumptions

Focus Building Type	L. Office
Focus Region	Island
Typical Application:	
Cost	$0
Useful Life	1 year
Savings:	
Computer Equipment	45%

Commercial Opportunity 7:

PC Power Management

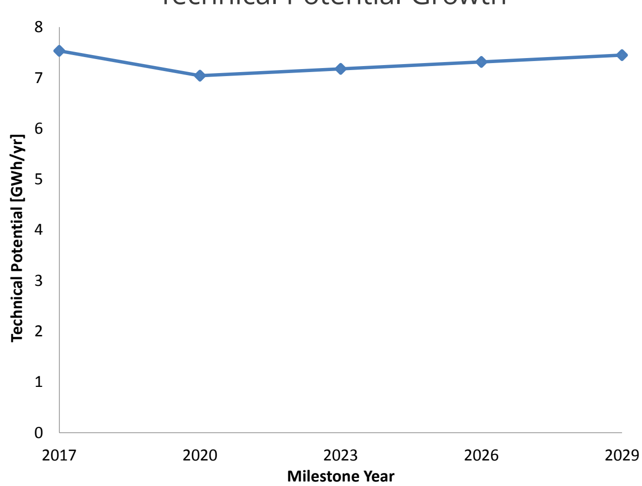
Economic Indicators

Simple Payback (L. Office - Island)	Immediate
Average CCE (¢/kWh):	
Island	0.00
Labrador	0.00
Isolated	0.00
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 270
Principal region	Island

Commercial Opportunity 7:

PC Power Management

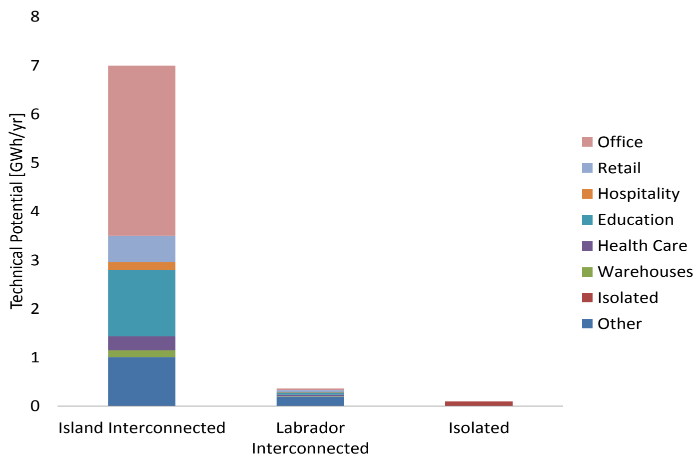
Technical Potential Growth



Commercial Opportunity 7:

PC Power Management

2029 Technical Potential Breakdown

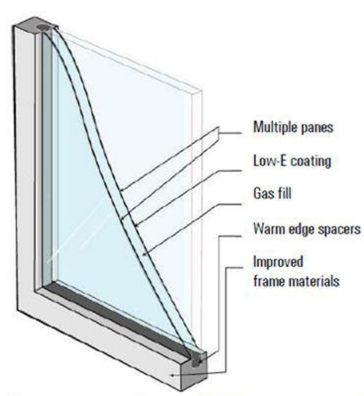


Commercial Opportunity 8:

High Performance Glazing Systems

High performance glazing systems incorporate technologies such as double or triple panes, low emissivity glass, inert gases, and well insulated frames and sashes.

Replace existing windows with high performance glazing systems.

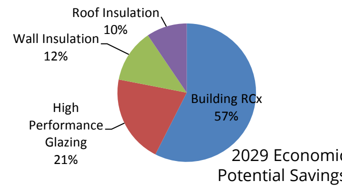


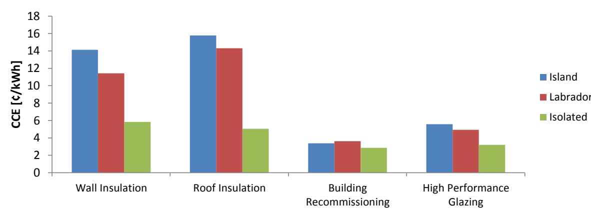
Commercial Opportunity 8:

High Performance Glazing

Comparison with Other Envelope Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Wall Insulation	18,068	Isolated
Roof Insulation	13,725	Isolated
Building Recommissioning	83,241	All
High Performance Glazing	29,812	All





Commercial Opportunity 8:

High Performance Glazing

Assumptions

Focus Building Type	L. Office
Focus Region	Island
Typical Application:	
Cost	$0.50/ft²
Useful Life	20 years
Savings:	
Space heating	15%

Commercial Opportunity 8:

High Performance Glazing

Economic Indicators

Simple Payback (L. Office - Island)	2.8 years
Average CCE (¢/kWh):	
Island	5.58
Labrador	4.92
Isolated	3.20
Basis	Incremental
Eligibility Timeline	At replacement
Eligible participants:	
Floor Area / # of Facilities by 2029	12,400,000 ft^2 / 240
Principal region	Island

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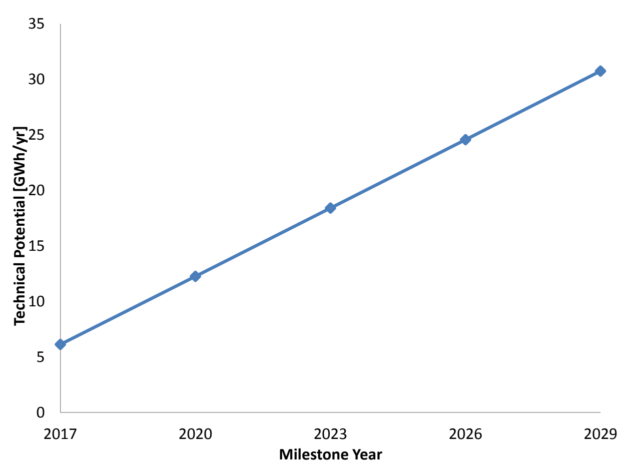
Commercial Opportunity 8:

High Performance Glazing

Technical Potential Growth



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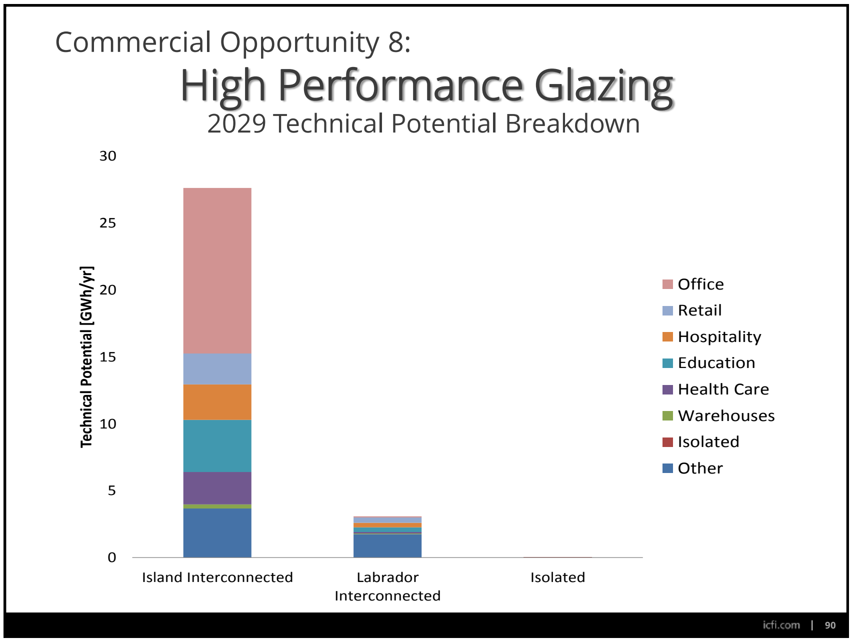
Commercial Opportunity 8:
High Performance Glazing
2029 Technical Potential Breakdown
Technical Potential [GWh/yr]
30
25
20
15
10
5
0
Island Interconnected
Labrador Interconnected
Isolated
Office
Retail
Hospitality
Education
Health Care
Warehouses
Isolated
Other
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Appendix H Background-Section 10: Achievable Workshop Measure Worksheets

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C1: LED Tubular Lamps

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Large Office		
MEASURE INFORMATION			
CCE (¢/kWh)	6.2		
Simple Payback (years)	5.0		
ECONOMIC POTENTIAL			
Total Floor Space (Approx)	12,400,000		
Total Number of Sites	280		
% Eligible	80%		
# Eligible Sites Per Year	230		
# Eligible Sites By 2029	230		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	70%	B	
Aggressive Marketing	80%	C	
ACHIEVABLE POTENTIAL			
BAU Marketing	161		
Aggressive Marketing	184		
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	L	Healthcare	H
Non-Food Retail	S	Schools	H
Food Retail	S	Universities	H
Large Hotels/Motels	H	Warehouses	L
Small Hotels/Motels	L	Restaurants	L
Other Regions:			
Labrador	L	Isolated	L
Related Measures:			
LED Lamps	H	LED Outdoor	H
LED Low Bay Fixtures	S	RW T8 Fixtures	L
LED High Bay Fixtures	H		
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Primary Incentive Target (User, Channel Member, Both)			Both
Sensitivity to Direct Program Support (High, Med, Low)			Low
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Demos and Cases Studies

GENERAL NOTES:
- Technology is changing very rapidly and the cost is coming down quite quickly
- Province tends to use a "wait-and-see" approach to implementing EE
- Likely very limited investments in fluorescent technology in the future

BARRIERS:
- Cost is currently the primary barrier
- The lamps are quite avaialble and starting to be popular (workshop participant's firm has sold about 18-20K of them in the last quarter)
- Not very popular in NL since there are no incentives currently
- Customer awareness is a barrier (i.e. not aware that it's currently an option)
- Government in the province tends to adopt technologies like this more quickly but private sector lags
- Public tendering act limits the technology that will be implemented in some facilities (i.e. lowest cost technology must be selected)
- Some fo the lower cost products may have performance issues
- Technology hasn't been around too long. Some people may be waiting for the technology to mature.
- Difficult for utilities to get in touch with the right contacts at the commercial facilities
- LED tubes may not work as well in some fixtures
- current economic crunch is limiting uptake at the moment

STRATEGIES/PARTNERS:
- Equipment typically goes through lighting distributors
- Implementers help spread the word
- Nobody is going to the marketplace to make the case for this technology currently
- Incentives are key to the overall strategy and there is a high sensitivity to this
- Some facilities may be overlit already, which allows for a deeper savings opportunity
- Can use non-energy benefits to help sell the technology
- Government agencies are much more developed than they were 20 years ago and they can be an important partner

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C2: High-Efficiency Air Source Heat Pumps

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Food Retail		
MEASURE INFORMATION			
CCE (¢/kWh)	1.0		Incr. basis
Simple Payback (years)	0.8		
ECONOMIC POTENTIAL			
Total Floor Space (Approx)	12,400,000		
Total Number of Sites	280		
% Eligible	86%		
# Eligible Sites Per Year	20		Incr. basis
# Eligible Sites By 2029	240		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	20%	B	
Aggressive Marketing	60%	B	
ACHIEVABLE POTENTIAL			
BAU Marketing	48		
Aggressive Marketing	144		
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	H	Healthcare	L
Non-Food Retail	S	Schools	S
Large Offices	L	Universities	L
Large Hotels/Motels	H	Warehouses	L
Small Hotels/Motels	L	Restaurants	S-H
Other Regions:			
Labrador	L	Isolated	L
Related Measures:			
Ductless Mini-Split HPs	H	High-Eff, RTUs	L
GSHP	L	High-Eff. Chillers	L
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Low
Primary Incentive Target (User, Channel Member, Both)			User
Sensitivity to Direct Program Support (High, Med, Low)			Med
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Contractor training, case

GENERAL NOTES:
- Technolgy is fairly mature but existing infrastructure is fairly old
- Not many RTUs in large offices
- Savings may be too high in retail applications since lighting and internal loads create quite a bit of heat
- Variable refrigerant tehnology may make more sense in certain applications
- About 15% penetration currently, although this may be limited to smaller RTUs

BARRIERS:
- Existing infrastructure may limit the opportunity in offices
- Customers see more maintenance costs with the hours of operation for the compressors
- Not practical for many offices since RTUs aren't too common and since zoning would be required
- Awareness may be a barrier in the commercial sector
- HVAC contractors may not be pushing ASHPs
- A lost of the space is leased and landlords are putting in lowest cost equipment
- Chains from other jurisdictions have natural gas space heating and may not be aware that there is an opportunity in electric space heating

STRATEGIES/PARTNERS:
- Restaurants are adopting the technology
- Technology is being adopted to some degree without utility support (i.e. about 1 in 20 currently)

- Schools not allowed to be air conditioned

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C3: ECM Motors and Evaporator Fan Motor Controllers

				COMMENTS
Focus Region	Island Interconnected			
Focus Sub-Sector	Food Retail			
MEASURE INFORMATION				
CCE (¢/kWh)	4.7			
Simple Payback (years)	4.7			
ECONOMIC POTENTIAL				
Total Floor Space (Approx)	3,300,000			
Total Number of Sites	780			
% Eligible	70%			Very small not eligible
# Eligible Sites Per Year	540			
# Eligible Sites By 2029	540			
PARTICIPATION RATES	**% by 2029**	**Curve**		
BAU Marketing	25%	B		
Aggressive Marketing	80%	B		
ACHIEVABLE POTENTIAL				
BAU Marketing	135			
Aggressive Marketing	432			
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)				
Other Sub-Sectors:				
Large Offices	N/A	Healthcare	N/A	
Small Offices	N/A	Schools	N/A	
Non-Food Retail	L	Universities	S	
Large Hotels/Motels	S	Warehouses	H	
Small Hotels/Motels	N/A	Restaurants	L	
Other Regions:				
Labrador	L	Isolated	Much L	
Related Measures:				
Refrigerated Display Cases with Doors	L	Floating Head Pressure Control	L	
LED Refrig. Lighting	H	Defrost Controllers	L	
High Eff. Compressors	S	Door Closers	L	
CEE Rated Equipment	H	Night Covers	L	
OTHER PARAMETERS				
Sensitivity to Incentives (High, Med, Low)				High
Primary Incentive Target (User, Channel Member, Both)				Both
Sensitivity to Direct Program Support (High, Med, Low)				High
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)				Awareness, direct-install in smaller facilities

GENERAL NOTES:
- Larger facilities will have pretty sophisticated equipment in place already and lots of support
- Smaller communities in Isolated regions have a lot of residential-style equipment
- Load for each evaporator fan is small but there are a lot of units and they run 24/7
- Measure isn't being implemented very oftern in many more mature units

BARRIERS:
- Awareness is one of the primary barriers
- Cost is a barrier in smaller facilities
- Payback period is long for retail facilities
- Potential landlord-tenant issues with smaller facilities as well
- Service contracts that are in place may restrict retrofits
- Technology may not be as prevelant or accessible as necessary
- There may be a perceived risk with food spoiling

STRATEGIES/PARTNERS:
- Likely going to need two different strategies; one for larger facilities and one for smaller "mom-and-pop" stores
-

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C4: VFDs on HVAC Motors

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Large Office		
MEASURE INFORMATION			
CCE (¢/kWh)	3.4		
Simple Payback (years)	3.2		
ECONOMIC POTENTIAL			
Total Floor Space (Approx)	12,400,000		
Total Number of Sites	280		
% Eligible	24%		
# Eligible Sites Per Year	70		
# Eligible Sites By 2029	70		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	5%	B	
Aggressive Marketing	70%	B	
ACHIEVABLE POTENTIAL			
BAU Marketing	4		
Aggressive Marketing	49		
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	L	Healthcare	H
Non-Food Retail	S	Schools	H
Food Retail	S	Universities	H
Large Hotels/Motels	H	Warehouses	N/A
Small Hotels/Motels	N/A	Restaurants	N/A
Other Regions:			
Labrador	L	Isolated	L
Related Measures:			
High Eff. Motors	H	Kitchen DCV	L
Demand Control Ventilation	L		
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Primary Incentive Target (User, Channel Member, Both)			Both
Sensitivity to Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Case studies, awareness, partnerships, whole building retrofits based on energy audits

GENERAL NOTES:
- Opportunity with both fans and pumps
- Awareness of the measure is quite high and it's commonly implemented
- Can be applied in constant volume systems as well in some cases

BARRIERS:
- Applies easily in a portion of facilities but significant additional retrofits are required in some cases
- Additional costs to implement in some applications
- No issue with availability on the Island
- Incentives are only currently available under the custom program, which some contractors may not be aware of
- Potential landlord-tenant issues, especially in large offices

STRATEGIES/PARTNERS:
- A prescriptive incentives would help make incentives more accessible but there are potential issues with savings being quite variable
- Bundled approach with additional retrofits would be useful in some application
- Working with controls contractors to help drum up sales and awareness
- Opportunity would likely be identified by energy audits

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C5: Advanced BAS

				COMMENTS
Focus Region	Island Interconnected			
Focus Sub-Sector	Large Office			
MEASURE INFORMATION				
CCE (¢/kWh)	3.0			
Simple Payback (years)	2.5			
ECONOMIC POTENTIAL				
Total Floor Space (Approx)	12,400,000			
Total Number of Sites	280			
% Eligible	90%			
# Eligible Sites Per Year	250			
# Eligible Sites By 2029	250			
PARTICIPATION RATES	**% by 2029**	**Curve**		
BAU Marketing	20%	B		
Aggressive Marketing	70%	B		
ACHIEVABLE POTENTIAL				
BAU Marketing	50			
Aggressive Marketing	175			
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)				
Other Sub-Sectors:				
Small Offices	L	Healthcare		H
Non-Food Retail	S	Schools		S-H
Food Retail	S	Universities		L
Large Hotels/Motels	S	Warehouses		Much L
Small Hotels/Motels	N/A	Restaurants		N/A
Other Regions:				
Labrador	S	Isolated		L
Related Measures:				
Programmable Tstats	H	Daylighting		S
Lighting Occupancy (Indoor)	H	Hotel Occupancy		L
Lighting Occupancy (Outdoor	H			
OTHER PARAMETERS				
Sensitivity to Incentives (High, Med, Low)				High
Primary Incentive Target (User, Channel Member, Both)				Both
Sensitivity to Direct Program Support (High, Med, Low)				High
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)				Education, case studies, bundling

GENERAL NOTES:
- Cost is likely too high. Should be closer to $600 per control point on average.
- Savings are likely too conservative. Would expect 25% savings on average.

BARRIERS:
- Similar to VFDs, this isn't something that's done on its own (i.e. done as part of a more holistic retrofit)
- Doesn't require much O&M if equipment and controls are installed and commissioned properly
- Equipment can easily be flipped to manual mode rather than being tuned
- Operators do not receive enough training to be able to operate sophisticated control systems
- Potential fear of the technology for building operators
- Potential issues with negative perception due to some systems not being operated properly
- Building owners may not want sign up to a service contract
- A lot of education required to ensure that systems are being operated properly

STRATEGIES/PARTNERS:
- Ensure that equipment is being maintained and that there is a service contract in place
- Education for both operators and contractors
- Ensure that equipment is properly commissioned and that M&V is being done
- Continuous optimization may be an option (as per BC Hydro approach)
- Can be bundled with a recommissioning program

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C6: High Performance New Construction

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Large Office		
MEASURE INFORMATION			
CCE (¢/kWh)		2.6	HPNC (25% Better)
Simple Payback (years)		2.5	
ECONOMIC POTENTIAL			
Total Floor Space (Approx)		1,800,000	
Total Number of Sites		40	
% Eligible		90%	
# Eligible Sites Per Year		3	Incr. basis
# Eligible Sites By 2029		40	
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	50%	A	
Aggressive Marketing	80%	C	
ACHIEVABLE POTENTIAL			
BAU Marketing		20	
Aggressive Marketing		32	
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	L	Healthcare	S
Non-Food Retail	L	Schools	H
Food Retail	L	Universities	H
Large Hotels/Motels	L	Warehouses	L
Small Hotels/Motels	L	Restaurants	L
Other Regions:			
Labrador	S	Isolated	L
Related Measures:			
HPNC (40% Better)	Much L		
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Med-Low
Primary Incentive Target (User, Channel Member, Both)			Both
Sensitivity to Direct Program Support (High, Med, Low)			Med
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Training for design community and new building owners

GENERAL NOTES:
- Much of the new construction recently has been government and they already build to a high efficiency standard
- This has pushed the local industry to a higher standard

BARRIERS:
- Cost is the primary barrier to implementation
- Building rating systems like LEED include a lot of measures that don't help with energy efficiency
- Major lost opportunity if it is missed at the time of new construction
- Free ridrship is a potential issue

STRATEGIES/PARTNERS:
- Non-energy benefits help the business case
- Buildings can be rented at a premium
- Engineering consultants are key in terms of delivery
- Workshops to deal with administrative burden and/or best way to implement without a rating system

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C7: PC Power Management

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Large Office		
MEASURE INFORMATION			
CCE (¢/kWh)	N/A		Behavioural measure
Simple Payback (years)	N/A		
ECONOMIC POTENTIAL			
Total Floor Space (Approx)	12,400,000		
Total Number of Sites	280		
% Eligible	95%		
# Eligible Sites Per Year	270		
# Eligible Sites By 2029	270		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	10%	B	
Aggressive Marketing	50%	B	
ACHIEVABLE POTENTIAL			
BAU Marketing	27		
Aggressive Marketing	135		
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	S	Healthcare	L
Non-Food Retail	L	Schools	S-H
Food Retail	L	Universities	S-H
Large Hotels/Motels	L	Warehouses	L
Small Hotels/Motels	L	Restaurants	L
Other Regions:			
Labrador	S	Isolated	S
Related Measures:			
ESTAR Computers	S	Task Lighting	L
ESTAR Office Equipment	S	Natural Ventilation	L
ESTAR Servers	S	Keep Doors Closed	L
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Low
Primary Incentive Target (User, Channel Member, Both)			User
Sensitivity to Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Education and marketing to IT departments and executive buy-in, lobby dashboards

GENERAL NOTES:
- Technology exists to implement power management settings

BARRIERS:
- IT department may need to push through updates during off hours
- Individuals may override power management settings that have been pushed down on them
- Remote use of work computers limits the proportion of computers that can be shut down

STRATEGIES/PARTNERS:
- Most effective to convince an IT department to implement and push down power management settings
- Education component is important to ensure persistence
- Competition (e.g. floor-by-floor) can be helpful

NL ACHIEVABLE POTENTIAL WORKSHOP - COMMERCIAL SECTOR

C8: Glazing

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Large Office		
MEASURE INFORMATION			
CCE (¢/kWh)	2.9		Incr. measure
Simple Payback (years)	2.8		
ECONOMIC POTENTIAL			
Total Floor Space (Approx)	12,400,000		
Total Number of Sites	280		
% Eligible	85%		
# Eligible Sites Per Year	10		Incr. measure
# Eligible Sites By 2029	240		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing	10%	B	
Aggressive Marketing	80%	C	
ACHIEVABLE POTENTIAL			
BAU Marketing	24		
Aggressive Marketing	192		
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Other Sub-Sectors:			
Small Offices	L	Healthcare	H
Non-Food Retail	L	Schools	H
Food Retail	L	Universities	H
Large Hotels/Motels	S	Warehouses	L
Small Hotels/Motels	L	Restaurants	L
Other Regions:			
Labrador	H	Isolated	H
Related Measures:			
Wall Insulation	S	Recommissioning	H
Roof Insulation	S		
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Med
Primary Incentive Target (User, Channel Member, Both)			User
Sensitivity to Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			Education, contractor training

GENERAL NOTES:

BARRIERS:
- Argon gas may leak out of some low quality windows
- Awareness of low cost may be an issue
- Commercial customers are looking for lowest cost options
- Landlord-tenant issues (i.e. split incentive)
- Only currently covered by custom program, which has seen no uptake

STRATEGIES/PARTNERS:
- Architects and contractors would be important partners
- Need to ensure that high efficiency glazings are included in specs
- Promote non-energy benefits

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Newfoundland and Labrador Conservation and Demand Management Potential Study: 2015

Industrial Sector Final Report

June 2015

Submitted to:
Newfoundland Power Inc.
Newfoundland and Labrador Hydro

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Executive Summary

Background and Objectives

Since the initial launch of takeCHARGE, NL's Conservation and Demand Management (CDM) market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation all have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and the demand management potential in the province. Similar to the 2007 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

Scope

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).

- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.

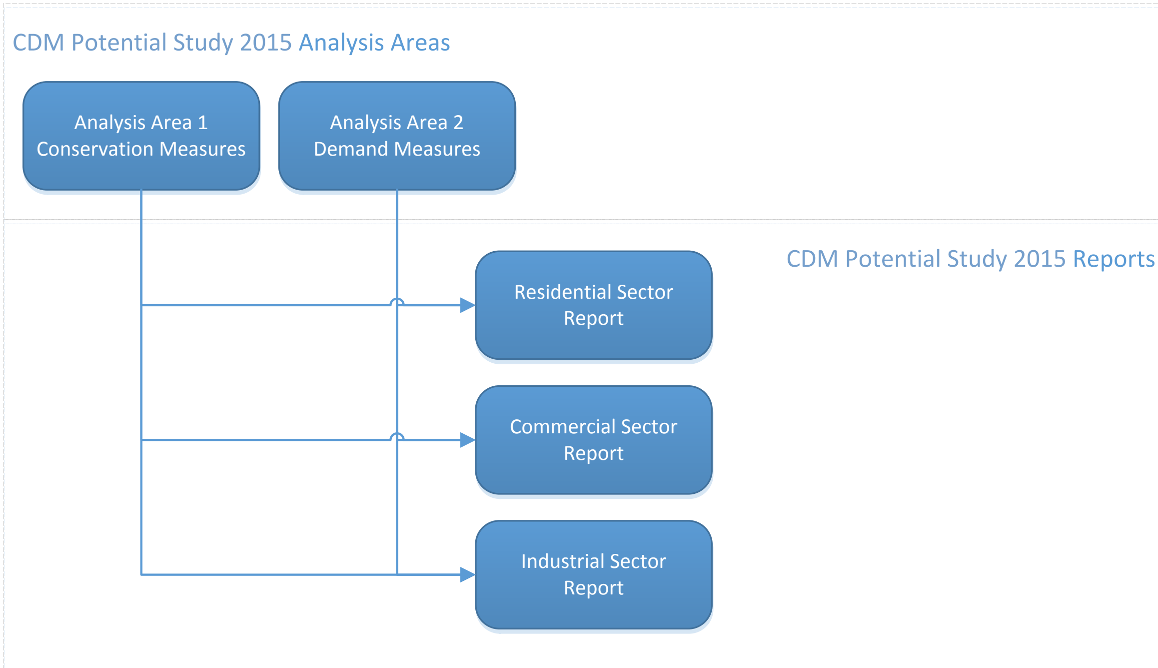
- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.

- **Technologies:** This study addresses a range of electricity conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

CDM Potential Study 2015 has been organized into two analysis areas and the results are presented in three reports, as show in Exhibit ES 1, below.

Exhibit ES 1 Overview of CDM POTENTIAL STUDY 2015 Organization – Analysis Areas and Reports

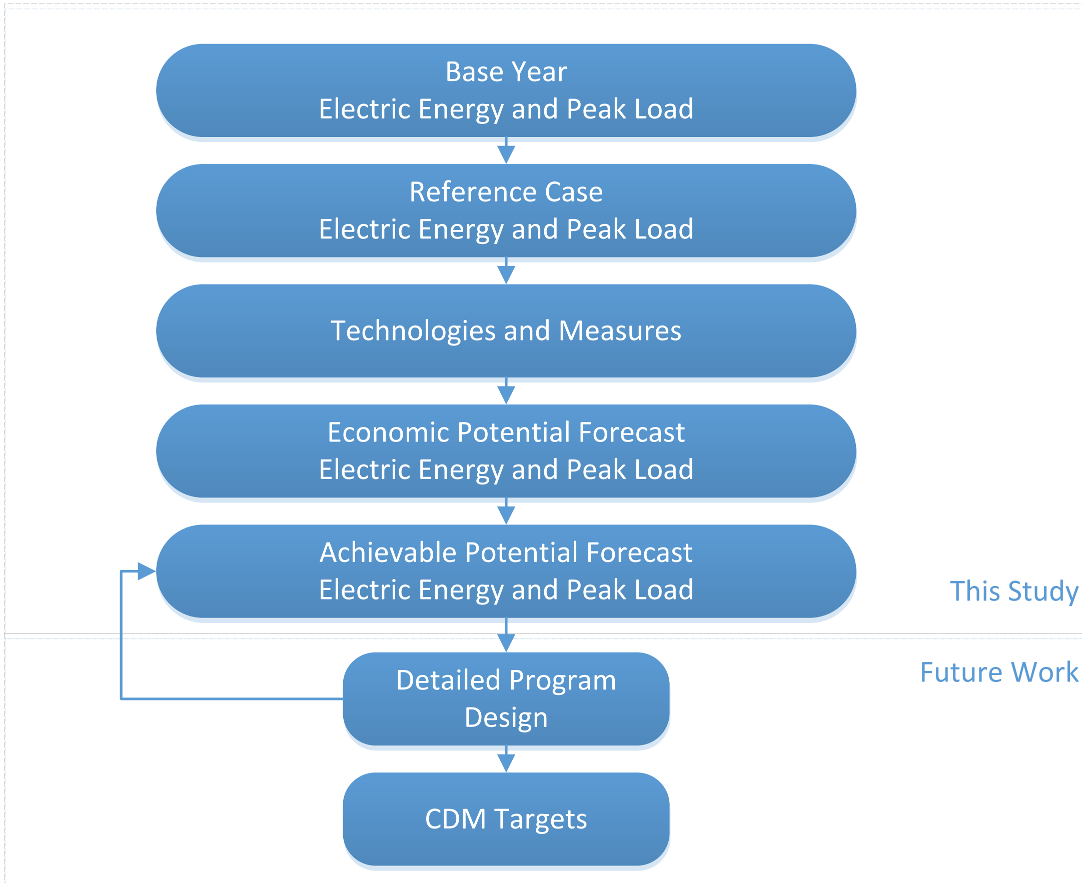


This report presents the results of both Analysis Area 1: Energy-efficiency Technologies and operation and maintenance (O&M) practices and Analysis Area 2: Demand Measures, for Industrial sector customers. This report addresses all commercially available electric energy-efficiency and peak load reduction measures that are applicable to NL's Industrial sector. It includes the potential for electrical efficiency and peak load reduction technologies expected to be commercially viable by the year 2029; residential customer behaviour measures and commercial and industrial operation and maintenance (O&M) practices are also addressed.

Approach

The assessment for this sector begins with a custom spreadsheet-based industrial analysis, which establishes how electricity is consumed in different industrial sub-sectors and how this breakdown of electricity consumption is forecast to change over the study period. This initial analysis feeds into the study's primary modelling platform, ISEEM (Industrial Sector Energy End-use Model), an ICF in-house spreadsheet-based macro model, where the potential savings from various technologies and measures are considered under different scenarios.

Exhibit ES 2 CDM POTENTIAL STUDY 2015: Main Analytic Steps



The major steps involved in the analysis are shown in Exhibit ES 2 and are discussed in greater detail in Section 2 of this report. As illustrated in Exhibit ES 2, the results of *CDM Potential Study 2015*, and in particular the estimation of Achievable Potential,[1] support on-going conservation and demand management (CDM) work; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific CDM targets or with program design.

Overall Industrial Study Findings

As in any study of this type, the results presented in this report are based on a number of important assumptions. Assumptions such as those related to the current penetration of efficient technologies and the rate of future industrial growth are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the NL utilities. However, the reader is referred to a number of caveats throughout the main text of the report. Given these assumptions, the CDM Potential Study 2015 findings confirm the existence of significant potential cost-effective opportunities for electricity consumption and peak load savings in NL's industrial sector.

Efficiency improvements would provide between 244 and 545 GWh/yr. of electricity consumption savings by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. Large

[1] The proportion of savings identified that could realistically be achieved within the study period.

industrial facilities (mining and processing, pulp and paper, and oil refining) represent 91% and 89% of these Lower and Upper Achievable Potential 2029 savings, respectively. The remainder of electricity savings are split between small-medium industrial facilities (fishing and fish processing, manufacturing, water systems, and other). This is in line with the Reference Case, where large industry accounts for 91% of sector electricity consumption by 2029, up slightly from 2014.

One key finding is the significant gap between the Upper and Lower Achievable Potential scenarios. This is a factor of what each scenario represents. For many measures, that are not new technologies, the Lower Achievable Potential represents that existing CDM programming has made limited progress towards the full potential for conservation. Conversely, the Upper Achievable Potential represents that there is significant potential for further adoption of measures if expanded CDM programs can help overcome key barriers.

The largest end-use to target in terms of Achievable Potential savings opportunities is pumping. In addition, there are significant savings to be found for fans and blowers, lighting, and process specific consumption, as well as several other important end uses.

The electricity consumption savings would provide associated peak load reductions of approximately 23 to 50 MW during NL's winter peak period by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. Demand reduction measures would provide further peak load reductions of approximately 96 to 116 MW by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. All told, this amounts to peak load reduction potential of between 32% and 44% with respect to the Reference Case industrial peak period load.

The demand response curtailment measure is the largest source of peak load reductions, representing approximately 93% of the potential from demand-specific measures, with much of this potential already in place through existing utility curtailment programs.

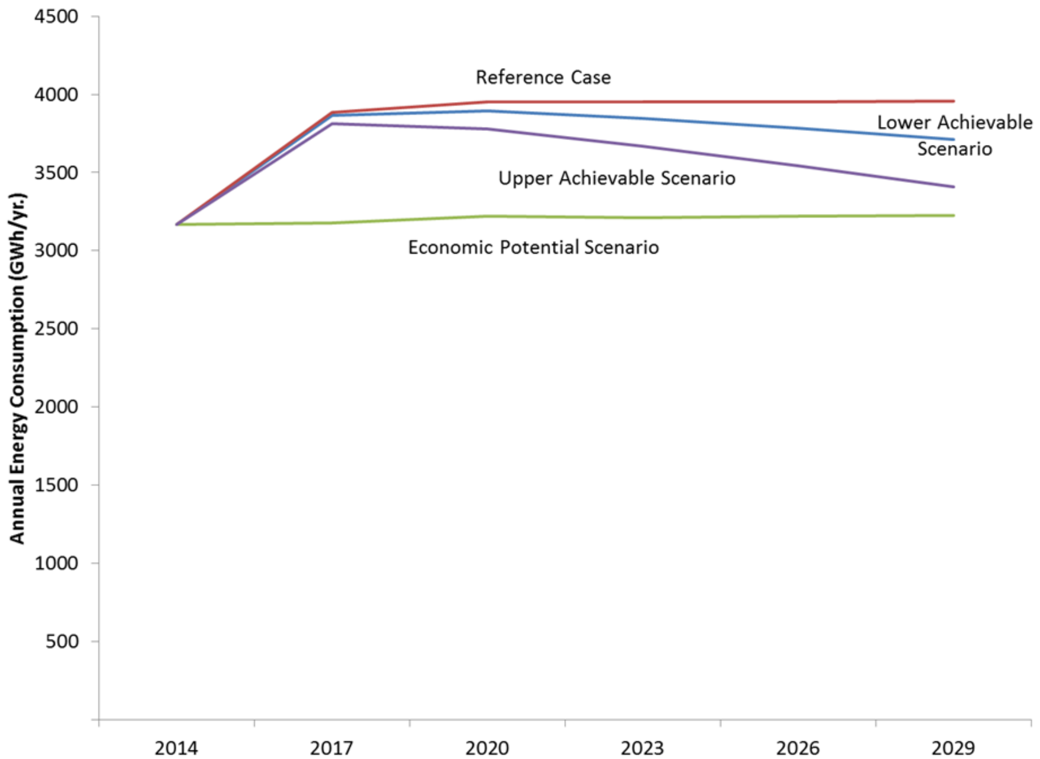
Summary of Electric Energy Savings in the Industrial Sector

A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by CDM Potential Study 2015 is presented in Exhibit ES 3 and Exhibit ES 4, by milestone year.

Exhibit ES 3 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
Year	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	709	18%	73	1.9%	19	0.5%
2020	729	19%	171	4.4%	57	1.5%
2023	743	19%	285	7.3%	108	2.8%
2026	735	19%	409	10.5%	170	4.4%
2029	728	19%	545	14.0%	244	6.3%

Exhibit ES 4 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Industrial Sector, (MWh/yr.)



Base Year Electricity Use

In the Base Year of 2014, NL's industrial sector consumed about 3,169 GWh/yr. Exhibit ES 5 shows that in the base year, process specific consumption represents about 22% of end-use consumption. This exhibit also highlights that motors and motor driven equipment, including compressed air systems, use close to 60% of all the electricity in industry. Within this group of end uses pumps account for 18% of base year end-use electricity, other motors account for 18%, and fans/blowers account for 15%.

Exhibit ES 5 also presents the Reference Case consumption by end use in 2029, at the end of the study period, for comparison. Overall, NL's Industrial sector is forecast to rise to about 3,956 GWh/yr. by 2029 in the absence of new utility CDM initiatives.

Exhibit ES 6 shows the distribution of Base Year electricity consumption by sub-sector. As illustrated, large industrial facilities account for the majority (89%) of industrial sector Base Year electricity use. The same exhibit also presents the Reference Case consumption by sub-sector in 2029, at the end of the study period, for comparison.

Reference Case – Electric Energy

Exhibit ES 5 Reference Case Electricity Use by End Use, Industrial Sector

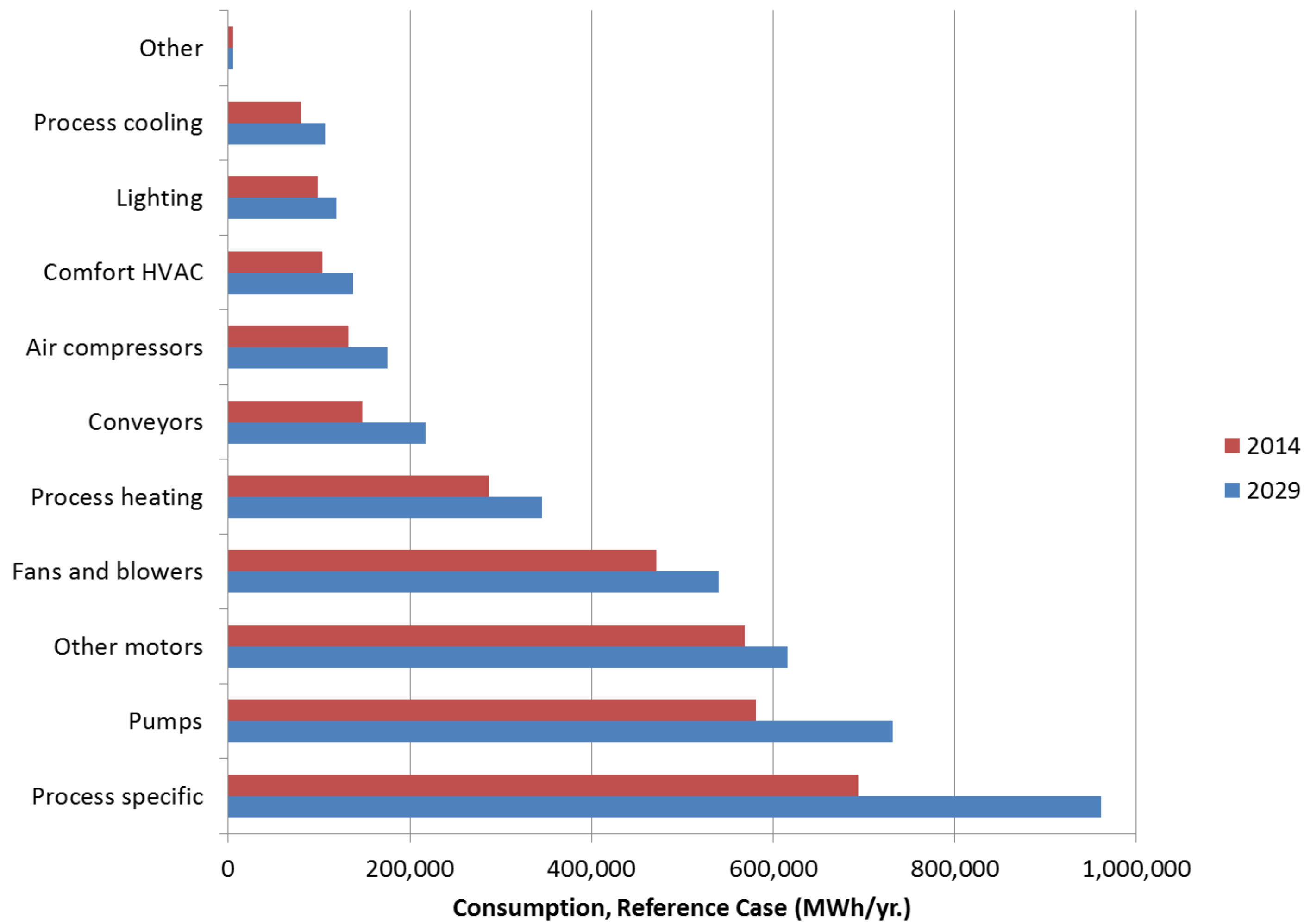
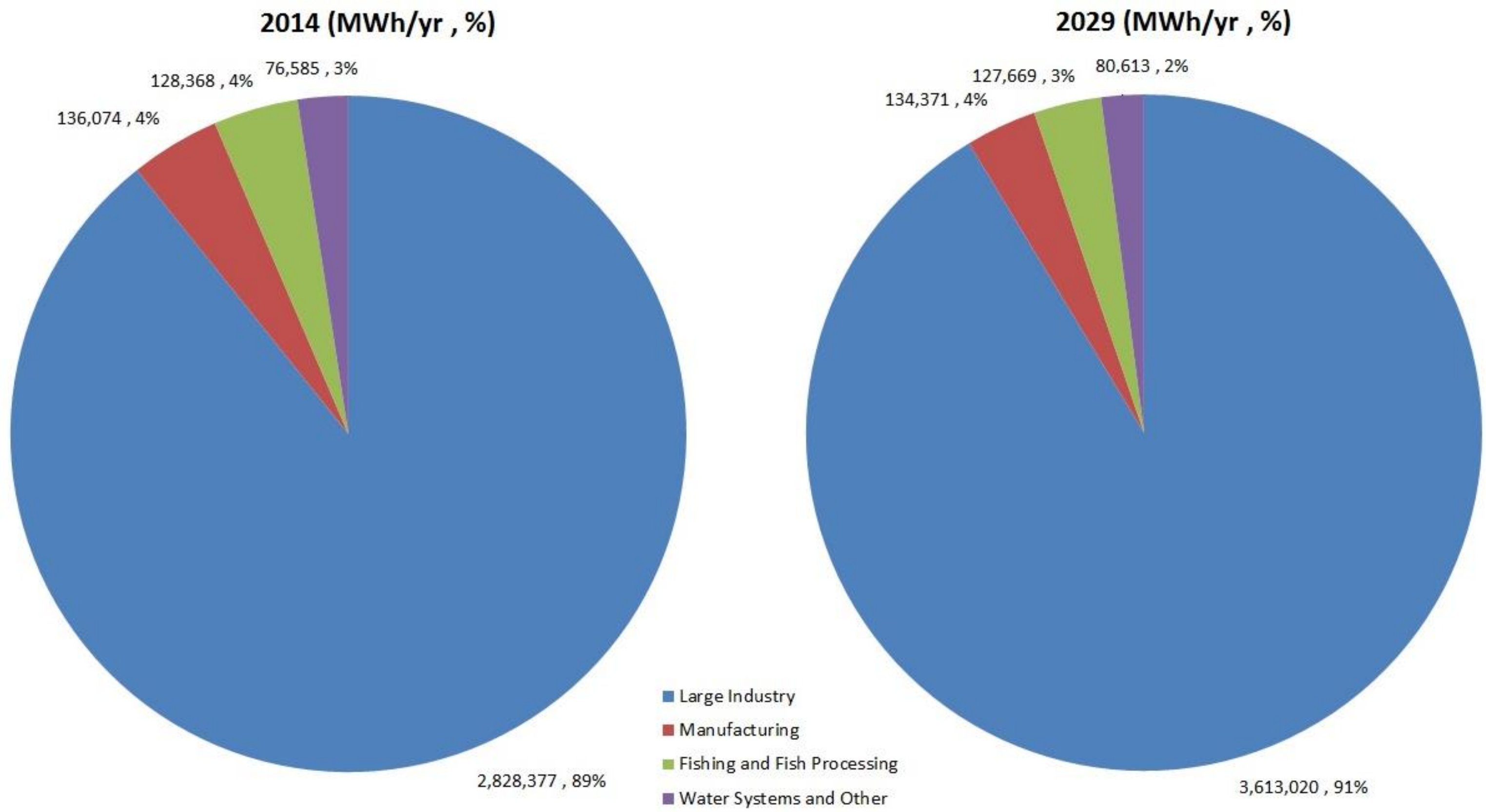


Exhibit ES 6 Reference Case Electricity Use by Sub-Sector, Industrial Sector



Economic Potential Forecast – Electric Energy

Under the conditions of the Economic Potential scenario,[2] the study estimated that electricity consumption in the industrial sector would decrease to approximately 3,244 GWh/yr. by 2029. Savings relative to the Reference Case would be approximately 712 GWh/yr. or about 18%, with the majority of the savings achieved by 2017. The Economic Potential savings are dominated by measures that are cost-effective based on their full cost (versus the "do-nothing" option), and therefore within the definitions of the scenario they would be adopted immediately and provide savings starting in the first milestone period.

Achievable Potential – Electric Energy

The Achievable Potential is the portion of the Economic Potential savings that could realistically be achieved within the study period.[3] In the industrial sector, the Achievable Potential for electricity savings was estimated to be 244 and 545 GWh/yr., respectively, in the Lower and Upper Achievable Potential scenarios. The savings in the intervening milestone years show a more realistic ramp-up pattern than that observed in the Economic Potential scenario.

The largest end-use to target in terms of Achievable Potential savings opportunities is pumping. In addition, there are significant savings to be found for fans and blowers, lighting, and process specific consumption, as well as several other important end uses. The top five measures in terms of Achievable Potential are pump control with ASDs, fan control with ASDs, energy management information systems (EMIS), optimization of pumping systems, and high efficiency lights (LEDs).

Summary of Peak Load Savings

A summary of the levels of annual peak period demand reductions contained in each of the forecasts addressed by CDM Potential Study 2015 is presented in Exhibit ES 7 and Exhibit ES 8, by milestone year. Based on discussions with utility personnel, the following peak period definition was used for this study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[4]

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[2] The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value, which has been set at different prices per kWh for the different regions. (One kWh from the Labrador hydroelectric grid is much less expensive than one kWh from an isolated diesel grid.)

[3] The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.

[4] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

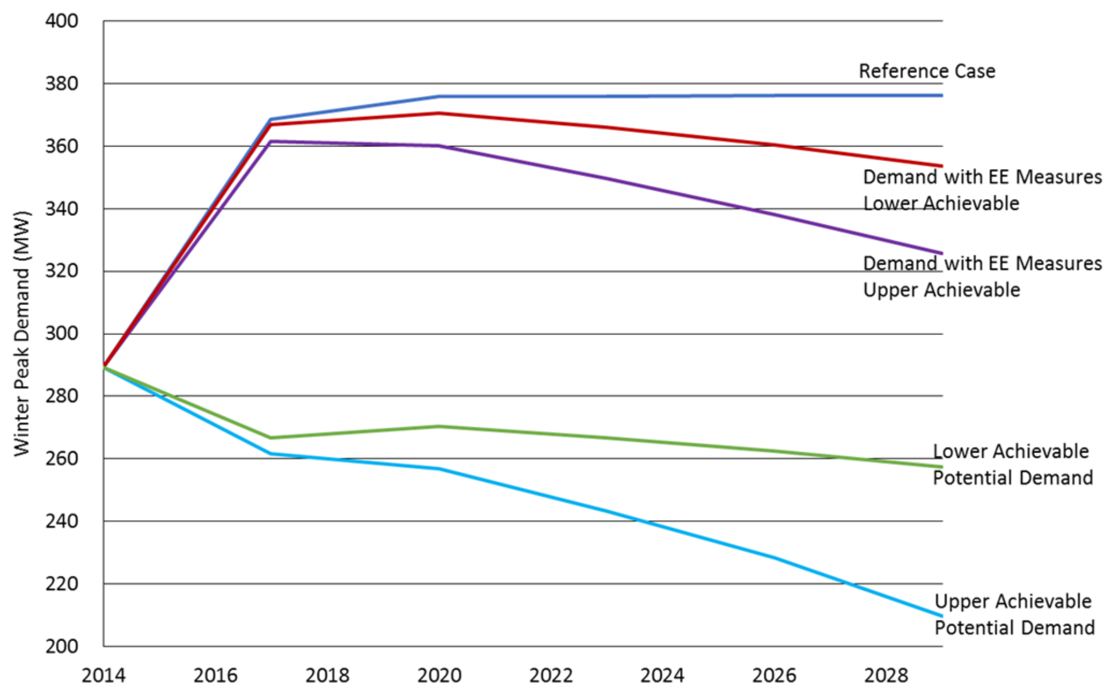
Exhibit ES 7 Peak Demand Reductions by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
	Potential Peak Demand Reduction (MW)	% Reduction Relative to Reference Case	Potential Peak Demand Reduction (MW)	% Reduction Relative to Reference Case	Potential Peak Demand Reduction (MW)	% Reduction Relative to Reference Case
2017	176	48%	107	29%	102	28%
2020	178	47%	119	32%	105	28%
2023	180	48%	133	35%	109	29%
2026	180	48%	148	39%	114	30%
2029	182	48%	166	44%	119	32%

Exhibit ES 8 provides a graphical view of the Upper and Lower Achievable Potential peak load reductions from both the energy efficiency measures and from measures targeted specifically at load management. More details on peak load reduction opportunities are provided in the main body of the report. Highlights of the findings include the following:

- The study estimates that the industrial sector peak load would grow to 376 MW by 2029, an increase of approximately 30%.
- Electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 23 to 50 MW by 2029, a decrease of between 6% and 13% relative to the Reference Case.
- Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 96 to 116 MW by 2029, a decrease of a further 26% to 31%.
- Demand reduction potential is dominated by the reductions associated with demand response curtailment measure, with much of this potential already in place through existing utility curtailment programs.

Exhibit ES 8 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Industrial Sector (MW)



Base Year Demand

In the Base Year of 2014, NL's industrial sector demand was approximately 289 MW, averaged over the 36-hour peak period. This may be compared against the overall average industrial demand for the year, which is:

*3,169 GWh / 8760 hours * 1000 MW/GW = 361 MW*

Exhibit ES 9 shows that the process specific end use is the largest industrial component of peak demand, at 21%. Process specific end use is also the largest in terms of annual electrical consumption and tends to be significant in the large industrial facilities, which operate at a fairly steady level year round, including the winter when the NL system peaks. Pumps and other motors are the second and third largest industrial components of peak demand (21% and 16%), once again matching the order of largest consumption end uses. Process heating is the fifth largest industrial contributor to peak demand at 11%. This is an increase from the end use's 9% share of industrial consumption, which makes sense given the additional heating requirements during peak winter periods. Similarly, HVAC rises from 3% portion of consumption to a 5% portion of Base Year peak demand.

The same exhibit also presents the Reference Case consumption by end use in 2029, at the end of the study period, for comparison. Overall, NL's Industrial sector is forecast to rise to about 376 MW by 2029 in the absence of new utility CDM initiatives, an increase of approximately 30%.

Exhibit ES 10 shows the distribution of Base Year electric peak demand by sub-sector. As illustrated, large industrial facilities account for the largest share (91%) of industrial sector Base Year peak demand. The same exhibit also presents the Reference Case demand by sub-sector in 2029, at the end of the study period, for comparison.

Reference Case – Electric Peak Demand

Exhibit ES 9 Electric Peak Demand by End Use, Industrial Sector, 2014 and 2029

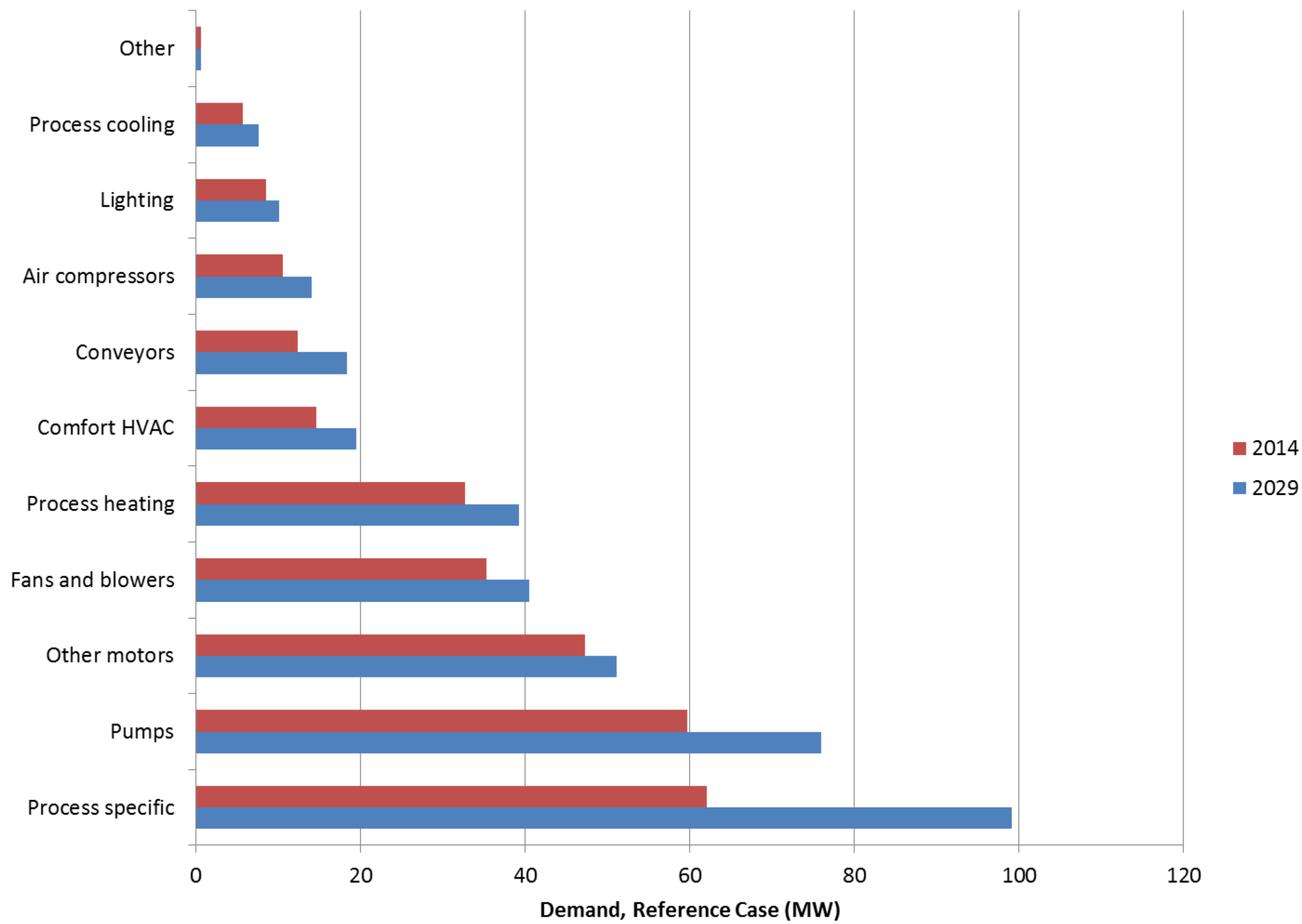
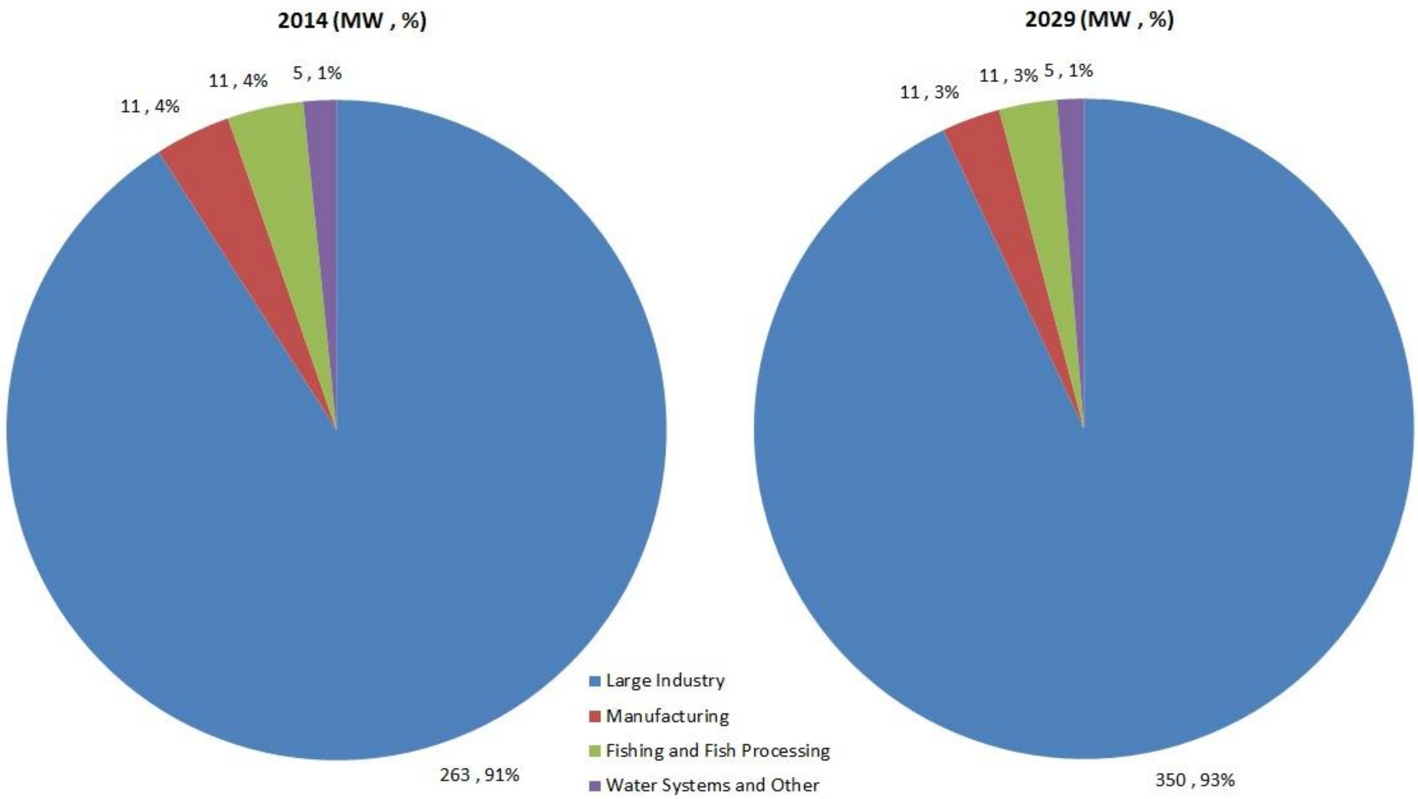


Exhibit ES 10 Electric Peak Demand by Sub Sector, Industrial Sector, 2014 and 2029



Economic Potential Forecast – Electric Peak Demand

Under the conditions of the Economic Potential scenario,[5] the study estimated that electric peak demand in the industrial sector would decrease to approximately 194 MW by 2029. Reductions relative to the Reference case would be approximately 182 MW or about 48%, with the majority of the reductions achieved by 2017. The Economic Potential reductions are dominated by measures that are cost-effective relative to the Utilities' cost of new capacity based on their full cost (versus the "do-nothing" option), and therefore within the definitions of the scenario they would be adopted immediately and provide reductions starting in the first milestone period.

Achievable Potential – Electric Peak Demand

The Achievable Potential is the portion of the Economic Potential reductions that could realistically be achieved within the study period. In the industrial sector, electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 23 to 50 MW by 2029, a decrease of between 6% and 13% relative to the reference case. Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 96 to 116 MW by 2029, a decrease of a further 26% to 31%. The demand reduction potential is dominated by the reductions associated with demand response curtailment measure. The reductions in the intervening milestone years reflect that much of this potential already in place through existing utility curtailment programs, but that there will be a ramp-up period for demand reductions from electricity savings.

[5] The Economic Potential Electric Peak Load Forecast is the expected electric peak load that would occur in the defined peak period if demand is reduced by the reductions associated with the energy efficiency measures in the Economic Potential Electricity Efficiency Forecast, and all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were also fully implemented.

Table of Contents

List of Exhibits

1 Introduction

Newfoundland Power Inc. and Newfoundland and Labrador Hydro have been successfully delivering electricity conservation programs to their customers since 2009 under the joint brand, takeCHARGE.

Since the initial launch of takeCHARGE, NL's CDM market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and demand management potential in province. Similar to the 2007 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

1.1 Study Scope

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).

- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.

- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.

- **Technologies:** This study addresses a range of electricity conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

1.1.1 Data Caveat

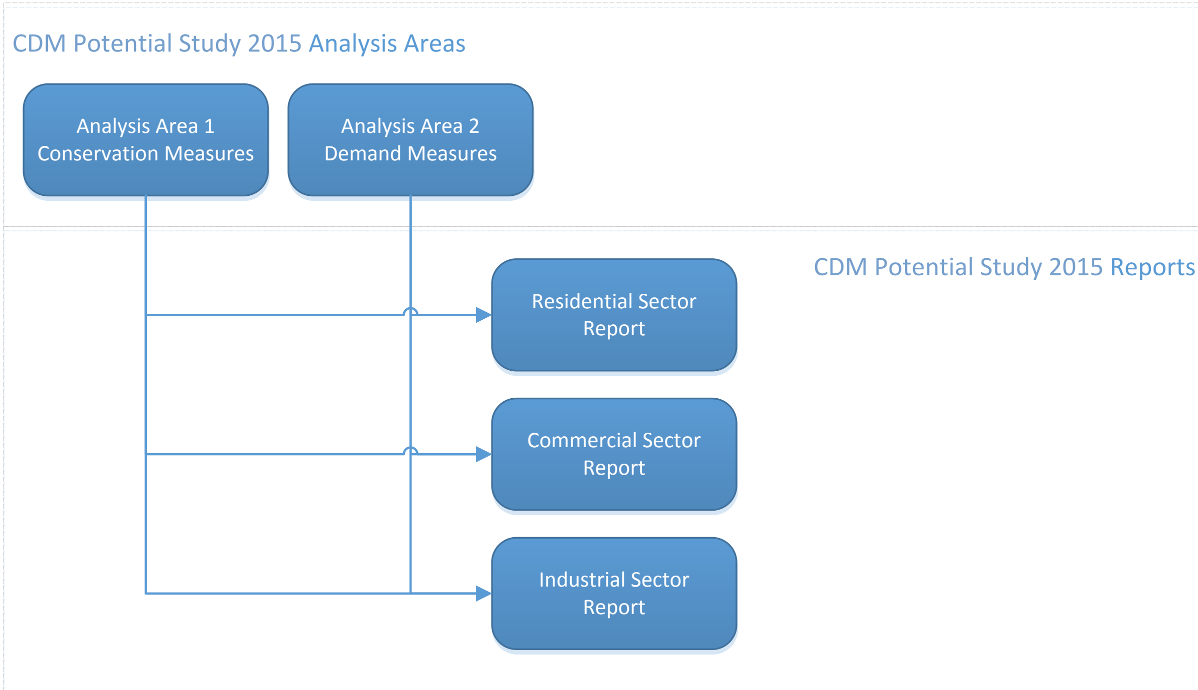
As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future industrial growth and customer willingness to implement new energy-efficiency measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and the Government of Newfoundland and are based on best available information, which in many cases includes the professional judgment of the consultant team, client personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.2 Study Organization

Exhibit 1 presents an overview of the study's organization; as illustrated, the study has been organized into two analysis areas and four individual reports.

A brief description of each analysis area and its report content is provided below.

Exhibit 1 Overview of *CDM Potential Study 2015* Organization – Analysis Areas and Reports



1.2.1 Analysis Area 1 – Conservation Measures

This area of the *CDM Potential Study 2015* assesses electric energy[6] reduction opportunities that could be provided by electrical efficiency technologies that are expected to be commercially viable by the year 2029; operation and maintenance (O&M) practices are also addressed. The results of Analysis Area 1 are presented in three individual sector reports and summarized in a Summary Report.

1.2.2 Analysis Area 2 – Demand Measures

This area of the *CDM Potential Study 2015* assesses peak load reduction opportunities that could be provided by peak load reduction technologies that are expected to be commercially viable by the year 2029; operational practices are also addressed. The results of Analysis Area 2 are presented in three individual sector reports and summarized in a Summary Report.

1.3 Report Organization

This report presents the Industrial sector results. It is organized and presented as follows:

- Section 2 presents an overview of the study methodology, including a definition of key terms and an outline of the major analytic steps involved.
- Section 3 presents a profile of Industrial sector Base Year electricity use in NL.

[6] The term “electric energy” is used in this report to distinguish electricity consumption (in units of kWh or MWh) from electricity demand during a specific period (in units of MW).

- Section 4 presents a profile of Industrial sector Base Year electric peak load, including the definition of peak periods that are included in this study.
- Section 5 presents the Reference Case, which provides a detailed estimate of electricity use in NL's Industrial sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 6 presents the Reference Case electric peak loads, which provide a detailed estimate of peak load requirements in NL's Industrial sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 7 identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Industrial sector.
- Section 8 presents the Industrial sector Economic Potential Electricity Forecast for the study period 2014 to 2029.
- Section 9 identifies and assesses the economic attractiveness of selected Industrial sector electric capacity-only peak load reduction measures, which in this study are defined as those measures that affect electric peak but have minimal or no impact on daily, seasonal or annual electricity use.
- Section 10 presents the estimated upper and lower Achievable Potential for electric energy savings for the study period 2014 to 2029.
- Section 11 lists sources and references.
- Section 12 is the Glossary.

1.4 Results Presentation

The preparation of CDM Potential Studies involves the compilation and analysis of an enormous amount of market and technology data and a nearly infinite number of ways of organizing and presenting the results. It is recognized that readers will have differing levels of needs with respect to the level of detail provided. Consequently, the results of this CDM Potential Study are presented at three levels of detail.

- **Main report body.** The main body of the report provides a relatively high-level reporting of the main steps involved in undertaking each stage of the study together with a concise summary of results, including comments and interpretation of key findings. It is assumed that the content and level of detail in the main report body is suitable for the majority of readers who wish to gain an understanding of the potential contribution of CDM options to NL's long-term electricity requirements.
- **Appendices.** A separate appendix accompanies each major section of the main report. Each appendix provides more detailed information on the methodology employed, including major assumptions or sample calculations as applicable, together with additional levels of results. It is assumed that this presentation is better suited to CDM analysts and managers wishing a more thorough understanding of the study results.
- **Software.** All of the data generated by the study is provided in two custom-designed Excel models: Data Manager and the measure TRM (technical resource manual) Workbook.

- **Data Manager** is a custom-designed Excel workbook with query protocols that enable the user to search and report the study results in a virtually infinite number of combinations. Data Manager is intended to support the most detailed level of CDM activity such as program design, preparation of regulatory submissions, etc.

- **The measure TRM Workbook** is a custom-designed model that provides comprehensive profiles of the CDM measures assessed within the study. Because the information is provided in software form, any changes to economic, financial or performance data inputs can be easily accommodated and revised results generated automatically.

2 Study Methodology

This section provides an overview of the methodology employed for this study. More specifically, it addresses:

- Definition of terms
- Major analytic steps
- Analytic models.

2.1 Definition of Terms

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

A brief description of some of the most important terms and their application within this study is included below.

Base Year Electricity Use	The Base Year is the starting point for the analysis. It provides a detailed description of where and how electrical energy is currently used in the existing building stock. Building electricity use simulations were undertaken for the major sub-sector types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2014.
Base Year Electric Peak Load Profile	Electric peak load profiles refer to one specific time period throughout the year when NL's generation, transmission and distribution system experiences particularly high levels of electricity demand. This period is of particular interest to system planners; improved management of electricity demand during this peak period may enable deferral of costly system expansion. This study addresses one specific peak periods, as outlined in the main text.
Reference Case Electricity Use (includes "natural" conservation)	The Reference Case electricity use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2014) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable electricity savings potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the sub-sectors, estimation of the expected growth in building stock, and finally an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case is calibrated to the Utilities most recent load forecast, minus the impacts of new, future CDM initiatives.
Reference Case Electric Peak Load Profile	The Reference Case peak load profile estimates the expected electric peak loads in the defined peak period over the study period in the absence of new utility CDM program initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable Potentials for peak load reduction.

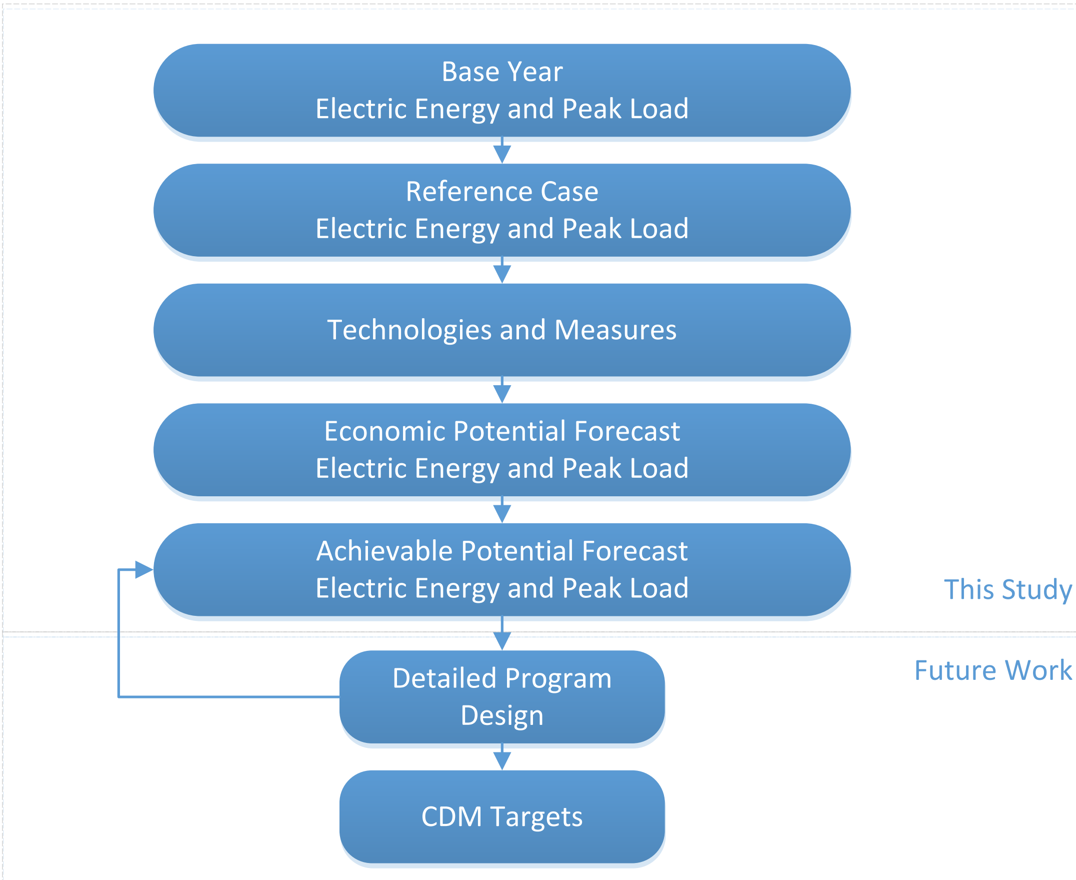
Conservation and Demand Management (CDM) Measures	CDM measures can include energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and customer-side generation (displace load off of grid). Customer –side generation and fuel switching are not included in this study.
The Cost of Conserved Energy (CCE)	The CCE is calculated for each energy-efficiency technology measure. The CCE is the annualized incremental capital and O&M cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.
The Cost of Electric Peak Reduction (CEPR)	The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.
Electric Capacity-Only Peak Load Reduction Measures	Capacity-only measures are technologies or activities that result in the shifting of certain electrical loads from periods of peak system demand to periods of lower system demand.
Economic Potential Electricity Forecast	The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value[7], which has been set at different prices per kWh for the different regions. (One kWh from the Labrador hydroelectric grid is much less expensive than one kWh from an isolated diesel grid.) All the energy-efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the economic threshold value for a given supply system were incorporated into the Economic Potential Forecast.
Economic Potential Electric Peak Load Forecast	The Economic Potential Electric Peak Load Forecast is the expected electric peak loads that would occur in each of the three defined peak periods if all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were fully implemented.
Achievable Potential	The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecasts that could realistically be achieved within the study period. The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.

[7] The economic threshold value is related to the cost of new avoided electrical supply. The values for each supply system are generally selected to provide the CDM Potential Study with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost effective over time. Further discussion is provided in Section 7 of this report.

2.2 Major Analytic Steps

The study was conducted within an iterative process that involved a number of well-defined steps, as illustrated in Exhibit 2.

Exhibit 2 Major Analytic Steps



A summary of the steps is presented below.

Step 1: Develop Base Year Electric Energy and Peak Load Calibration Using Actual Utility Billing Data

Build a model of electric energy and demand for the sector, disaggregated to all the building types and end uses, calibrated to sales of electricity in NL. This includes the following sub-steps:

- Compile and analyze available data on NL's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period.

Step 2: Develop Reference Case Electric Energy Use and Peak Load Profile

Extend the base year model to the end of the study period, based on forecast building stock growth and expected natural changes in construction practices, equipment efficiency levels and/or practices. This includes the following sub-steps:

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with load forecasting data provided by the Utilities for the study period.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period over the study period.

Step 3: Identify and Assess Energy-efficiency and Peak Load Reduction Measures

Compile information on upgrade measures that can save electric energy and/or reduce peak demand, and assess them for technical applicability and economic feasibility. This includes the following sub-steps:

- Develop list of energy-efficiency upgrade and peak load reduction measures.
- Compile detailed cost and performance data for each measure.
- For energy-efficiency measures, identify the baseline technologies employed in the Reference Case, develop energy-efficiency upgrade options and associated electricity savings for each option, and determine the CCE for each upgrade option.
- For each peak load reduction measure, identify the affected end use, the potential load reduction or off-peak shifting and determine the CEPR.
- Based on the above results, prepare summary tables that show the amount of potential peak load reduction provided by each measure and at what cost ($/kW/yr.).
- Apply each peak load reduction measure to the affected end use, regardless of cost, and determine total peak reduction.
- Summarize the peak load reduction impacts in a supply curve.

Step 4: Estimate Economic Electric Energy Savings Potential

Develop an estimate of the electric energy savings potential that would result from implementing all of the economically feasible measures in all the buildings where they are applicable. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new electricity generation and set an economic threshold value; different economic threshold values were selected for each supply system (hydroelectric and diesel grids).
- Identify the combinations of energy-efficiency upgrade options and building types where the cost of saving one kilowatt of electricity is equal to, or less than, the cost of new electricity generation.
- Apply the economically attractive electrical efficiency measures from Step 3 within the energy-use simulation model developed previously for the Reference Case.
- Determine annual electricity consumption in each building type and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: Estimate Achievable Potential Electricity Savings

Develop an estimated range for the portion of economic potential savings that would likely be achievable within realistic CDM programs. This includes the following sub-steps:

- Bundle the electric energy and peak load reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a high-level implementation framework, including measure description, cost and savings profile, target sub-sectors, potential delivery allies, barriers and possible synergies.
- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a full day workshop involving the client, the consultant team, trade allies and technical experts to reach general agreement on the upper and lower range of Achievable Potential.

Step 6: Estimate Peak Load Impacts of Electricity Savings

Develop an estimate for the peak load impacts associated with the measures that save electric energy. This includes the following sub-steps:

- The electricity (electric energy) savings (MWh) calculated in the preceding steps were converted to peak load (electric demand) savings (kW).[8]
- The conversion of electricity savings to hourly demand drew on a library of specific sub-sector and end-use electricity load shapes. Using the load shape data, the following steps were applied:
  - Annual electricity savings for each combination of sub-sector and end use were disaggregated by month
  - Monthly electricity savings were then further disaggregated by day type (weekday, weekend day and peak day)
  - Finally, each day type was disaggregated by hour.

2.3 Analytical Models

The analysis of the Industrial sector employs one main modelling platform:

- ISEEM (Industrial Sector Energy End-use Model), an ICF proprietary spreadsheet-based macro model.

The assessment of the Industrial sector begins with a separate customized ICF spreadsheet analysis. This includes an end use breakdown analysis to gather key information from a variety of sources and balance them so as to define the driving inputs for the subsequent modeling. This analysis is based on survey results, audit reports, utility billing data, utility load forecasts, previous studies, and project team experience. It addresses:

- How electricity is consumed in different industrial sub-sectors
- How this breakdown of electricity consumption is forecast to change over the study period

This information is used to generate archetypes for each sub-sector, which represent all of the plants in that sub-sector. Exhibit 3 illustrates how these archetypes combine sub-sector, end use, and fuel share data to generate the energy use forecasts used in the study. The generic plant construct is used to define an electricity consumption profile representative of a ‘typical’ or archetype plant within a given industry sub-sector (or a specific type of plant within a given sub-sector if there are

[8] Peak load savings were modelled using the Cross-Sector Load Shape Library Model (LOADLIB).

substantial process differences). The generic plant is a composite of energy use patterns, energy intensities, and consumption levels within the particular target sub-sector. The candidate energy management measures are applied to the generic plant to model energy savings potential.

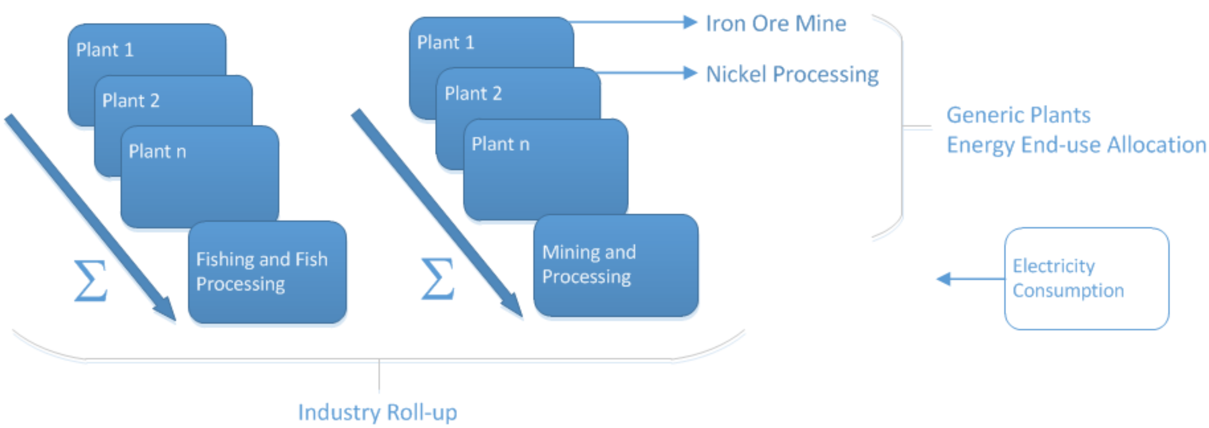
The outputs from the end use breakdown analysis also provide the energy-use intensity (EUI) inputs for the archetype module of ISEEM. ISEEM consists of two modules:

- A general parameters module that contains general sector data (e.g., number of facilities, growth rates, etc.)
- An end use module that contains data on end use saturation levels, fuel shares, unit electricity use, etc.

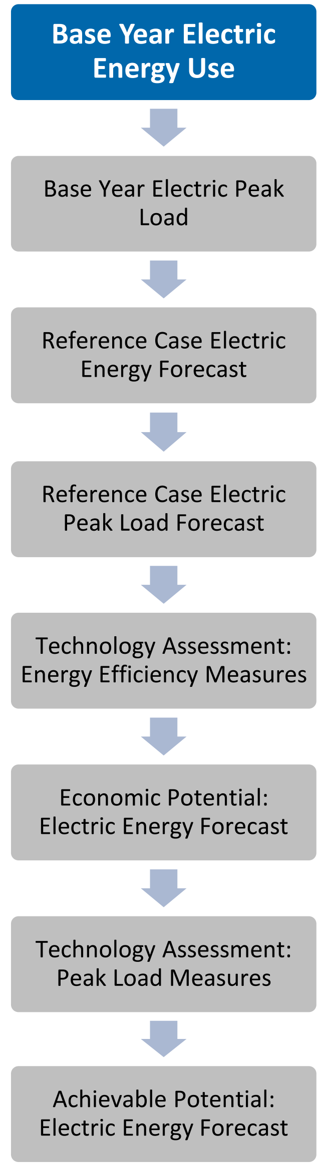
ISEEM combines the data from each portion of the analysis and provides total use of electricity by service region, sub-sector, and end use. ISEEM also enables the analyst to estimate the impacts of the electrical efficiency measures on a utility's on-peak system demand.

ICF's approach has been successfully employed in numerous domestic and international conservation and demand management projects. ICF is recognized as a global leader in CDM Potential studies and evolves it's techniques to stay on the leading edge. The deployment of ISEEM in this project will ensure that results of the industrial study integrate seamlessly with the outputs from the commercial and residential models, CSEEM and RSEEM. This will provide the Utilities with a more powerful Data Manager tool to help with future conservation and demand management planning.

Exhibit 3 Industrial Plant Archetypes



3 Base Year (2014) Electric Energy Use



3.1 Introduction

This section provides a profile of Base Year (2014) electricity use in NL's Industrial sector. The discussion is organized into the following sub-sections:

- Segmentation of Industrial sector
- Definition of end uses
- Development of electricity use profiles
- Summary of Industrial base year electricity use

This study is based on the total electricity use by industrial facilities in Newfoundland and Labrador. The study does not separate out a portion of this electricity use to reflect the self-generation capacity owned by some large industrial facilities. While some of these facilities do include combined heat and power (CHP) and hydroelectric generation, this capacity is all grid-connected.

Conversations with the Utilities indicated their preference to consider total electricity use, which is in line with how the organizations track consumption and load forecasts. Considering total electricity use reflects the full potential for conservation and demand management measures in the Industrial Sector. In summary, all electricity used by equipment at industrial facilities is included in this study, regardless of whether or not it was self-generated.

3.2 Segmentation of Industrial Sector

The first major task in developing the profile of Base Year electricity use involved the segmentation of the industrial accounts into specific sub-sectors. The choice of sub-sectors was determined by the combination of four factors:

- Data availability
- The need to maintain customer confidentiality
- The need to facilitate subsequent analysis of potential electrical efficiency improvements, which means that there must be similarity in terms of major design and operating considerations, such as manufacturing process, hours of operation and product type

The Industrial sub-sectors that are used to present the results of this study are shown in Exhibit 4 below. While modeling will be conducted separately for each of the six sub-sectors named in the right column of this exhibit, the presentation of results will contain a single 'Large Industrial' category that aggregates results from the three corresponding sub-sector models. This aggregation was included to ensure that confidentiality of facility information is maintained.

Exhibit 4 Industrial Sub-Sectors

Level of Electricity Consumption	Study Sub-Sectors
Large Industrial	Pulp and Paper, Mining and Processing, Oil Refining
Small and Medium Industrial	Fishing and Fish Processing
	Manufacturing
	Water Systems and Other

A brief description of the industrial customers included in each of the sub-sectors shown in Exhibit 4 is provided below.

- **Large Industrial**: The Large Industrial classification is based on the amount of electricity used and not on production volumes or number of employees. Facilities classified as such are those expected to use more than 50 GWh of electricity annually. There are five transmission level customers who fall into this group from the following sub-sectors: Mining and Processing, Pulp and Paper, and Oil Refining. These three sub-sectors will be modeled separately but the results will be presented together. It should also be noted that because the Mining and Processing sub-sector also contains some small and medium sized mining operations, the modeling results from these smaller facilities will also be included within the Large Industrial category.

- **Small and Medium Industrial**: Similar to the Large Industrial category, this category is based on the amount of electricity and includes facilities that are expected to use less than 50 GWh/yr. These sub-sectors were selected to align with the categories the Utilities use to track small-medium industrial consumption. The following sub-sectors are included here:

  - **Fishing and Fish Processing**: This sub-sector consists of approximately 600 metered accounts. This sub-sector's monthly electricity consumption is seasonal (monthly consumption peaking in July and August; minimum usage from January to March). The monthly peak consumption is almost 3 times more than the minimum monthly consumption.

  - **Manufacturing**: This sub-sector consists of approximately 1025 metered accounts; monthly electricity consumption is relatively stable throughout the year, with a bit of an increase in winter months.

  - **Water Systems and Other:** This sub-sector includes all the other industrial facilities using less than 50 GWh/yr that are not included under the Fishing or Manufacturing sub-sectors. The main sub-sectors included are: Municipal Water and Sewer Facilities, Commercial and Utility Water Systems, and Sawmills. Approximately 1425 metered accounts are included in this sub-sector and the monthly electricity consumption is relatively consistent throughout the year.

The modeling of energy use was executed at the sub-sector level, with archetypes for each of the three Large and three Small and Medium Industrial sub-sectors. A summary of the distribution of NL's industrial sub-sectors is provided in Exhibit 5. The first exhibit provides details of the estimated breakdown by sub-sector and region. The column chart shows the breakdown by sub-sector type graphically. Note that there are only five customers that meet the Large Industrial designation, but the numbers in the exhibit below reflect the inclusion of metered accounts from small-medium mining operations within this category.

Exhibit 5 Existing Newfoundland Industrial Metered Accounts by Sub-Sector and Region

Sub Sectors	Island	Labrador	Isolated	Grand Total
Large Industry	88	44	-	132
Fishing and Fish Processing	558	1	40	599
Manufacturing	1,008	12	7	1,027
Water Systems and Other	1,251	72	102	1,425
Grand Total	2,905	129	149	3,183

As illustrated in Exhibit 5:

- The NL electric utilities currently service about 3,183 industrial metered accounts.
- Approximately 91% of industrial metered accounts are in the Island Interconnected region, approximately 4% are in the Labrador Interconnected region, and the remaining 5% are on various isolated diesel grids.
- 45% of the industrial metered accounts are designated as water systems and other, approximately 32% are manufacturing accounts, approximately 19% are fishing and fish processing accounts, and the remaining 4% of accounts are primarily made up of small-medium mining accounts, as well as the 5 large industrial accounts.
- It should be noted that high metered accounts numbers in certain sub-sectors will not necessarily translate into those sub-sectors accounting for a large portion of industrial consumption. The base year highlights that the size of customers, and not the number of customers, is the key determining factor driving which sub-sectors account for the largest portion of electricity consumption.

3.3 Definition of End Uses

Electricity use within each of the sub-sectors noted above is further defined on the basis of specific end uses. In this study, an end use is defined as "the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy." As discussed in the introduction, this study is focused on the full potential for conservation, which is dependent on how consumption can be reduced at the end use level. This analysis does not remove a portion of electricity use to reflect the self-generation capacity of some facilities, as all of the equipment at those facilities is still a target for conservation, and this would underrepresent the potential for conservation in the province.

A summary of the major industrial sector end uses used in this study is provided in Exhibit 6, together with a brief description of each.

Exhibit 6 Industrial Electric End Uses

<table>
<tr><th colspan="2">Electricity End Use</th><th>Description</th></tr>
<tr><td colspan="2">Process heating</td><td>Process heating, including hot water and steam production and distribution</td></tr>
<tr><td colspan="2">Process cooling / refrigeration / freezing</td><td>Process related cooling, refrigeration and freezing</td></tr>
<tr><td rowspan="3">Motors and motor driven equipment</td><td>Compressed air</td><td>Compressed air utilities, including compressors and compressed air distribution system</td></tr>
<tr><td>Pumps</td><td>Process pumps</td></tr>
<tr><td>Fans and blowers</td><td>Fans and blowers</td></tr>
</table>

Exhibit 6 Continued: Industrial Electric End Uses

Electricity End Use		Description
	Conveyors	Conveyors and material handling
	Other motors	Motors not included in other categories, for example, motors in grinding, stamping, pressing equipment
Process specific		Processes and equipment not included in the other process categories and are specific to a sub-sector
Building envelope and comfort	Lighting	Lighting systems
	Heating, ventilation and air conditioning (HVAC)	HVAC for comfort and work space climate control
Other		End uses not included in the other categories. These include supporting end uses, office equipment, and other assorted equipment that might be found at a facility.

3.4 Development of Industrial Electricity Use Profiles

Electricity end-use profiles were developed for the six sub-sectors described above. The profiles map proportionally how much electricity is used by each of the end uses for each sub-sector. For sub-sectors where the differences between facilities in each region were clearly understood, the profiles were customized for each of the study's regions. These profiles represent the sub-sector archetypes and are used in the model to calculate the electricity used by each end use for each sub-sector, in each region.

The archetype profiles developed for large industry were based on the results of a survey of the facilities included in these sub-sectors. In all but one case site personnel provided data, which included both the allocation of electricity use by end use and general best practices implemented at the sites. The other archetype end use profiles were developed based on audit reports from NL's commercial end use survey, and experience from previous industry studies in NL and other Canadian jurisdictions. The resulting end use breakdowns can be found in Appendix A. Differences from the equivalent breakdowns included in the 2008 study are mainly driven by changes to the facilities that make up the sub-sectors (for example, the large industrial landscape has shifted) and by additional data that was available for this study.

3.5 Summary of Industrial Base Year Electricity Use

This section combines the electricity end use profiles with the utility consumption data to produce a summary of the breakdown of electricity use in NL's Industrial sector in the Base Year. The results are presented in five separate exhibits:

- Exhibit 7 presents the results in tabular form by sub-sector and end use
- Exhibit 8, Exhibit 9, and Exhibit 10 present the model results graphically by sub-sector, by region, and by end use, respectively
- Exhibit 11 and Exhibit 12 present the model results as a series of stacked bars, showing the percentage or MWh, consumed by end use for each sub-sector.

Additional highlights are provided below.

By Sub-Sector

Large Industry (Mining and Processing, Pulp and Paper, and Oil Refining) accounts for 89% of overall industrial consumption in the base year. The remaining consumption is split relatively evenly between Fishing and Fish Processing (4%), Manufacturing (4%), and Water Systems and Other (3%).

By Region

The Labrador Interconnected region accounts for approximately 51% of industrial electricity consumption in the base year. The Island Interconnected region accounts for about the same portion of the base year, at approximately 49% of industrial electricity consumption. Isolated diesel grids account for a very small portion of industrial consumption, at less than 1%.

By End Use

Motors and motor driven equipment, including compressed air systems, use close to 60% of all the electricity in industry. Within this group of end uses other motors account for about 18% of end-use electricity, pumps also account for 18%, and fans/blowers account for 15%.

By Sub-Sector and End Use

The last exhibit in this section highlights the differences among sub-sectors. The breakdown of energy consumption varies significantly by sub-sector. For example, Fishing and Fish Processing is around 53% process cooling, while Water Systems and Other is dominated by pumping consumption.

These differences also translate into significant variation between the results for each region, based on the facilities specific to that area. These base year results can be analyzed from many different perspectives in the Data Manager files, which are discussed below.

Data Manager – Final Edition

As part of this report, an Excel application called Data Manager is provided. This Excel workbook includes all the exhibits that were produced using the Data Manager for Chapters 3, 4, 5, and 6, and the corresponding Appendices. It also has the ability to produce charts and tables looking at the data filtered and segmented in other ways. For example:

- The user can produce a pie chart of electricity consumption by end use for an individual sub-sector of interest, such as Fishing and Fish Processing.
- The user can produce separate charts for each region.
- The user can produce a column chart showing the electricity consumption for all motive power end uses in each of several sub-sectors, with each sub-sector as a separate column and the different motive power consumption values shown stacked on top of each other.
- The user can produce a line chart showing consumption for a particular sub-sector by year.
- The user can produce a column chart showing the consumption of different sub-sectors in each rate class (different rate classes within industrial distinguish between facility size, for example).

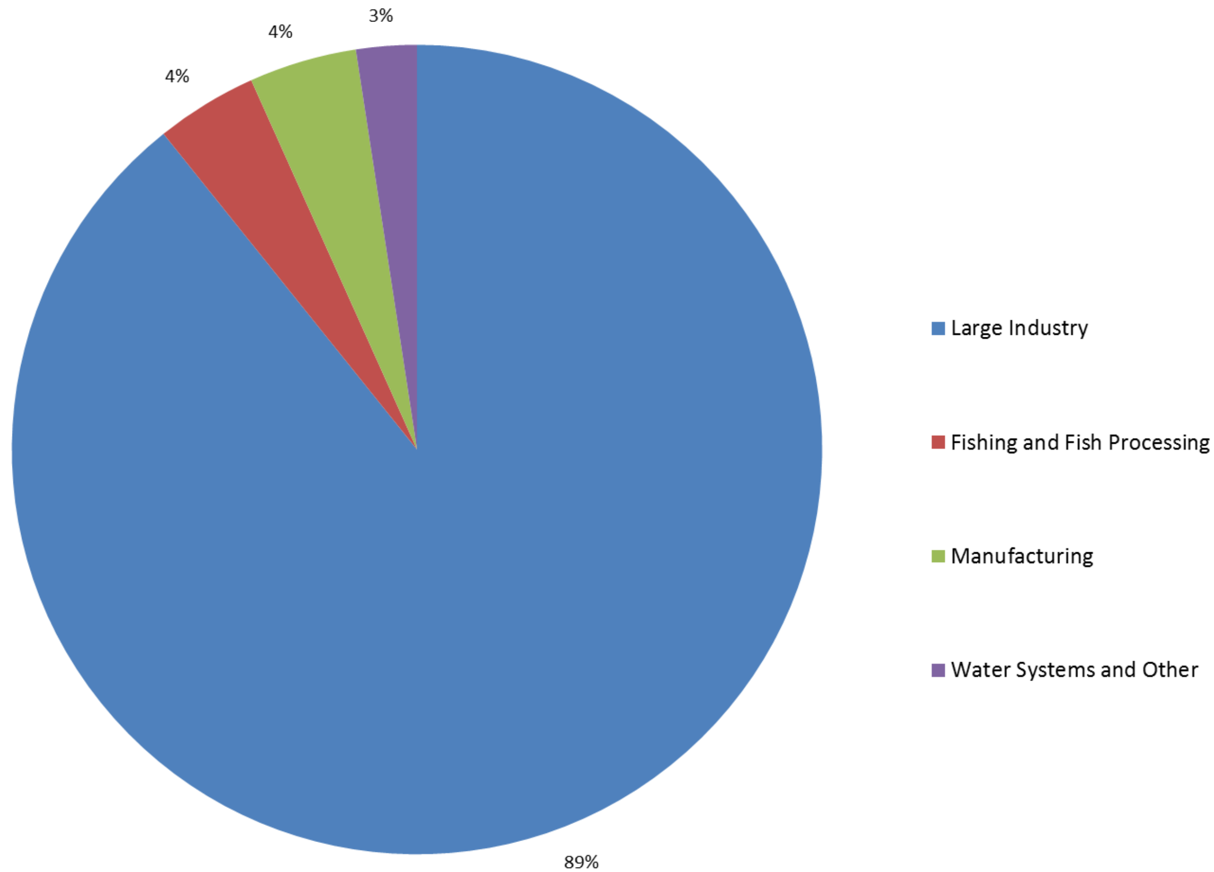
Data Manager has a user interface designed for someone with basic knowledge of Excel.

Exhibit 7 Electricity Consumption by End Use and Sub-Sector in the Base Year (2014), (MWh/yr.)

	Reference Case Consumption (MWh/yr.)					
Sub-Sector	**Air compressors**	**Comfort HVAC**	**Conveyors**	**Fans and blowers**	**Lighting**	**Other**
Large Industry	114,864	63,253	139,539	451,374	66,231	1,816
Fishing and Fish Processing	3,662	15,927	5,100	1,266	8,878	1,663
Manufacturing	13,359	22,895	2,544	11,100	20,518	1,061
Water Systems and Other	742	2,013	39	7,221	2,437	883
Grand Total	**132,627**	**104,087**	**147,222**	**470,962**	**98,064**	**5,424**

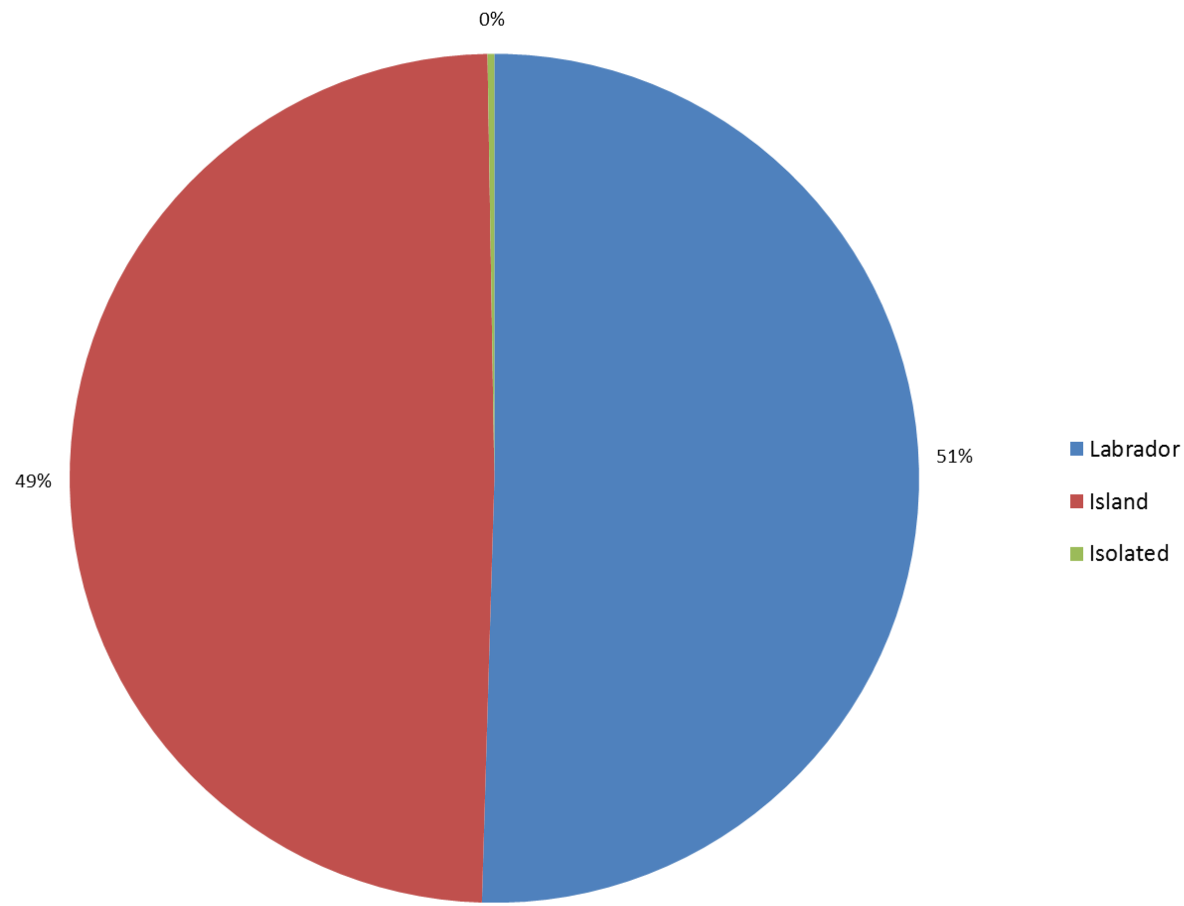
	Reference Case Consumption (MWh/yr.)					
Sub-Sector	**Other motors**	**Process cooling**	**Process heating**	**Process specific**	**Pumps**	**Grand Total**
Large Industry	516,357	3,880	271,244	681,186	518,634	2,828,377
Fishing and Fish Processing	5,339	68,032	9,830	2,014	6,656	128,368
Manufacturing	39,644	7,951	4,121	4,759	8,121	136,074
Water Systems and Other	7,692	-	2,228	5,814	47,516	76,585
Grand Total	**569,033**	**79,863**	**287,423**	**693,774**	**580,927**	**3,169,404**

Exhibit 8 Distribution of Electricity Consumption, by Sub-Sector in the Base Year (2014)



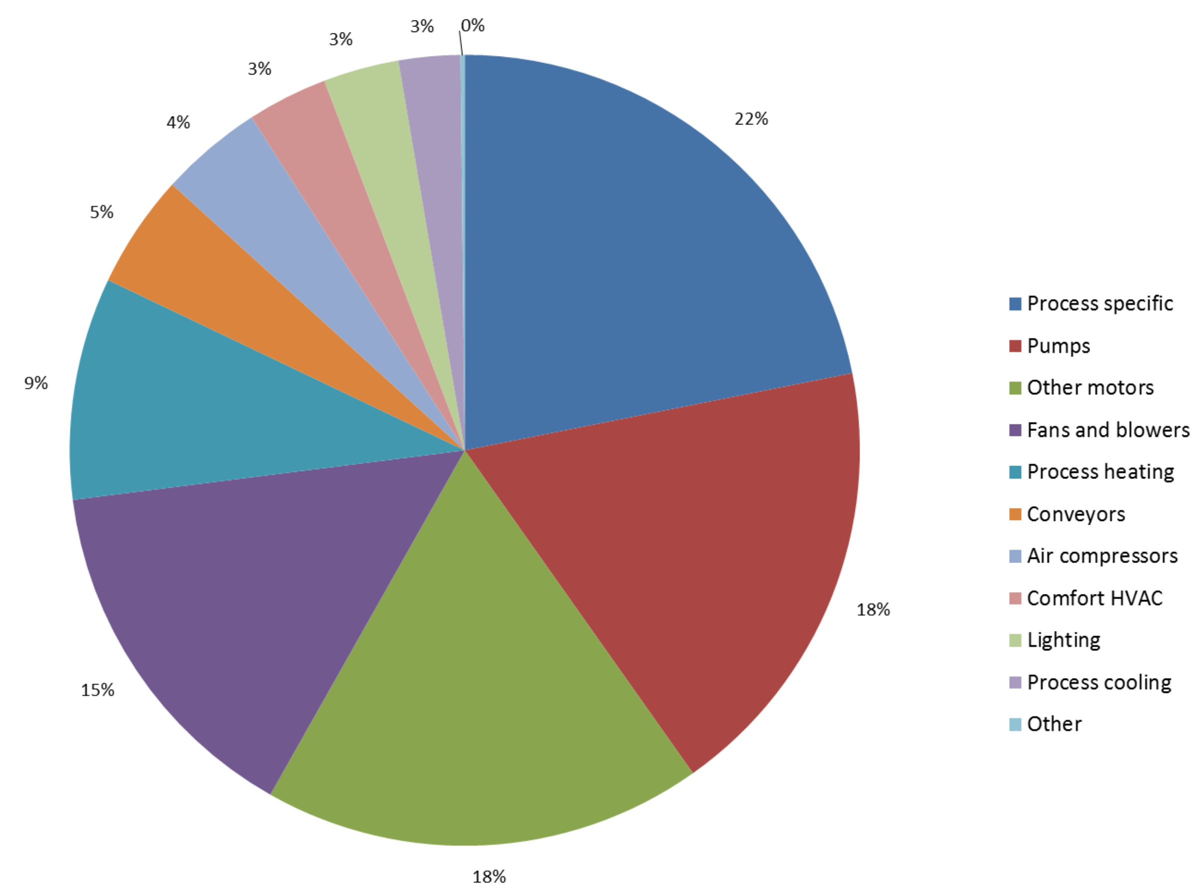
Totals may not add to 100% due to rounding.

Exhibit 9 Distribution of Electricity Consumption, by Region in the Base Year (2014)



Totals may not add to 100% due to rounding.

Exhibit 10 Distribution of Electricity Consumption, by End Use in the Base Year (2014)



Totals may not add to 100% due to rounding.

Exhibit 11 Distribution (%) of Electricity Consumption, by Sub-Sector and End Use in the Base Year (2014)

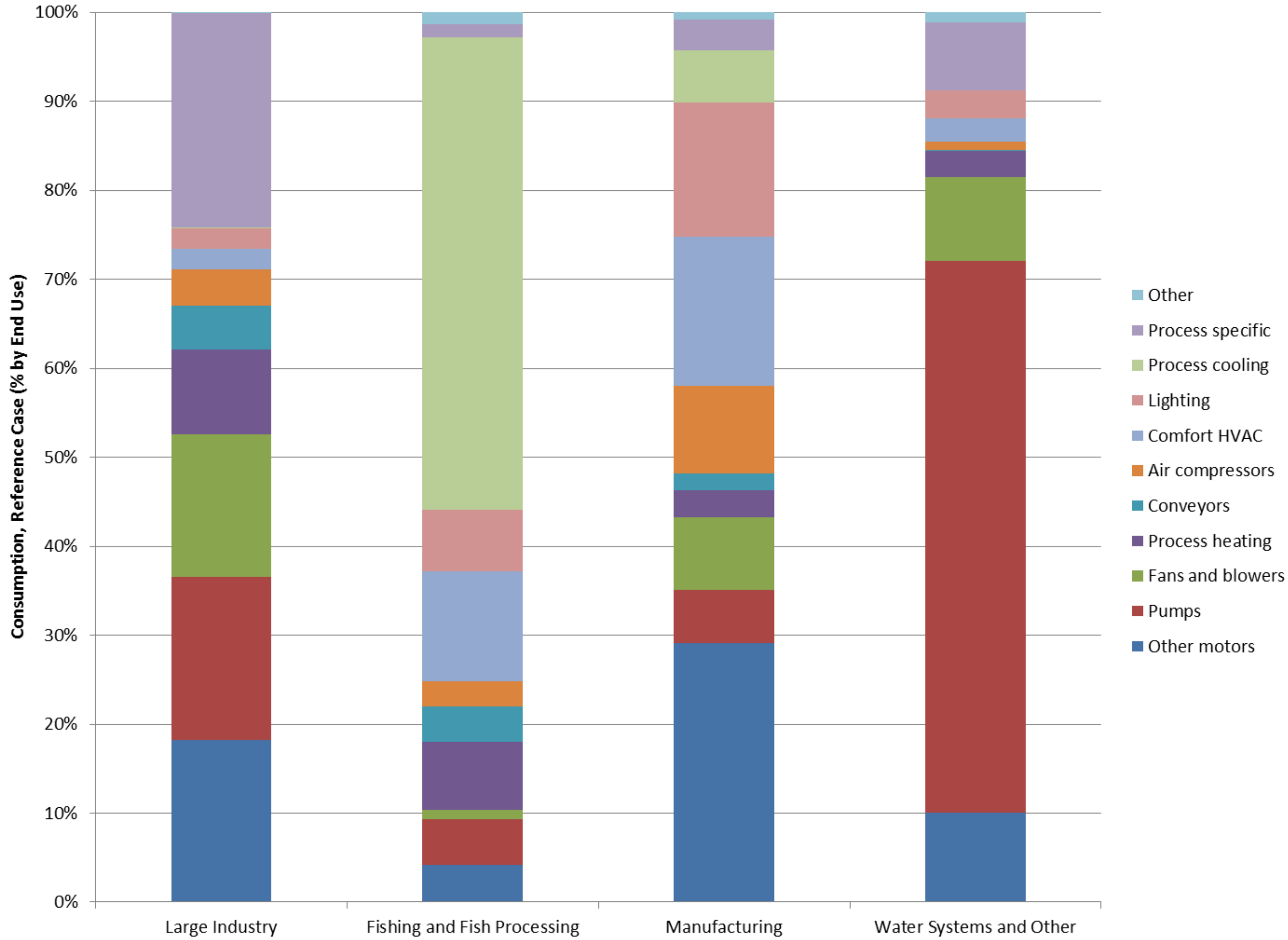
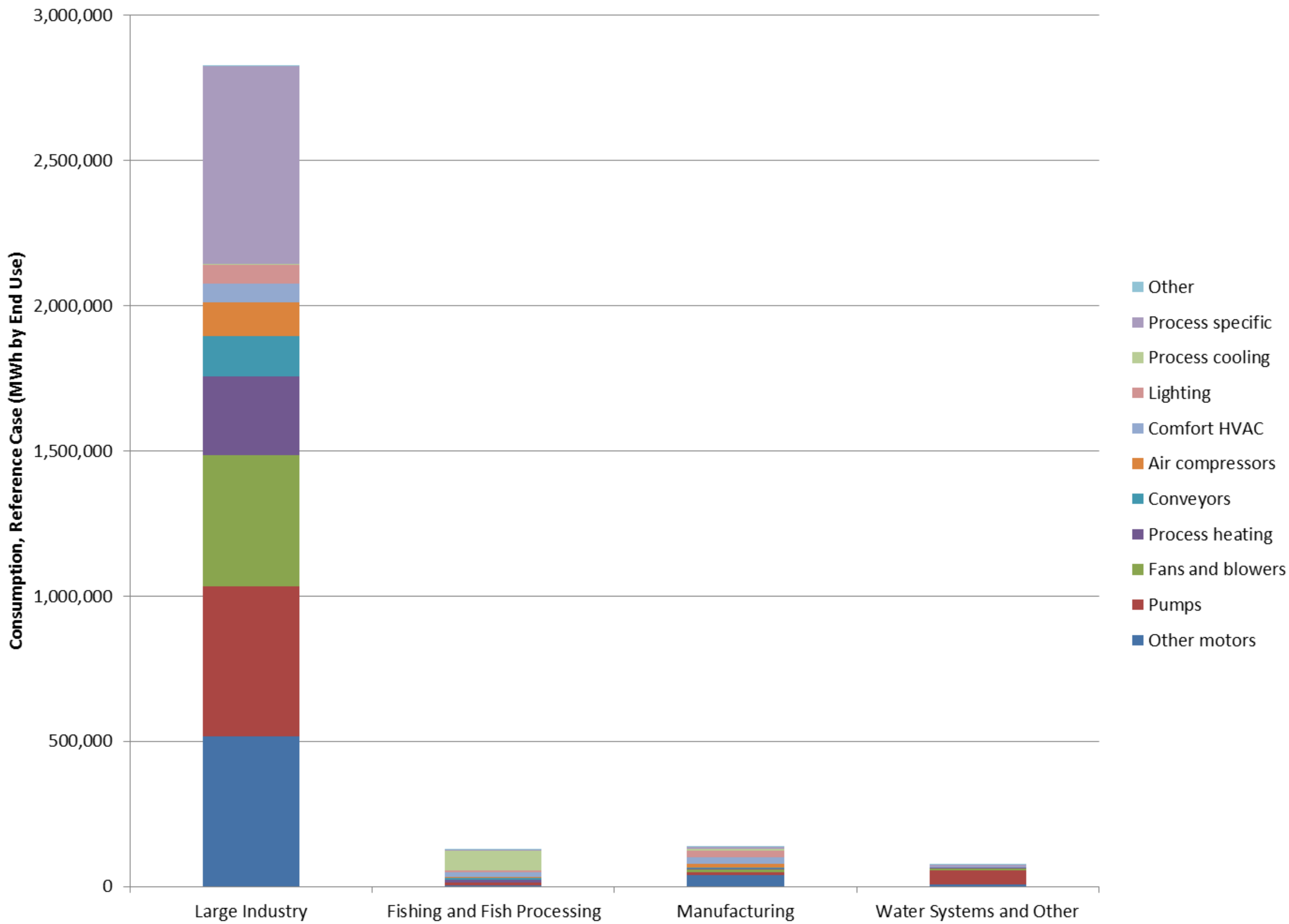
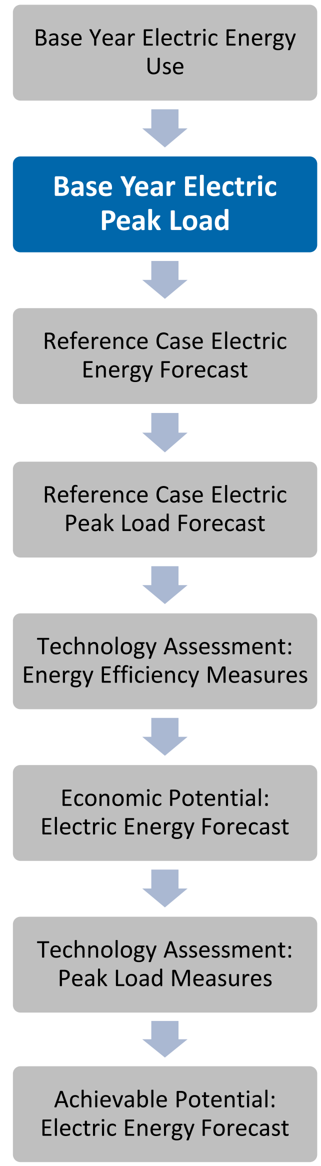


Exhibit 12 Distribution (MWh) of Electricity Consumption, by Sub-Sector and End Use in the Base Year (2014)



4 Base Year (2014) Electric Peak Load



4.1 Introduction

This section provides a profile of the Base Year electric peak load for NL's Industrial sector. The discussion is organized into the following sub-sections:

- Peak period definitions
- Methodology
- Summary of results.

Additional details are provided in Appendix B.

4.2 Peak Period Definitions

Based on discussions with utility personnel, the peak period of interest was the same as in the 2007-2008 study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[9]

The system capacity constraints are very dependent on cold weather. The NL utilities are do not currently experience capacity constraints in the summer. In future, there may be financial advantages to reducing system demand in summer in order to market more power to summer-peaking utilities in the U.S. That possibility was not explored in this study.

4.3 Methodology

The electric peak load profile converts the annual electric energy use (MWh) presented in Section 3 to hourly demand (MW). Development of the electric peak load estimates employs four specific factors, which are described below and shown graphically in Exhibit 13.

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. In decreasing order of priority, this allocation factor can be obtained from either:
  - Monthly consumption statistics from end-use load studies
  - Monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months, or
  - Heating or cooling degree days applied to an appropriate base.

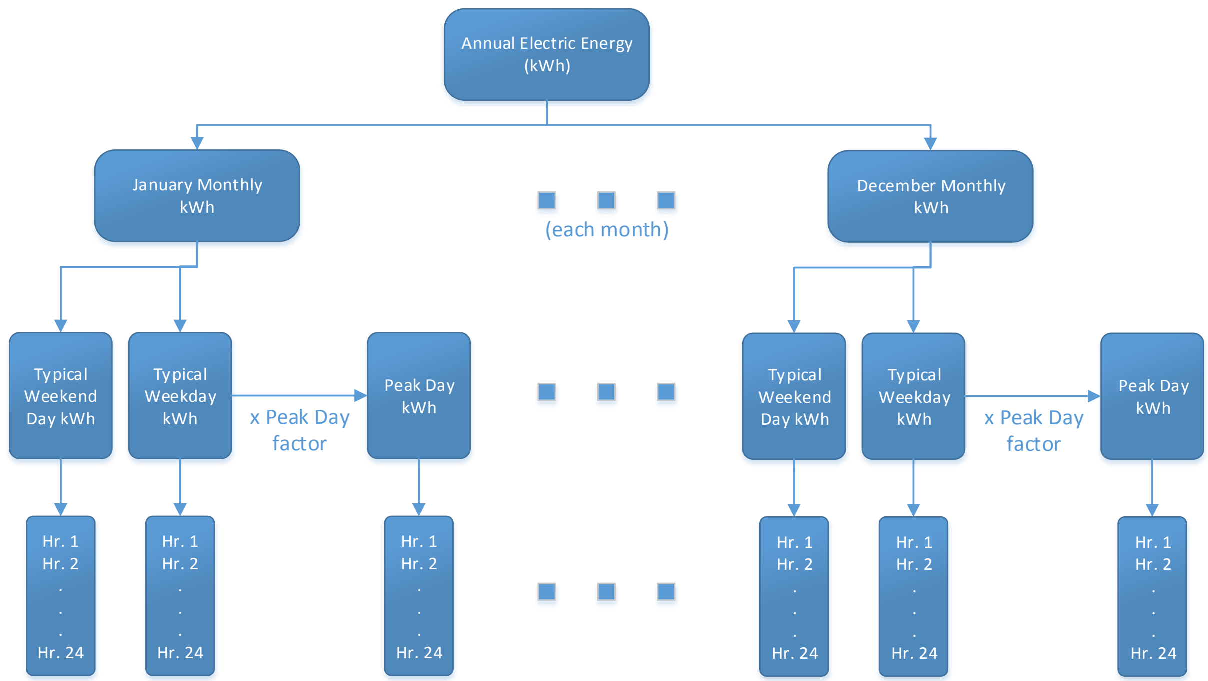
- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.

[9] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.

- **Per Unit Hourly Factor:** This factor reflects the operating hours of the electric equipment or end uses among different hours of the day for each day type (weekday, weekend day, peak day) and for each month. For example, for lighting, this would be affected by time of day and season (affected by daylight).

Exhibit 13 Overview of Peak Load Profile Methodology



4.4 Summary of Results

The factors defined above provided the basis for converting the annual industrial electricity use presented in Section 3 to aggregate peak loads in the peak period.

Exhibit 14 presents the results for the Industrial sector Base Year. The results are presented here for the total Newfoundland service territory, but individual results for each of the three regions in NL are available in the Data Manager file. The results show the contribution of Industrial sector demand that is coincident with the total demand in the peak period.

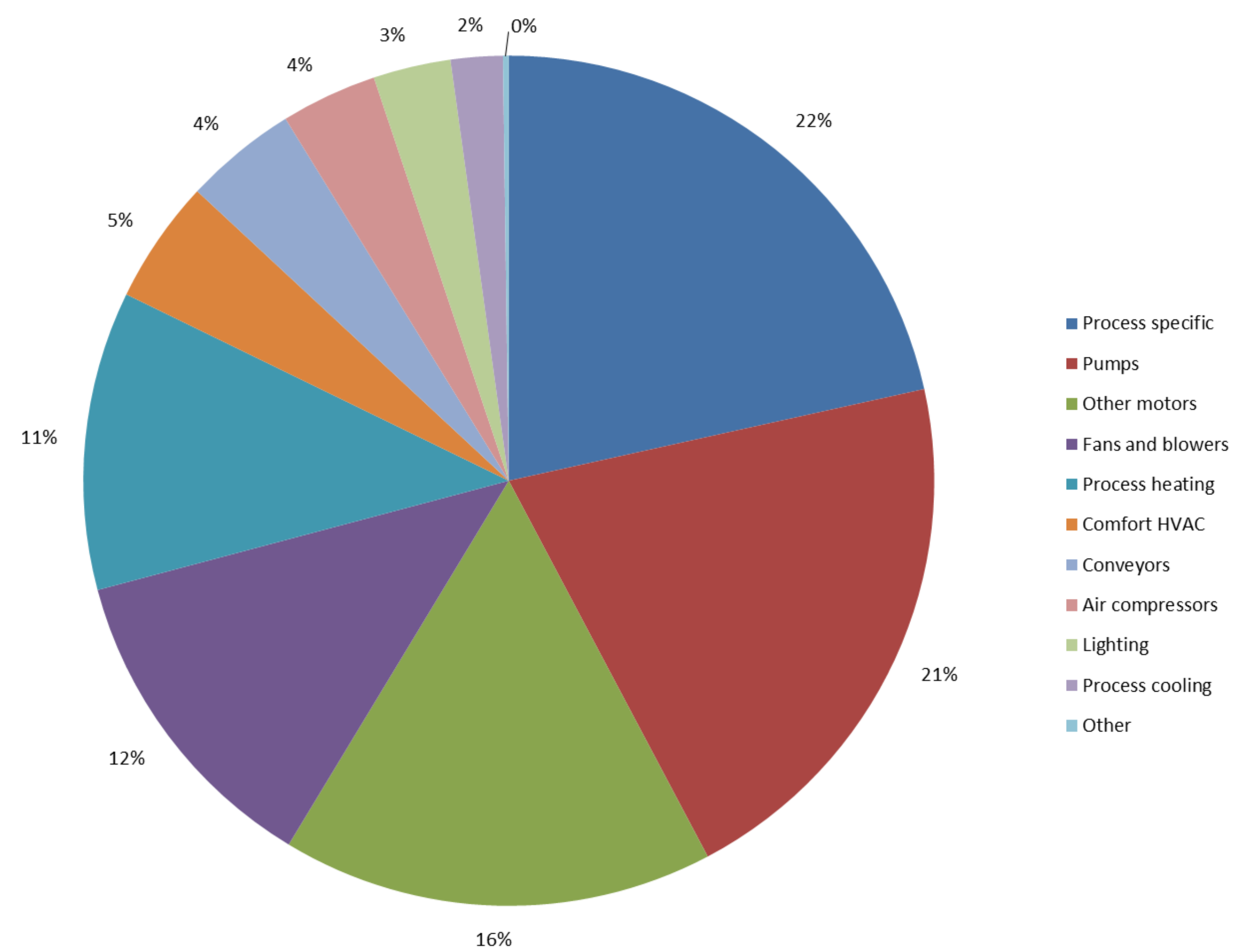
Exhibit 14 Industrial Sector Base Year (2014) Aggregate Peak Demand, All Regions (MW)

Sub Sectors	Reference Case Peak Demand (MW)
Large Industry	258
Fishing and Fish Processing	11
Manufacturing	11
Water Systems and Other	5
Grand Total	**285**

Exhibit 15 shows the contribution, by end use, to the industrial component of the peak demand. Some key observations may be made:

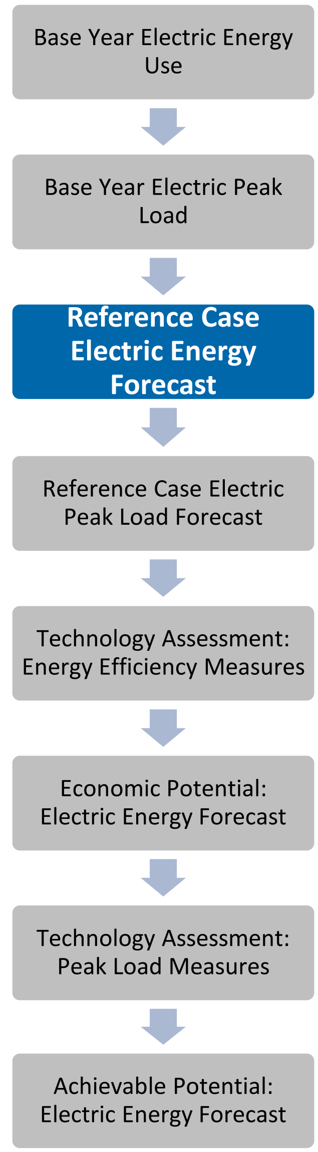
- Process specific end use is the largest industrial component of peak demand. As shown in the previous section, process specific end use is also the largest in terms of annual electrical consumption. It also tends to be significant in the large industrial facilities, which operate at a fairly steady level year round, including the winter when the NL system peaks.
- Pumps and other motors are the second and third largest industrial components of peak demand, once again matching the order of largest consumption end uses.
- Process heating is the fifth largest industrial contributor to peak demand at 11%. This is an increase from the end use's 9% share of industrial consumption, which makes sense given the additional heating requirements during peak winter periods. Similarly, HVAC rises from 3% portion of consumption to a 5% portion of base year peak demand.
- While Fishing and Fish Processing facilities operate seasonally, with a large fluctuation in their consumption, their largest electricity requirements are in the summer months, resulting in less impact on the Utilities' winter peak period.

Exhibit 15 Contribution by End Use to Industrial Aggregate Peak Demand (%)



Additional detail is provided in Appendix B.

5 Reference Case Electric Energy Forecast



5.1 Introduction

This section presents the Industrial sector Reference Case for the study period (2014 to 2029). The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new utility-based CDM initiatives. The Reference Case, therefore, provides the point of comparison for the calculation of electricity saving opportunities associated with each of the scenarios that are assessed within this study.

The Reference Case discussion is presented within the following sub-sections:

- Methodology
- Summary of model results.

5.2 Methodology

Development of the Reference Case involved the following six steps:

Step 1: Electricity consumption was forecast for each sub-sector in each region.

Step 2: The impact of anticipated growth in different facilities and rate classes was factored into sub-sector end use profiles.

Step 3: Impacts from 'natural conservation changes' were estimated in the sub-sector end use profiles.

Exhibit 16 shows the estimated industrial electricity consumption in each milestone period, by sub-sector. The estimates shown are derived from the Utilities' load forecasts.

As growth across different facilities and sub-sectors is uneven, certain sub-sector end use profiles needed to be adjusted to match these differences. More specifically, for sub-sectors like Mining and Processing, which contain a blend of distinct large and small-medium facilities, that each has their own end use profile, the relative growth of these different elements needed to be accounted for in the weighted average sub-sector end use profile. This ensured that if a single large facility was growing faster than the rest of the facilities in its sub-sector, that the end use profile used in the reference case for all of the sub-sector's facilities would reflect the increased portion of consumption at the growing facility.

At the same time, expectations for naturally occurring conservation were built into the sub-sector end use profiles to match typical values found by ICF in previous studies. It should be noted that since the Reference Case is being calibrated to the Utilities' load forecasts, natural conservation estimates did not reduce the overall consumption levels. Instead, their impact changes the relative importance of different end uses over the course of the study period.

Exhibit 16 Industrial Consumption Growth by Sub-Sector and Milestone Year

Year	Sub-Sectors	Industrial Consumption - All Regions (MW/yr.)
2014	Large Industry	2,828,377
	Fishing and Fish Processing	128,368
	Manufacturing	136,074
	Water Systems and Other	76,585
	Year Total	3,169,404
2017	Large Industry	3,545,751
	Fishing and Fish Processing	128,129
	Manufacturing	135,714
	Water Systems and Other	76,818
	Year Total	3,886,412
2020	Large Industry	3,610,520
	Fishing and Fish Processing	128,005
	Manufacturing	135,364
	Water Systems and Other	77,802
	Year Total	3,951,691
2023	Large Industry	3,611,310
	Fishing and Fish Processing	127,889
	Manufacturing	135,024
	Water Systems and Other	78,920
	Year Total	3,953,143
2026	Large Industry	3,612,167
	Fishing and Fish Processing	127,777
	Manufacturing	134,693
	Water Systems and Other	79,717
	Year Total	3,954,354
2029	Large Industry	3,613,020
	Fishing and Fish Processing	127,669
	Manufacturing	134,371
	Water Systems and Other	80,613
	Year Total	3,955,674

A detailed discussion of the methodology employed in each of the remaining steps is provided in Appendix C.

5.3 Summary of Results

This section presents the results of the model runs for the entire study period. They are presented in four exhibits:

- Exhibit 17 presents the model results in tabular form, by sub-sector, end use, and milestone year
- Exhibit 18 presents the model results for 2029 by sub-sector

- Exhibit 19 presents the model results for 2029 region
- Exhibit 20 presents the model results for 2029 by end use
- Exhibit 21 and Exhibit 22 show the evolving relative contribution (% or MWh) of different end uses towards the total consumption in different sub-sectors

Selected highlights of electricity use in 2029 are provided below.

By Sub-Sector

The Large Industry sub-sector accounts for the majority of industrial electricity use in Newfoundland and Labrador, increasing its share of consumption to 91% in 2029. The remaining consumption continues to be split relatively evenly between Manufacturing (4%), Fishing and Fish Processing (3%), and Water Systems and Other (2%).

By Region

The Island Interconnected region is expected to have the most growth, and grows from 49% of the industrial total in 2014 to 56% in 2029. The Labrador Interconnected region accounts for approximately 44% of industrial electricity consumption in 2029, with isolated diesel grids continuing to account for less than 1%. The increasing Island Interconnected portion of consumption is due to significant growth in this region, and not decreasing consumption in Labrador.

By End Use

In 2029, the process specific end use increases and remains the largest end use at 24%. All end uses see a slight rise in their share of total industrial electricity between 2014 and 2029, with the exception of other motors and fans and blowers.

By Sub-Sector and End Use

The last exhibit in this section shows the trends in consumption by end uses. The following key observations can be made:

- The most significant changes are seen in the Large Industry sub-sector, which is highlighted by a growing process specific portion.
- The distribution of electricity consumption is expected to remain relatively stable in most of the small-medium sub-sectors.
- Once again, the large differences between the breakdowns for different sub-sectors will translate into significant variation between the results for each region, based on the facilities specific to that area.

Exhibit 17 Reference Case Electricity Consumption, All Regions, Modelled by End Use, Sub-Sector and Milestone Year (MWh/yr.)

Sub-Sectors	Year	Industrial Consumption (MWh/yr.)					
		Process specific	Pumps	Other motors	Fans and blowers	Process heating	Conveyors
Large Industry	2014	681,186	518,634	516,357	451,374	271,244	139,539
	2017	922,564	654,995	555,649	515,495	321,743	203,247
	2020	943,517	669,107	559,068	520,651	326,781	208,330
	2023	945,199	668,351	560,019	520,567	327,443	208,742
	2026	946,890	667,598	560,971	520,484	328,108	209,155
	2029	948,562	666,836	561,924	520,398	328,771	209,564
Fishing and Fish Processing	2014	2,014	6,656	5,339	1,266	9,830	5,100
	2017	2,016	6,642	5,343	1,265	9,840	5,105
	2020	2,019	6,633	5,352	1,265	9,860	5,114
	2023	2,023	6,625	5,361	1,265	9,879	5,124
	2026	2,026	6,618	5,370	1,264	9,899	5,134
	2029	2,030	6,610	5,379	1,264	9,919	5,143
Manufacturing	2014	4,759	8,121	39,644	11,100	4,121	2,544
	2017	4,767	8,111	39,711	11,098	4,129	2,549
	2020	4,775	8,102	39,778	11,096	4,138	2,553
	2023	4,783	8,092	39,845	11,094	4,146	2,558
	2026	4,791	8,082	39,912	11,092	4,154	2,563
	2029	4,799	8,072	39,980	11,090	4,162	2,568
Water Systems and Other	2014	5,814	47,516	7,692	7,221	2,228	39
	2017	5,848	47,653	7,737	7,249	2,241	40
	2020	5,939	48,256	7,857	7,348	2,277	40
	2023	6,041	48,942	7,992	7,460	2,316	41
	2026	6,118	49,427	8,094	7,542	2,347	41
	2029	6,203	49,973	8,206	7,633	2,380	42

Sub-Sectors	Year	Industrial Consumption (MWh/yr.)					
		Air compressors	Comfort HVAC	Lighting	Process cooling	Other	Grand Total
Large Industry	2014	114,864	63,253	66,231	3,880	1,816	2,828,377
	2017	152,838	93,985	95,149	28,248	1,838	3,545,751
	2020	158,049	96,443	96,250	30,364	1,959	3,610,520
	2023	157,957	96,510	94,172	30,386	1,965	3,611,310
	2026	157,867	96,577	92,138	30,408	1,971	3,612,167
	2029	157,773	96,642	90,147	30,427	1,976	3,613,020
Fishing and Fish Processing	2014	3,662	15,927	8,878	68,032	1,663	128,368
	2017	3,657	15,921	8,678	67,995	1,666	128,129
	2020	3,654	15,930	8,489	68,017	1,671	128,005
	2023	3,652	15,939	8,305	68,041	1,675	127,889
	2026	3,649	15,948	8,124	68,065	1,680	127,777
	2029	3,647	15,957	7,948	68,089	1,684	127,669
Manufacturing	2014	13,359	22,895	20,518	7,951	1,061	136,074
	2017	13,350	22,908	20,072	7,953	1,064	135,714
	2020	13,342	22,921	19,636	7,956	1,067	135,364
	2023	13,333	22,934	19,210	7,959	1,070	135,024
	2026	13,324	22,947	18,792	7,962	1,072	134,693
	2029	13,315	22,960	18,384	7,965	1,075	134,371
Water Systems and Other	2014	742	2,013	2,437	-	883	76,585
	2017	745	2,022	2,394	-	889	76,818
	2020	754	2,051	2,374	-	904	77,802
	2023	766	2,084	2,358	-	920	78,920
	2026	774	2,108	2,333	-	933	79,717
	2029	782	2,135	2,310	-	947	80,613

Exhibit 18 Distribution of Electricity Consumption in 2029 by Sub-Sector

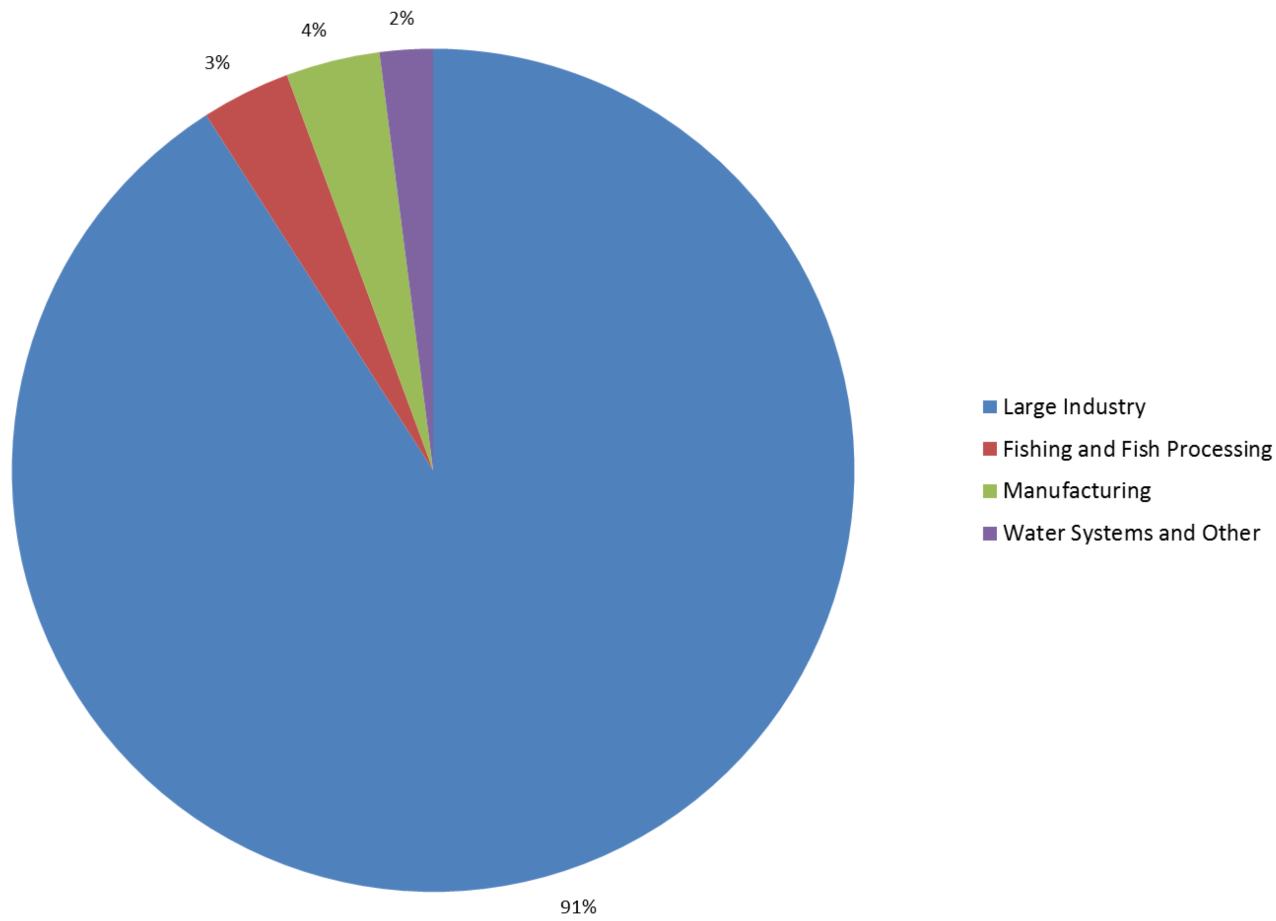


Exhibit 19 Distribution of Electricity Consumption in 2029 by Region

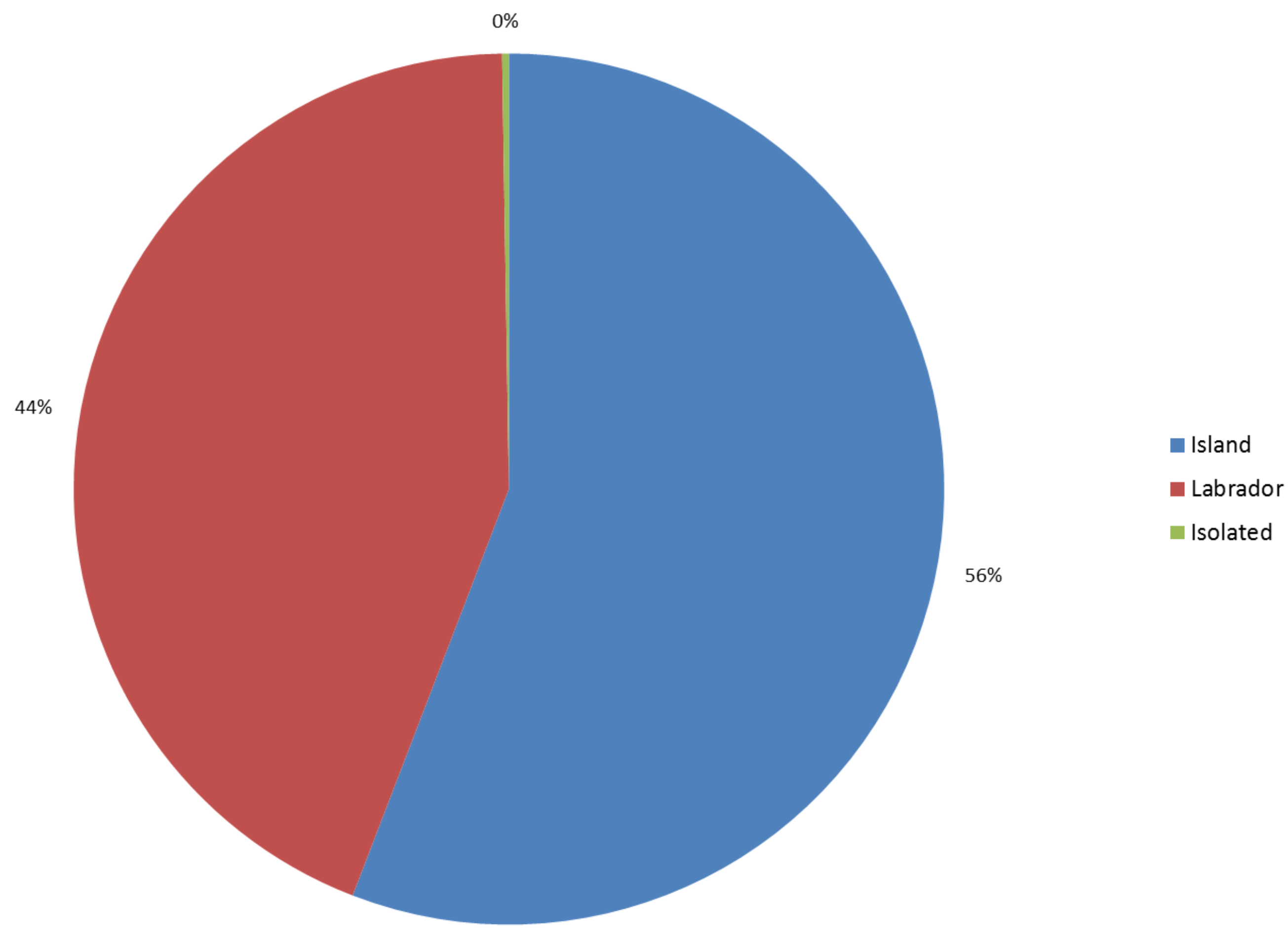


Exhibit 20 Distribution of Electricity Consumption in 2029 by End Use

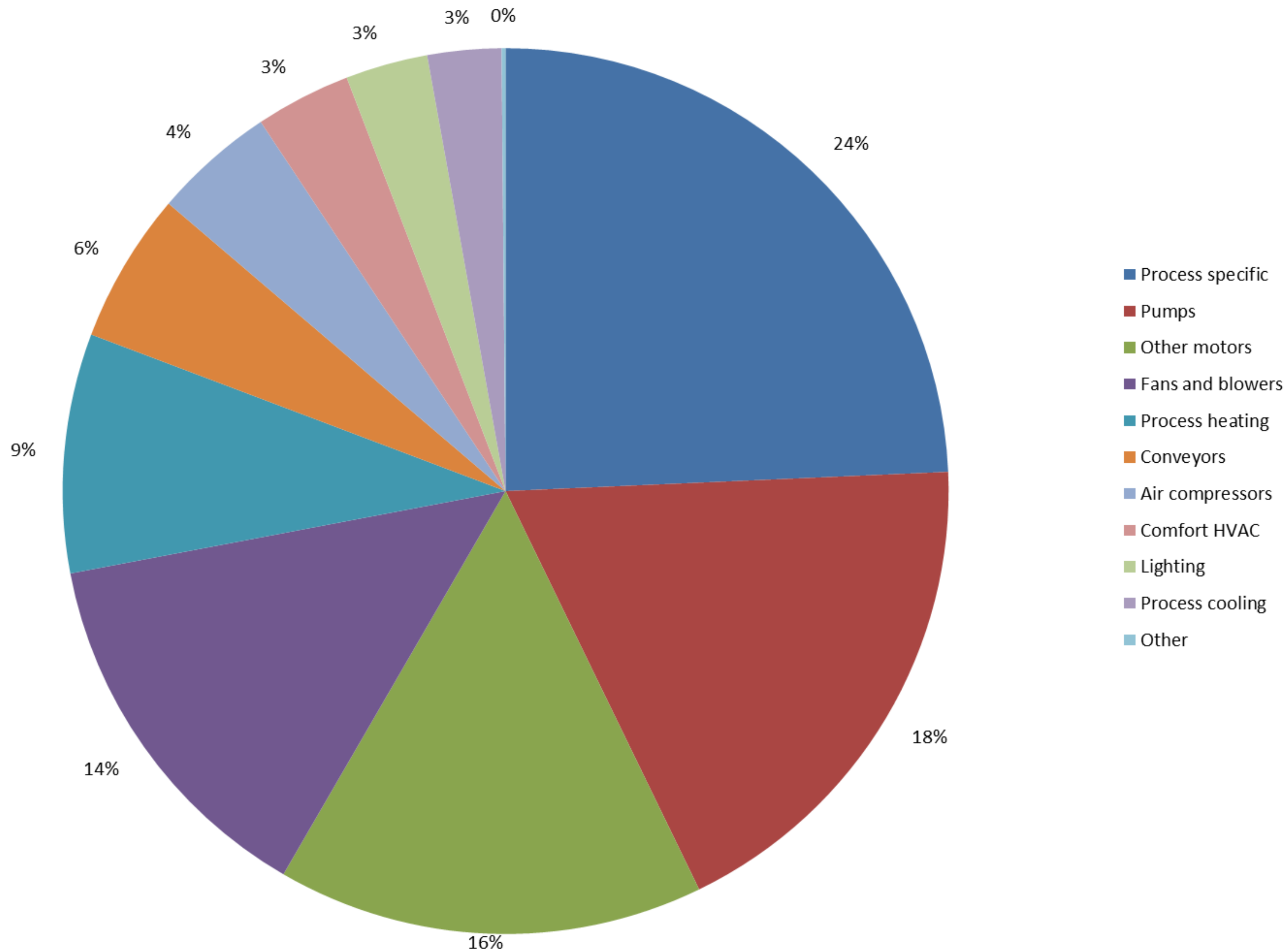


Exhibit 21 Distribution (%) of Electricity Consumption 2014-2029, by Sub-Sector and End Use

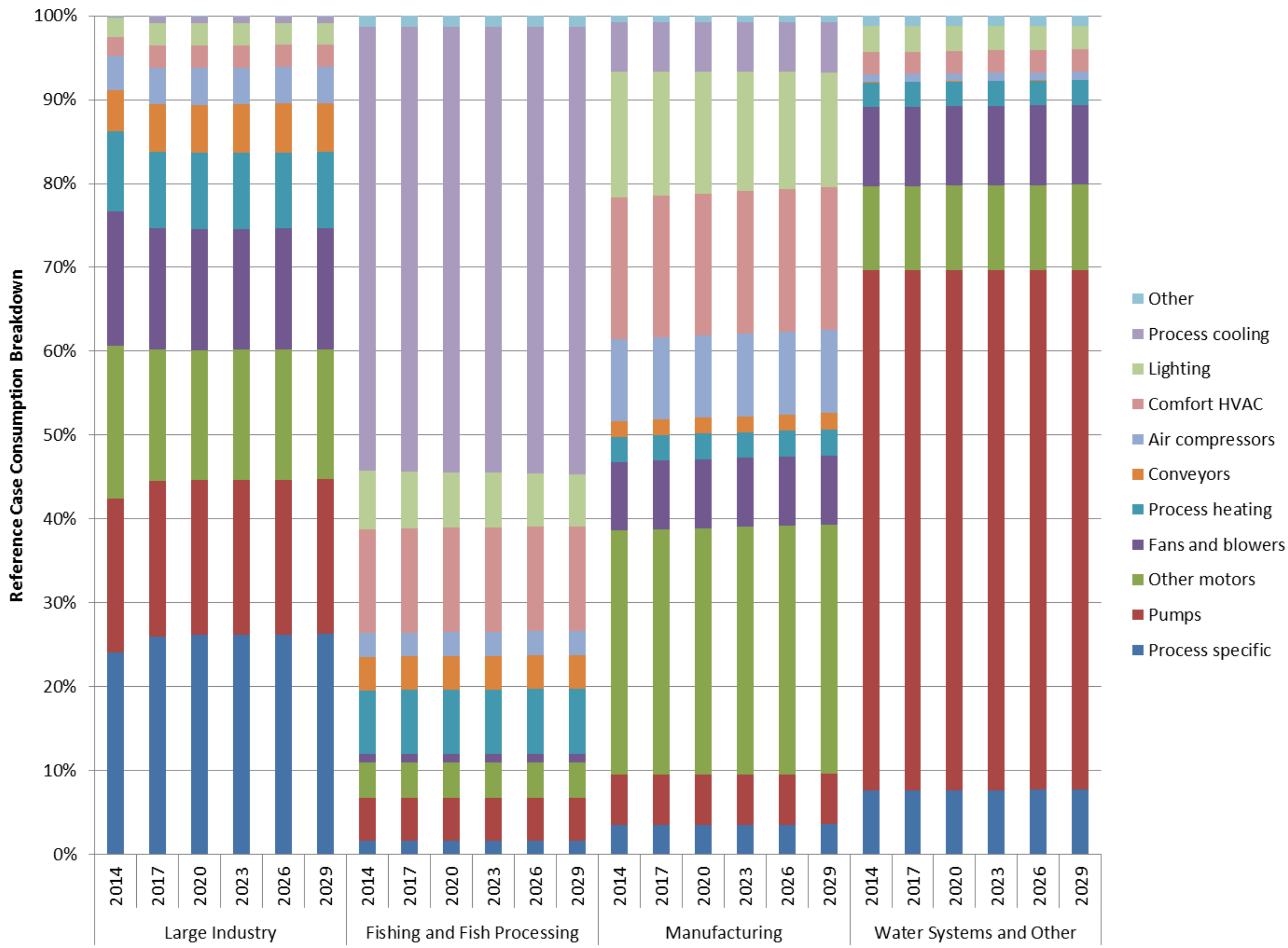
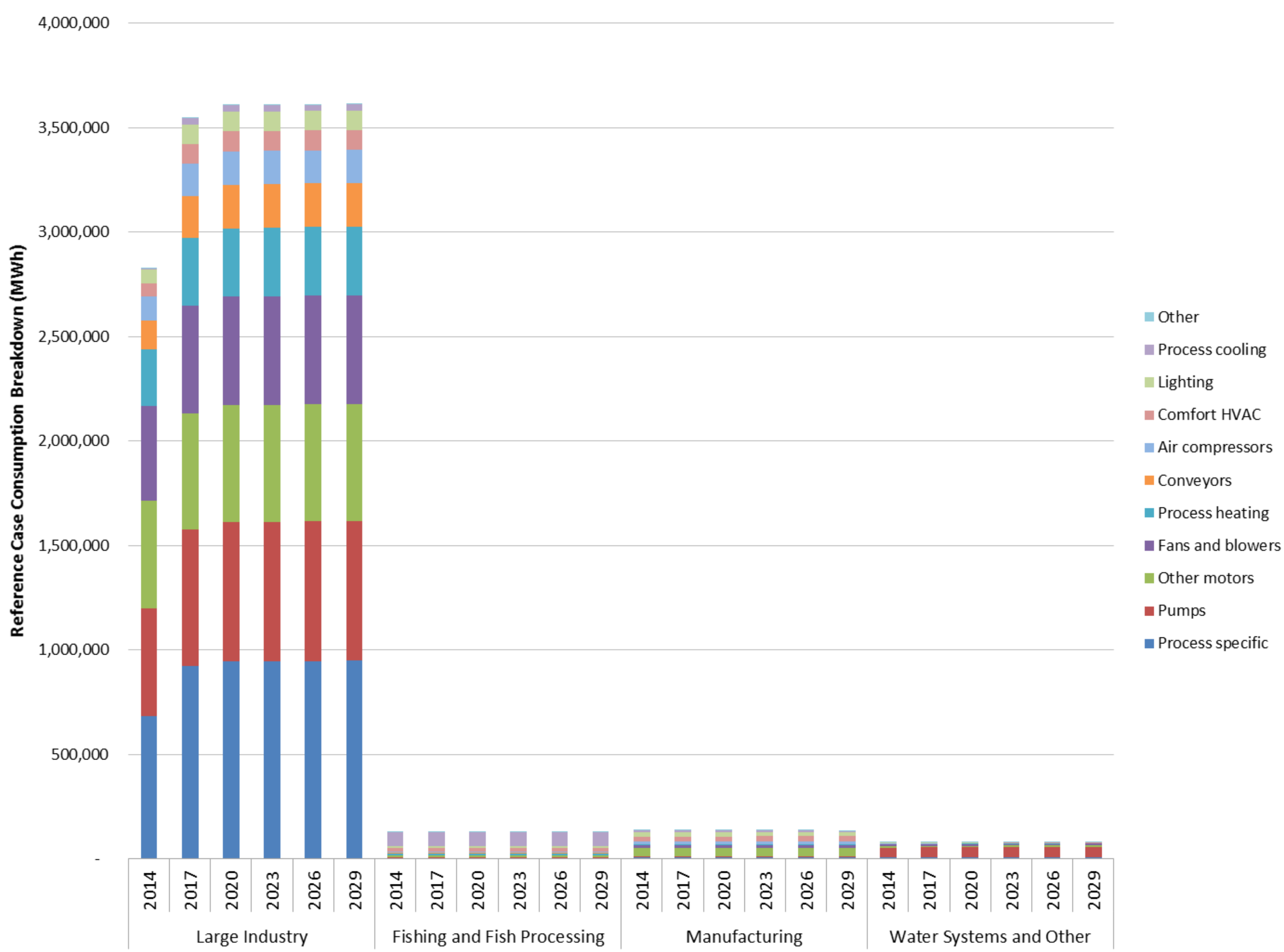
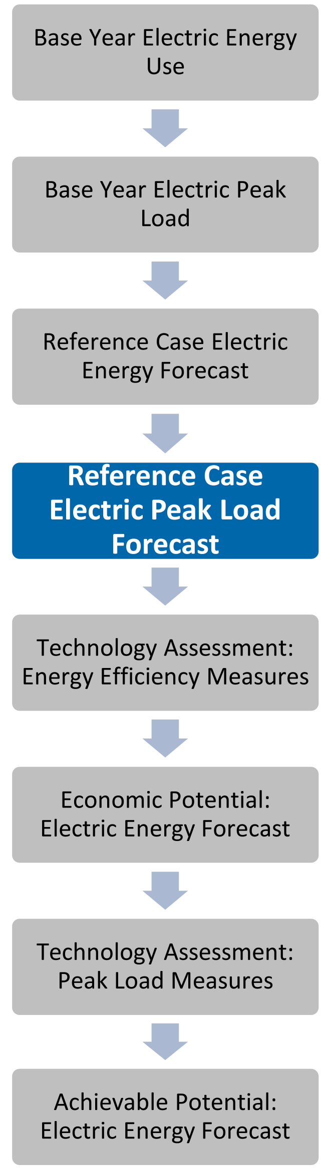


Exhibit 22 Distribution (MWh) of Electricity Consumption 2014-2029, by Sub-Sector and End Use



6 Reference Case Electric Peak Load Forecast



6.1 Introduction

This section provides a profile of the electric peak load for NL's industrial sector over the Reference Case period of 2014 to 2029. The Reference Case peak load profile estimates the expected level of demand in the peak period that would occur over the study period in the absence of new CDM initiatives or rate changes. The Reference Case, therefore, provides the point of comparison for the calculation of peak load savings associated with each of the subsequent scenarios that are assessed within this study.

The discussion is organized into the following sub-sections:

- Methodology
- Summary of results.

6.2 Methodology

The electric peak loads for each combination of end use, sub-sector and milestone year were calculated in exactly the same manner as shown in Section 4, which presented the Base Year peak load profiles.

For this Reference Case, the electric energy consumption (from Section 5) is converted to a demand value for each of the three peak period definitions by dividing the applicable electric energy value for each sub-sector and end use by the corresponding Industrial sector load shape hours-use factors, as presented in Appendix B.

6.3 Summary of Results

A summary of the Reference Case peak load profiles is presented in Exhibit 23

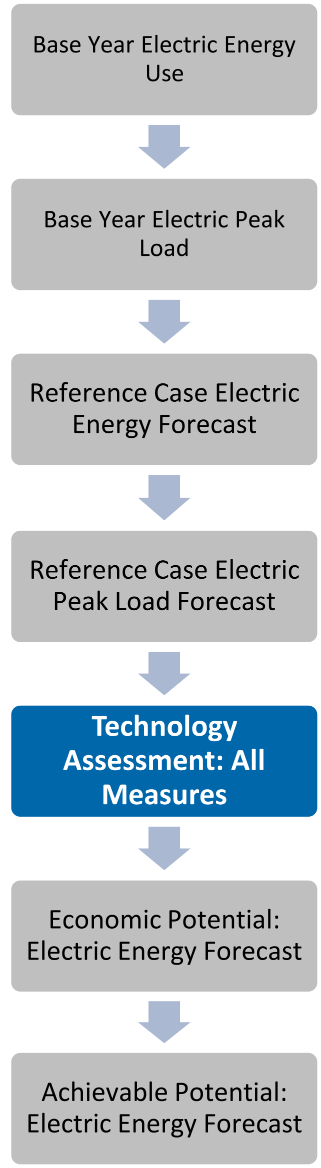
Exhibit 23 Electric Peak Loads, by Milestone Year and Sub-Sector, All Regions (MW)

Sub-Sectors	Year	Reference Case Peak Demand (MW)
Large Industry	2014	258
	2017	337
	2020	344
	2023	344
	2026	344
	2029	344
Fishing and Fish Processing	2014	11
	2017	11
	2020	11
	2023	11
	2026	11
	2029	11
Manufacturing	2014	11
	2017	11
	2020	11
	2023	11
	2026	11
	2029	11
Water Systems and Other	2014	5
	2017	5
	2020	5
	2023	5
	2026	5
	2029	5
Grand Total	2014	285
	2017	363
	2020	370
	2023	370
	2026	371
	2029	371

Selected highlights include:

- Since the hours-use factors applied are not assumed to change during the study period, trends in peak demand contributions for specific sub-sectors are expected to follow the electricity consumption trends for those sub-sectors. Large Industry, for example, will continue to make the largest industrial contribution to peak demand throughout the study period.
- The overall electricity consumption for process specific end use is expected to grow over the study period, and consequently the contribution it makes to the peak demand will also grow, continuing to be the single largest peak demand end use in the Industrial Sector.
- Similarly, peak demand contributions for specific end uses are expected to follow the electricity consumption trends for those end uses. Lighting, because of natural gains in efficiency as LEDs are adopted, will make a gradually declining contribution towards the peak demand.

7 Technology Assessment: All Measures



7.1 Introduction

This section identifies and assesses the economic attractiveness of the selected energy efficiency measures for the Industrial sector. It also identifies and assesses the economic attractiveness of selected Industrial sector electric capacity-only peak load reduction measures, which in this study are defined as those measures that affect electric peak but have minimal or no impact on daily, seasonal or annual electric energy use. The discussion is organized and presented as follows:

- Methodology
- Energy efficiency technologies
- Electric peak load reduction measures
- Summary of unbundled results
- Energy efficiency supply curves
- Demand reduction supply curves.

7.2 Methodology

The following steps were employed to assess the measures:

- Select candidate measures
- Establish technical performance for each option
- Establish the capital, installation and operating costs for each option
- Calculate the cost of conserved energy (CCE) for each energy efficiency technology and O&M measure
- Calculate the cost of electric peak load reduction (CEPR) for each option.

A brief description of each step is provided below.

Step 1 Select Candidate Measures

The candidate measures were selected in close collaboration with client personnel based on a combination of a literature review and previous study team experience. The selected measures are all considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs, which will be addressed in this section, were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources, including the experience and on-going research work of study team members. In the case of some of the peak load reduction measures, comfort may be affected and the trade-off between benefits (e.g., cost savings) and costs (including reduction in comfort) were judged based on past experience with similar technologies and customer acceptance. Information was collected for typical “small”, “medium”, and “large” equipment, as they relate to each end use.

The measures for each sub-sector use an equipment size (or mix of sizes) that is most representative of what would be found in the sub-sector.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources, including the experience and on-going research work of study team members.

In the case of energy efficiency measures, the incremental cost is applicable when a measure is installed in a new facility, or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy efficiency measure relative to the baseline technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.[10]

Unlike energy efficiency measures, in which major equipment, such as heating and water heating systems are typically replaced, or thermal envelope measures such as insulation upgrades affect systems directly, capacity-only measures are typically implemented via add-on control equipment, although some built-in control equipment exists. The incremental cost is thus defined as the control equipment itself or incremental cost for a controllable appliance or device relative to the baseline appliance cost (e.g., remote accessible thermostat vs. standard thermostat), plus any required infrastructure (e.g., automatic meter reading or communications gateways). In cases where a more efficient appliance with peak control functions replaces a standard appliance, both electric energy and electric peak reduction are achieved, with some splitting of incremental costs attributable to each function. Where a new or replacement end use is installed that operates off peak, thus achieving electric peak reduction without significant energy impacts, incremental costs for the electric peak reduction device will be compared with standard equipment without assuming any early replacement and, thus, salvage value.

In all cases the costs and savings are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs. All costs are expressed in constant 2014 dollars.

Step 4 Calculate CCE for Each Energy Efficiency Measure

One of the important sets of information provided in this section is the CCE associated with each energy efficiency measure. The CCE for an energy efficiency measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the accompanying TRM Workbook is expressed in constant 2014 dollars.

[10] With some exceptions, many measures could conceivably be applied as either a full-cost measure (applicable immediately) or as an incremental cost measure (upon end of service life), depending on how financially attractive it is. Therefore, for all but a few measures, the TRM Workbook is configured to evaluate the measure at full cost and include it on that basis if it passes the screen, then roll to evaluating it on an incremental basis, and only fail it completely if it fails both tests. Where a measure is always full cost (such as the block heater timer, where the baseline technology is the "do nothing" option), the incremental cost option is excluded. Where a measure is always incremental cost (such as high-performance homes, where the baseline technology has to be a standard construction home, not no home at all), the full cost option is excluded.

It is recognized that some measures can be implemented prior to the end of their useful life, that is, early retirement. This intermediate option between full and incremental cost could increase the rate of adoption for some of the incremental measures, raising the Economic Potential savings modestly. However, in this study early retirement is treated as a program option.

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CCE is calculated according to the following formula:

$$\frac{C_A + M}{S}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O&M)
S is the annual kWh electricity savings

And A is the annualization factor

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:

i is the discount rate
n is the life of the measure

The detailed CCE tables (see TRM Workbook) show both incremental and full installed costs for the energy efficiency measures, as applicable. If the measure or technology is installed in a new facility or at the point of natural replacement in an existing facility, then the incremental cost of the measure versus the cost of the baseline technology is used. If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the full cost of the efficient measure is used.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations that accompany this document, a discount rate of 7% (real) is used.

Step 5 Calculate CEPR for Each Peak Load Measure

The CEPR for a peak load reduction measure is defined as the annualized incremental cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the TRM Workbook is in constant (2014) dollars.

The CEPR provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CEPR is calculated according to the following formula:

$$\frac{C_A + M}{S_p}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O & M)
S_p is the annual kW load reduction associated with peak definition p.

And A is the annualization factor.

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:
i is the discount rate;
n is the life of the measure.

Note that the annual O&M cost will include, in some cases, amortized costs associated with infrastructure considered a prerequisite for implementation of the measure. This could include automated metering infrastructure (AMI), such as advanced metering, communications gateways and other related system investments. These costs would typically support multiple applications (e.g., communications gateways could enable control of heating, air conditioning, water heating, and pumping), as well as facilitate time-differentiated rates that would be required for a feasible and cost-effective program implementation (e.g., thermal energy storage). It should also be noted that the measure lifetime is for the control device, function or feature, rather than that of the unit it is controlling. The study does not presume any specific technology or infrastructure, but does assume that a marketplace will develop for such systems, whether or not NL utilities adopt them, or develops access directly or indirectly to customer control equipment.

The CEPR can be compared to benefits, which include the value of reduced peak for the utility (avoided capacity and transmission and distribution (T&D) investment or purchase costs), the customer (e.g., bill savings) and society (e.g., value of environmental benefits) to determine its cost effectiveness from various perspectives (societal, utility, participant and non-participant).

As with the CCE for energy savings, the CEPR calculation is sensitive to the chosen discount rate, which, as for the CCE, used a 7% (real) discount rate. Higher discount rates will tend to reduce savings and decrease cost effectiveness where costs are incurred upfront and benefits accrue over many years.

Step 6 Estimate Approximate Unbundled Electric Energy Savings Potential for Each Energy Efficiency Measure and Demand Reduction for Each Peak Load Measure

The next step in the assessment was to prepare an approximate estimate of the potential unbundled electric energy savings that could theoretically be provided by each energy efficiency measure over the study period, and similarly to prepare an estimate of demand reductions that could be provided by each peak load measure. The term "unbundled" means that the savings for each measure are calculated in isolation from other important factors that ultimately determine the potential for real life savings.

The strength of this approach is that it provides insight into the relative size of the potential electric energy savings or demand reductions associated with individual measures; this perspective is often of particular value to utility CDM program design personnel who may need to consider combinations of measures that differ from those selected for the CDM Potential analysis.

However, it should be noted that the savings from individual measures cannot be used directly to calculate total savings potential or demand reduction. This is due primarily to two factors:

- **More than one upgrade may affect a given end use:** For example, improved refrigeration insulation reduces refrigeration electricity use, as does the installation of a cooling tower to reject heat in the low temperature outdoor environment (free cooling). On its own, each measure will reduce overall cooling electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of bundles of measures that reduce the load for a given end use (e.g., wall insulation and air curtains that reduce the space heating load) and then to introduce measures that make the remaining load more efficiently (e.g., a high-efficiency packaged HVAC system). Similarly, more than one peak load measure may affect a given end use, or peak load measures may be applied to the same end use that one or more energy efficiency measures may also affect.

- **There are interactive effects among end uses:** For example, the electricity savings from more efficient lighting result in reduced waste heat. During the space heating season, lighting waste heat contributes to a facility's internal heat gains, which lower the amount of heat that must be provided by the HVAC system. Overall these interactive effects are minimal for the Industrial sector, where process loads typically dominate, and HVAC makes up a relatively small portion of consumption. As such, interactive effects are not modeled for the Industrial sector in this study.

The above factors are incorporated in later stages of the analysis.

Step 7 Prepare Energy Efficiency and Demand Reduction Supply Curves

The final step in the assessment of the selected energy efficiency measures was the generation of an energy efficiency supply curve and a demand reduction supply curve. Energy efficiency supply curves are built up based on the conserved electricity and the CCE for each measure. Similarly, demand reduction supply curves are built up based on the demand reduction and the CEPR for each measure. The ISEEM model was used to model the application of all technically feasible measures, accumulating the electricity savings or demand reduction and associated implementation costs for each sub-sector type.

Measures were applied sequentially to account, at least approximately, for interaction between measures. Similarly, the demand measures were also applied sequentially, but began with the demand reference case, not the demand that would remain after all the efficiency measures were applied. Thus the interaction between energy efficiency and demand reduction is neglected for this supply curve.

The accumulated savings and costs for each measure were added together to present the overall energy efficiency supply curve for the province. They were sorted in order from lowest cost per kWh saved to highest cost, and presented on a graph showing CCE versus electricity savings.

The accumulated demand reduction and costs for each measure were added together to present the overall demand reduction supply curve for the province. They were sorted in order from lowest cost per kW reduction to highest cost, and presented on a graph showing CEPR versus demand reduction.

7.3 Energy Efficiency Technology Assessment

Exhibit 24 shows the energy efficiency technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 24 Energy Efficiency Technologies Included in this Study

Air Compressors
- Premium Efficiency ASD Compressor
- Use Cooler Air from Outside for Make Up Air
- Optimized Distribution System (Incl. Pressure and Air End Uses)
- Optimized Sizes of Air Receiver Tanks
- Sequencing Control
- Air Leak Survey and Repair

Conveyors
- Optimized Conveyor Motor Control
- Premium Efficiency Conveyor Motors

Fans and Blowers
- Premium Efficiency Fan Control with ASDs
- Synchronous Belts
- Premium Efficiency Motors for Fans and Blowers
- Correctly Sized Fans: Impeller Trimming or Fan Selection
- Optimized Distribution System (Incl. Pressure Losses)

HVAC
- Automated Temperature Control
- Air Compressor Heat Recovery
- Ventilation Heat Recovery
- Ventilation Optimization
- Reduced Temperature Settings
- High-Efficiency Packaged HVAC
- Warehouse Loading Dock Seals
- Improved Building Insulation
- HVAC Air Curtains

Lighting
- High Efficiency Lights (LEDs)
- Automated Lighting Controls
- High-Efficiency Lighting Design

Other Motors
- Correctly Sized Motors
- Optimized Motor Control
- Premium Efficiency Motors

Process Cooling/Refrigeration/Freezing
- Chiller Economizer
- Free Cooling
- Floating Head Pressure Controls
- High Efficiency Chiller
- Optimized Distribution System
- Premium Efficiency Refrigeration Control System and Compressor Sequencing
- Improve Insulation of Refrigeration System
- Smart Defrost Controls
- Improved Ice Production System
- Air Curtains

Process Heating
- Heat Pumps
- Insulation
- Process Heat Recovery to Preheat Makeup Water
- High Efficiency Oven/Dryer/Furnace/Kiln
- High Efficiency Water Heater

Process Specific
- Process Optimization Efforts – Fishing and Fish Processing
- Process Optimization Efforts – Pulp and Paper
- Process Optimization Efforts – Mining and Processing
- Process Optimization Efforts – Oil Refining
- Advanced 'Predictive' Process Control Systems

Pumps
- Optimization of Pumping System
- Premium Efficiency Pump Motor
- Premium Efficiency Pump Control with ASDs
- Correctly Sized Pumps: Impeller Trimming or Pump Selection

System
- Sub-Metering
- Energy Management Information System (EMIS)
- Organizational Energy Management (EM Team)
- Operation and Maintenance (O&M) Program Supporting Efficiency
- Integrated Plant Control System

7.3.1 Technology Screening Results

A summary of the results is provided in Exhibit 25. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[11] for the CCE that is shown (e.g. full versus incremental)
- The measure's average CCE for each region

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 25 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some sub-sector types and on an incremental cost basis in others is shown as "Full/Incr."

Exhibit 25 Industrial Sector Energy Efficiency Technology Measures, Screening Results[12]

End Use	Measure Name	Basis	Average CCE (¢/kWh)		
			Island	Labrador	Isolated
Air Compressors	Premium Efficiency ASD Compressor	Full/Incr.	3.67	2.91	8.32
	Use Cooler Air from Outside for Make Up Air	Full	0.89	0.60	1.97
	Optimized Distribution System (Incl. Pressure and Air End-Uses)	Full	4.35	3.73	6.97
	Optimized Sizes of Air Receiver Tanks	Full	2.17	1.88	3.48
	Sequencing Control	Full	8.84	4.79	22.71
	Air Leak Survey and Repair	Full	3.63	2.41	7.81
Conveyors	Optimized Conveyor Motor Control	Full	3.16	3.94	2.68
	Premium Efficiency Conveyor Motors	Incr.	3.80	1.52	24.06
Fans and Blowers	Premium Efficiency Fan Control with ASDs	Full	1.80	1.50	2.90
	Synchronous Belts	Full	1.31	1.01	2.25
	Premium Efficiency Motors for Fans and Blowers	Incr.	1.88	1.55	27.03
	Correctly Sized Fans: Impeller Trimming or Fan Selection	Full	0.27	0.22	0.45
	Optimized Distribution System (Incl. Pressure Losses)	Full/Incr.	5.39	4.67	8.84
HVAC	Automated Temperature Control	Full	3.88	3.52	6.64
	Air Compressor Heat Recovery	Full	12.01	12.38	13.24
	Ventilation Heat Recovery	Full	20.73	18.80	35.43
	Ventilation Optimization	Full	43.01	50.16	19.16
	Reduced Temperature Settings	Full	0.00	0.00	0.00
	High-Efficiency Packaged HVAC	Incr.	4.24	3.85	22.52
	Warehouse Loading Dock Seals	Full	18.05	15.51	35.04

[11] See Step 4 in Section 7.2 for a fuller description.
[12] Average CCE does not include program costs.

Exhibit 25 Continued: Industrial Sector Energy Efficiency Technology Measures, Screening Results

End Use	Measure Name	Basis	Average CCE (¢/kWh)		
			Island	Labrador	Isolated
	Improved Building Insulation	Incr.	64.91	63.19	89.85
	HVAC Air Curtains	Full	60.07	54.48	102.68
Lighting	High Efficiency Lights (LEDs)	Full	4.30	4.27	5.27
	Automated Lighting Controls	Full	4.37	4.34	5.35
	High-Efficiency Lighting Design	Full	10.18	10.11	12.48
Other Motors	Correctly Sized Motors	Incr.	-3.95	-3.37	16.19
	Optimized Motor Control	Full	0.71	0.61	1.17
	Premium Efficiency Motors	Incr.	2.38	2.00	6.68
Process Cooling / Refrigeration / Freezing	Chiller Economizer	Full	11.08	11.67	8.01
	Free Cooling	Full	1.50	1.50	1.08
	Floating Head Pressure Controls	Full	1.11	1.13	0.80
	High Efficiency Chiller	Full/ Incr.	5.36	4.86	8.01
	Optimized Distribution System	Full	7.81	8.00	5.65
	Premium Efficiency Refrigeration Control System and Compressor Sequencing	Full	7.47	8.18	5.42
	Improve Insulation of Refrigeration System	Full	12.49	11.90	9.00
	Smart Defrost Controls	Full	0.43	0.25	0.31
	Improved Ice Production System	Full	3.48	0.00	3.48
	Air Curtains	Full	9.53	9.50	6.90
Process Heating	Heat Pumps	Full	34.82	9.82	71.92
	Insulation	Full	0.52	0.25	1.11
	Process Heat Recovery to Preheat Makeup Water	Full	7.69	4.91	13.03
	High Efficiency Oven/Dryer/Furnace/Kiln	Incr.	8.39	5.40	17.46
	High Efficiency Water Heater	Incr.	90.45	54.77	163.46
Process Specific	Process Optimization Efforts - Fishing and Fish Processing	Full	21.09	0.00	21.09
	Process Optimization Efforts - Pulp and Paper	Full	1.31	N/A	N/A
	Process Optimization Efforts - Mining and Processing	Full	2.48	2.48	0.00
	Advanced 'Predictive' Process Control Systems	Full	1.75	11.57	N/A
	Process Optimization Efforts - Oil Refining	Full	0.00	N/A	N/A
Pumps	Optimization of Pumping System	Full	2.46	2.09	5.06
	Premium Efficiency Pump Motor	Incr.	2.33	1.98	7.70
	Premium Efficiency Pump Control with ASDs	Full	1.14	0.97	2.32
	Correctly Sized Pumps: Impeller Trimming or Pump Selection	Full	0.07	0.06	0.15
System	Sub-Metering	Full	0.55	0.29	2.77
	Energy Management Information System (EMIS)	Full	2.69	3.33	8.09
	Organizational Energy Management (EM Team)	Full	1.97	3.42	4.52
	Operation and Maintenance (O&M) Program Supporting Efficiency	Full	1.04	1.90	2.21
	Integrated Plant Control System	Full	3.11	1.87	12.45

7.4 Demand Reduction Technology Assessment

Exhibit 26 shows the demand reduction technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 26 Demand Reduction Technologies Included in this Study

System

- Operating Changes for Reduced Peak Load (DR Curtailments)
- Peak Shifting Through On-Site Storage
- Power Factor Correction Equipment

7.4.1 Technology Screening Results

A summary of the results is provided in Exhibit 27. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[13] for the CEPR that is shown (e.g. full versus incremental)
- The measure's average CEPR for each region

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 27 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some sub-sector types and on an incremental cost basis in others is shown as "Full/Incr."

The first demand measure included here, operating changes for reduced peak load, represents the peak demand reductions that the Utilities can achieve through curtailment arrangements with their customers. For Newfoundland Power this represents participation by all general service customers in their curtailable service option. For Newfoundland and Labrador Hydro this represents interruptible power arrangements in place with large industrial customers for peak period curtailment. In both cases this study will consider current and potential future levels of curtailment.

Exhibit 27 Industrial Sector Demand Reduction Technology Measures, Screening Results[14]

Measure Name	Basis	Average CEPR ($/kW)		
		Island	Labrador	Isolated
Operating changes for reduced peak load (DR Curtailments)	Full	32	32	32
Peak shifting through on-site storage	Full	25	78	59
Power factor correction equipment	Full	21	17	60

[13] See Step 4 in Section 7.2 for a fuller description.
[14] Average CEPR does not include program costs.

7.5 Energy Efficiency Supply Curve

This sub-section includes an energy efficiency supply curve for the total Newfoundland service territory. This supply curve shows the avoided cost for each region as a horizontal line. Regional supply curves are available in the Data Manager file, and are also important since the avoided costs and CCE's vary by region. This supply curve is presented for the year 2029, but the Data Manager file can be used to generate supply curves for the other years.

The supply curve were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 25. The following approach was used:

- Measures were introduced in sequence.
- Where more than one measure affects the same end use, the savings shown for the second measure are incremental to those already shown for the first.
- Sequence is determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It includes consideration of CCE results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CCE, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in two exhibits:

- Exhibit 28 presents the potential by measure for all regions. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 29 presents the supply curve for all regions. A few of the measures are numbered as landmarks. The numbers match those in Exhibit 28.

Equivalent exhibits specific have been created for each of the three regions in Data Manager, and include a comparison of avoided costs levels of range of reasonableness.

Exhibit 28 All Regions Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
-	Correctly Sized Motors	6,405	6,405	-$0.04[15]
1	Process Optimization Efforts - Oil Refining	-	6,405	$0.00
2	Reduced Temperature Settings	2,715	9,120	$0.00
3	Correctly Sized Pumps: Impeller Trimming or Pump Selection	40,996	50,116	$0.00
4	Correctly Sized Fans: Impeller Trimming or Fan Selection	26,016	76,132	$0.00
5	Insulation	4,876	81,009	$0.00
6	Smart Defrost Controls	1,340	82,348	$0.00
7	Optimized Motor Control	9,329	91,677	$0.01
8	Use Cooler Air from Outside for Make Up Air	2,834	94,511	$0.01

[15] This CCE value is negative since the opportunity involves the selection of a smaller replacement motor at the equipment's end of life, which is actually less expensive than the default of purchasing a new oversized motor.

Exhibit 28 Continued: All Regions Measure Potential and CCE

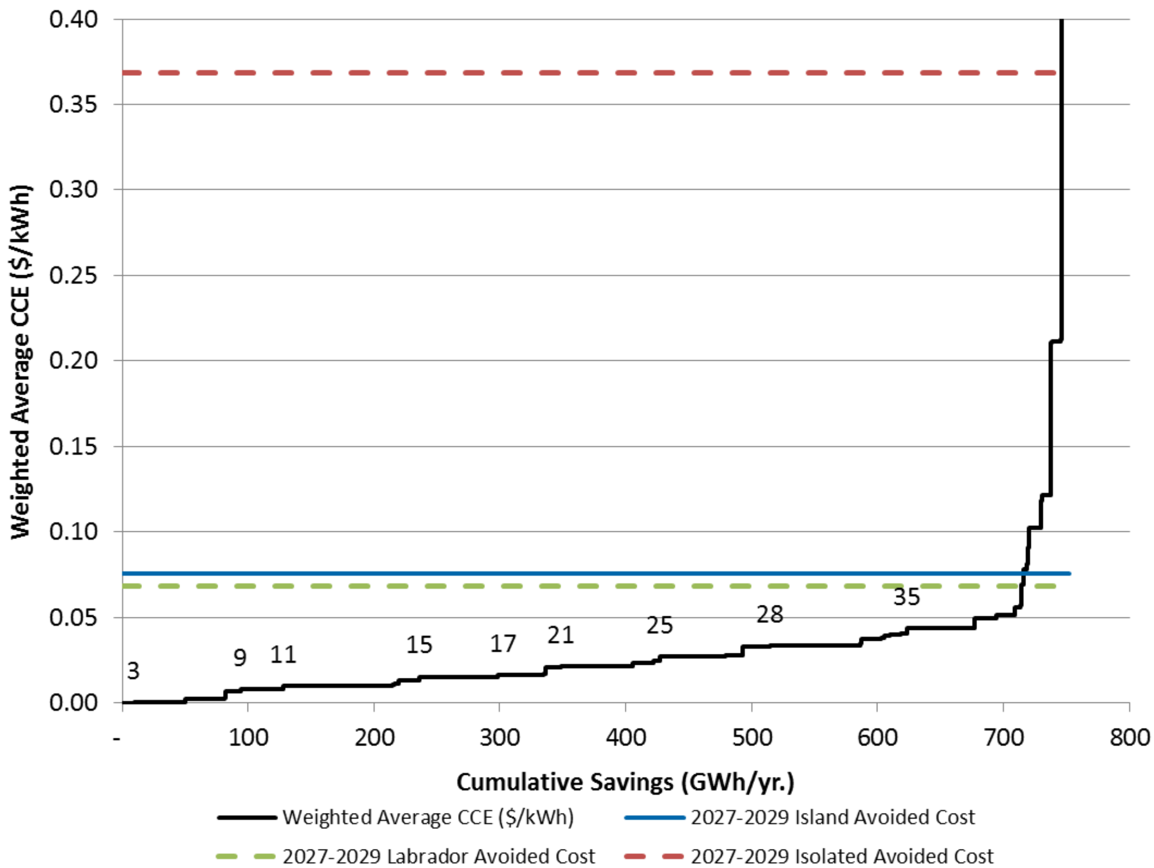
Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
9	Sub-Metering	33,548	128,060	$0.01
10	Floating Head Pressure Controls	318	128,378	$0.01
11	Premium Efficiency Pump Control with ASDs	86,257	214,635	$0.01
12	Synchronous Belts	1,422	216,057	$0.01
13	Free Cooling	3,326	219,383	$0.01
14	Process Optimization Efforts - Pulp and Paper	16,272	235,655	$0.01
15	Premium Efficiency Fan Control with ASDs	62,406	298,061	$0.02
16	Premium Efficiency Motors for Fans and Blowers	4,671	302,733	$0.02
17	Operation and Maintenance (O&M) Program Supporting Efficiency	31,672	334,405	$0.02
18	Premium Efficiency Conveyor Motors	1,920	336,325	$0.02
19	Premium Efficiency Pump Motor	6,542	342,867	$0.02
20	Premium Efficiency Motors	5,796	348,663	$0.02
21	Optimization of Pumping System	56,790	405,453	$0.02
22	Advanced ‘Predictive’ Process Control Systems	15,610	421,063	$0.02
23	Optimized Sizes of Air Receiver Tanks	1,300	422,363	$0.02
24	Process Optimization Efforts - Mining and Processing	4,485	426,847	$0.02
25	Organizational Energy Management (EM Team)	52,540	479,387	$0.03
26	Air Leak Survey and Repair	13,357	492,744	$0.03
27	Integrated Plant Control System	21,897	514,641	$0.03
28	Energy Management Information System (EMIS)	71,478	586,119	$0.03
29	Improved Ice Production System	1,174	587,292	$0.03
30	Premium Efficiency ASD Compressor	15,783	603,075	$0.04
31	Automated Temperature Control	2,601	605,676	$0.04
32	Optimized Conveyor Motor Control	3,818	609,494	$0.04
33	Optimized Distribution System (Incl. Pressure and Air End-Uses)	8,859	618,352	$0.04
34	High-Efficiency Packaged HVAC	5,111	623,463	$0.04
35	High Efficiency Lights (LEDs)	48,612	672,075	$0.04
36	Automated Lighting Controls	4,892	676,967	$0.04
37	Process Heat Recovery to Preheat Makeup Water	17,501	694,468	$0.05

Exhibit 28 Continued: All Regions Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
38	Optimized Distribution System (Incl. Pressure Losses)	14,679	709,147	$0.05
39	High Efficiency Oven/Dryer/Furnace/Kiln	82	709,229	$0.05
40	Premium Efficiency Refrigeration Control System and Compressor Sequencing	3,719	712,948	$0.06
41	Optimized Distribution System	1,330	714,279	$0.06
42	High Efficiency Chiller	2,014	716,292	$0.07
43	Heat Pumps	2,145	718,437	$0.08
44	Chiller Economizer	1,325	719,762	$0.08
45	Air Curtains	412	720,174	$0.09
46	Improve Insulation of Refrigeration System	1,756	721,930	$0.10
47	High-Efficiency Lighting Design	7,954	729,884	$0.10
48	Sequencing Control	761	730,645	$0.12
49	Air Compressor Heat Recovery	7,284	737,929	$0.12
50	Process Optimization Efforts - Fishing and Fish Processing	148	738,077	$0.21
51	Ventilation Heat Recovery	7,519	745,597	$0.21
52	Warehouse Loading Dock Seals	410	746,006	$0.21
53	Ventilation Optimization	4,154	750,160	$0.43
54	High Efficiency Water Heater	1,536	751,696	$0.54
55	HVAC Air Curtains	160	751,856	$0.62
56	Improved Building Insulation	6,238	758,094	$0.66

The CCE values presented in Exhibit 28 do not always match those presented elsewhere in the report. The CCE values presented in these exhibits are calculated weighted averages, based on the particular mixture of sub-sectors and regions in which the measure is applied at each stage of the analysis. So for example, CCE values presented in this exhibit may differ significantly from those shown in Exhibit 25. The CCE values in Exhibit 25 present a preliminary average for each region, weighted based on the breakdown of consumption by sub-sector in that region. By contrast, the CCE values in Exhibit 28 are based on the technical potential scenario. So the CCE values in this exhibit are more precisely weighted, based on the end-use breakdown, and the applicability/market penetration of measures in each sub-sector. It is also important to note that there is not necessarily a correlation between which region's CCE value from Exhibit 25 is closest to the CCE value in Exhibit 28, and which region accounts for the majority of Technical Potential savings in Exhibit 28.

Exhibit 29 All Regions Energy Efficiency Supply Curve



7.6 Demand Reduction Supply Curve

This sub-section includes demand reduction supply curves for each of the three regions studied. It is important to present the supply curves for each region separately, because the avoided costs are different. The supply curves presented are for the year 2029, but the Data Manager can be used to generate supply curves for the other years. Each supply curve shows the avoided cost for that region as a horizontal line, with dashed lines showing the upper and lower edge of the range of reasonableness.

The supply curves were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 26. The following approach was used:

- Measures were introduced in sequence
- Where more than one measure affected the same end use, the reduction shown for the second measure are incremental to those already shown for the first
- Sequence was determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It included consideration of CEPR results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CEPR, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in two exhibits:

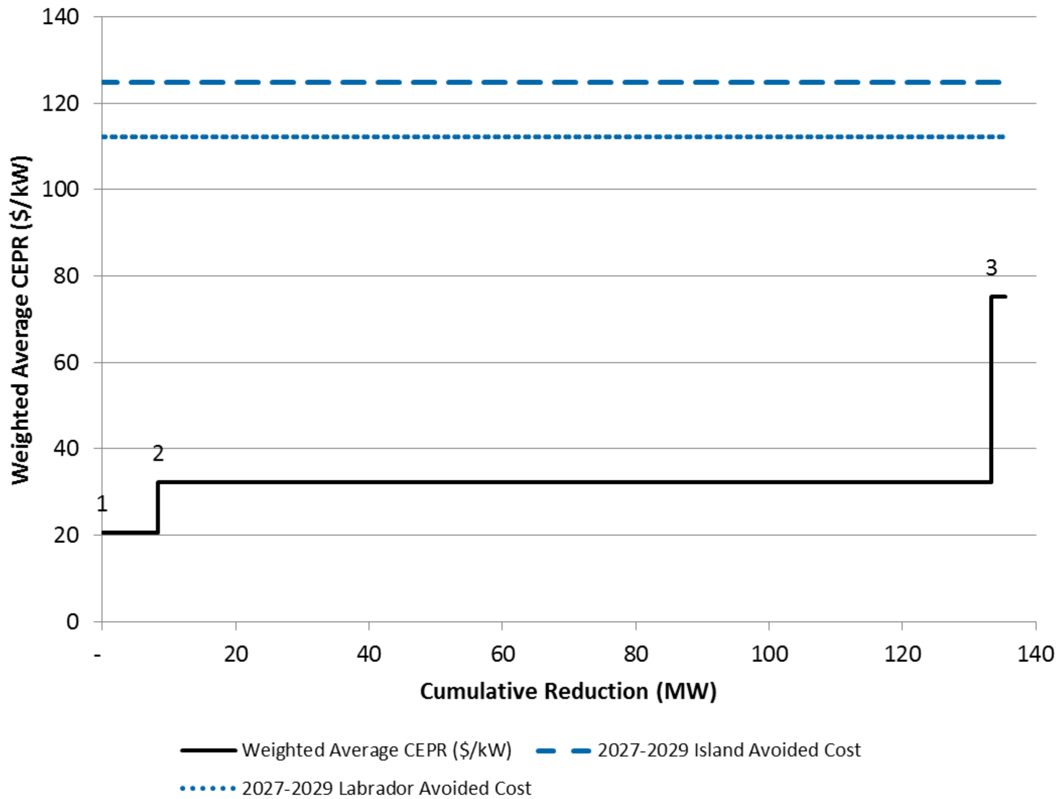
- Exhibit 30 presents the potential by measure for all regions. The columns provide the reduction for the measure, cumulative reduction, and CEPR, with measures sorted and numbered in order of increasing CEPR.
- Exhibit 31 presents the supply curve for all regions. The measures are numbered to match those in Exhibit 30.

As mentioned in Section 7.4.1 the demand response curtailment measure is made up of Newfoundland and Labrador Hydro's interruptible power arrangements with large industrial facilities and Newfoundland Power's curtailment program for general service customers. While most of this potential demand reduction is from large industry, it is worth noting that all of Newfoundland Power's general service curtailment potential is captured in this report. In addition to water system and manufacturing facilities, general service customers participating in the curtailment program also include some facilities like hospitals, which would normally be classified as 'commercial' buildings in this study. Since all of the demand reductions from Newfoundland Power's curtailment program will be captured here, the results will slightly overestimate the potential curtailment from what are otherwise classified as industrial facilities in this report, but this approach aligns with Newfoundland Power's single general service customer category.

Exhibit 30 All Regions Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Power factor correction equipment	8	8	$20.53
2	Operating changes for reduced peak load (DR Curtailments)	125	133	$32.21
3	Peak shifting through on-site storage	2	136	$75.16

Exhibit 31 All Regions Demand Reduction Supply Curve



Equivalent exhibits specific have been created for each of the three regions in Data Manager, and include a comparison of avoided costs levels of range of reasonableness.

8 Economic Potential: Electric Energy and Demand Forecast

8.1 Introduction

This section presents the Industrial sector Economic Potential Forecast for electric energy and demand for the study period 2014 to 2029. The Economic Potential Electric Energy Forecast estimates the level of electricity consumption that would occur if all equipment was retrofitted or upgraded to the level that is cost effective against the economic threshold values for electricity in the three regions in NL. The model also estimates the peak demand implications of applying all the cost-effective efficiency measures. Starting from that point, the Economic Potential Peak Demand Forecast estimates the level of peak demand that would occur if all cost-effective demand reduction measures were also applied. In this study, "cost effective" means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) or the cost of electricity peak reduction (CEPR) in the preceding section, is equal to or less than the economic threshold value for a given region.

The discussion in this section covers the following:

- Avoided costs used for screening
- Major modelling tasks
- Technologies included in Economic Potential Forecast
- Presentation of energy efficiency results
- Interpretation of energy efficiency results
- Summary of peak load reductions from energy efficiency
- Presentation of load reduction results
- Interpretation of load reduction results
- Range of reasonableness.

8.2 Avoided Costs Used For Screening

The Utilities agreed on a set of economic threshold values for electricity supply to be used in this study. The values vary by region and milestone year as shown in Exhibit 32. Each of the values for the years after 2014 represents the average of the three years in the milestone period.

Exhibit 32 Avoided Costs of New Electricity Supply

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.108	$0.037	$0.21
2017	$0.125	$0.039	$0.23
2020	$0.050	$0.045	$0.26
2023	$0.059	$0.053	$0.29
2026	$0.068	$0.061	$0.34
2029	$0.076	$0.068	$0.37

The Economic Potential Electric Energy Forecast then incorporates all the electric energy-efficient upgrades that the technology assessment found to have a CCE equal to or less than these thresholds.

The Utilities also agreed on a set of economic threshold values for new generation capacity to be used in this study. These values also vary by region and milestone year as shown in Exhibit 33. Again, each value for the years after 2014 represents an average of the three years in the milestone period. The cost of new capacity for the Isolated region was not available. For the purposes of the study, the higher of the two values for the other two regions was used in each milestone year.

Exhibit 33 Avoided Costs of New Electric Generation Capacity

Year	Avoided Cost per kW		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$50.911	$72.059	
2017	$65.116	$82.527	
2020	$101.821	$91.601	
2023	$115.126	$103.571	
2026	$124.930	$112.390	
2029	$124.907	$112.370	

The Economic Potential Peak Demand Forecast then incorporates all the demand reduction upgrades that the technology assessment found to have a CEPR equal to or less than these thresholds.

The Utilities also provided a range of reasonableness for all of these avoided costs. The lower range for new electricity supply is considered to be 10% below the costs per kWh shown in Exhibit 32 while the upper range is considered to be 30% above those values. The upper range for new electric generation capacity supply is considered to be 10% below the costs per kW shown in Exhibit 33 while the upper range is considered to be 20% above those values. The purpose for establishing the range of reasonableness is to show the sensitivity of the results to varying avoided cost scenarios and to improve the ability of planners to examine options that may become more cost effective over time.

Emerging end-use technology measures are becoming cheaper over time as these markets become more cost effective. This is apparent by examining a range of measures that have become very low cost (e.g., CFLs reduced by a factor of 5-10x since introduction; the same applies to more efficient motors, light sources and appliances). Including these apparently more costly measures in this study allows the review of these measures in the near future, as programs are effective in introducing more competitiveness within these markets. At the same time, new sources of supply are expected to come online during the study period, so it is important to explore the implications of lower avoided costs.

8.3 Major Modelling Tasks

By comparing the results of the Industrial sector Economic Potential Electric Energy and Peak Demand Forecasts with the Reference Case, it is possible to determine the aggregate level of potential electricity savings and demand reductions within the Industrial sector, as well as identify which specific building sub-sectors and end uses provide the most significant opportunities for savings.

To develop the Industrial sector Economic Potential Electric Energy Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibit 25 were reviewed, using the 7% (real) discount rate.

- Technology upgrades that had a CCE equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CCE that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing equipment reaches the end of its useful life.
- Electricity use within each of the sub-sectors was modelled with the same energy models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.
- When more than one upgrade option was applied to a given end use, the measure order was selected to apply major retrofits first. In our experience the total potential is maximized when the expensive measures are applied first, since having the low CCE measures at the beginning will reduce subsequent measure savings and can make the high CCE measures fail, while low CCE measures at the end will still pass the economic screens.

To develop the Industrial sector Economic Potential Peak Demand Forecast, the following tasks were completed:

- The Economic Potential Electric Energy Forecast was used to generate the reductions in peak demand associated with efficiency improvements. These reductions were applied to the demand Reference Case to generate a Post-Efficiency Case to serve as the starting point for the demand reduction model. This was intended to avoid any double counting of demand reductions.
- The CEPR for each of the load reduction upgrades presented in Exhibit 26 were reviewed, using the 7% (real) discount rate.
- Technology upgrades that had a CEPR equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CEPR that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Peak demand within each of the sub-sectors was modelled with the same demand models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.

8.4 Technologies Included in Economic Potential Forecast

Exhibit 34 provides a listing of the efficiency technologies included in this forecast. Exhibit 35 provides a listing of the demand reduction technologies selected for included in this forecast. In each case, the exhibits show the following:

- End use affected
- Upgrade option(s) selected
- Rate at which the upgrade options were introduced into the stock.

Exhibit 34 Efficiency Technologies Included in Economic Potential Forecast

End Use	Upgrade Option	Sub-Sector	Rate of Introduction
Air Compressors	Premium Efficiency ASD Compressor	All	At natural rate of replacement
	Use Cooler Air from Outside for Make Up Air	All	Immediate
	Optimized Distribution System (Incl. Pressure and Air End-Uses)	All	Immediate
	Optimized Sizes of Air Receiver Tanks	All	Immediate
	Sequencing Control	All	Immediate
	Air Leak Survey and Repair	All	Immediate
Conveyors	Optimized Conveyor Motor Control	All	Immediate
	Premium Efficiency Conveyor Motors	All	At natural rate of replacement
Fans and Blowers	Premium Efficiency Fan Control with ASDs	All	Immediate
	Synchronous Belts	All	Immediate
	Premium Efficiency Motors for Fans and Blowers	All	At natural rate of replacement
	Correctly Sized Fans: Impeller Trimming or Fan Selection	All	Immediate
	Optimized Distribution System (Incl. Pressure Losses)	All	Immediate
HVAC	Automated Temperature Control	All	Immediate
	Air Compressor Heat Recovery	All	Immediate
	Ventilation Heat Recovery	All	Immediate
	Ventilation Optimization	All	Immediate
	Reduced Temperature Settings	All	Immediate
	High-Efficiency Packaged HVAC	All	At natural rate of replacement
	Warehouse Loading Dock Seals	All	Immediate
	Improved Building Insulation	All	Immediate
	HVAC Air Curtains	All	Immediate
Lighting	High Efficiency Lights (LEDs)	All	Immediate
	Automated Lighting Controls	All	Immediate
	High-Efficiency Lighting Design	All	Immediate
Other Motors	Correctly Sized Motors	All	Immediate

Exhibit 34 Continued: Efficiency Technologies Included in Economic Potential Forecast

End Use	Upgrade Option	Sub-Sector	Rate of Introduction
	Optimized Motor Control	All	Immediate
	Premium Efficiency Motors	All	At natural rate of replacement
Process Cooling / Refrigeration / Freezing	Chiller Economizer	All	Immediate
	Free Cooling	All	Immediate
	Floating Head Pressure Controls	All	Immediate
	High Efficiency Chiller	All	At natural rate of replacement / immediate in some sub-sectors
	Optimized Distribution System	All	Immediate
	Premium Efficiency Refrigeration Control System and Compressor Sequencing	All	Immediate
	Improve Insulation of Refrigeration System	All	Immediate
	Smart Defrost Controls	All	Immediate
	Improved Ice Production System	Fishing and Fish Processing	Immediate
	Air Curtains	All	Immediate
Process Heating	Heat Pumps	All	Immediate
	Insulation	All	Immediate
	Process Heat Recovery to Preheat Makeup Water	All	Immediate
	High Efficiency Oven/Dryer/Furnace/Kiln	All	At natural rate of replacement
	High Efficiency Water Heater	All	At natural rate of replacement
Process Specific	Process Optimization Efforts - Fishing and Fish Processing	Fishing and Fish Processing	Immediate
	Process Optimization Efforts - Pulp and Paper	Pulp and Paper	Immediate
	Process Optimization Efforts - Mining and Processing	Mining and Processing	Immediate
	Advanced 'Predictive' Process Control Systems	All Large Industry	Immediate
	Process Optimization Efforts - Oil Refining	Refining	Immediate
Pumps	Optimization of Pumping System	All	Immediate
	Premium Efficiency Pump Motor	All	At natural rate of replacement
	Premium Efficiency Pump Control with ASDs	All	Immediate
	Correctly Sized Pumps: Impeller Trimming or Pump Selection	All	Immediate
System	Sub-Metering	All	Immediate

Exhibit 34 Continued: Efficiency Technologies Included in Economic Potential Forecast

End Use	Upgrade Option	Sub-Sector	Rate of Introduction
	Energy Management Information System (EMIS)	All	Immediate
	Organizational Energy Management (EM Team)	All	Immediate
	Operation and Maintenance (O&M) Program Supporting Efficiency	All	Immediate
	Integrated Plant Control System	All	Immediate

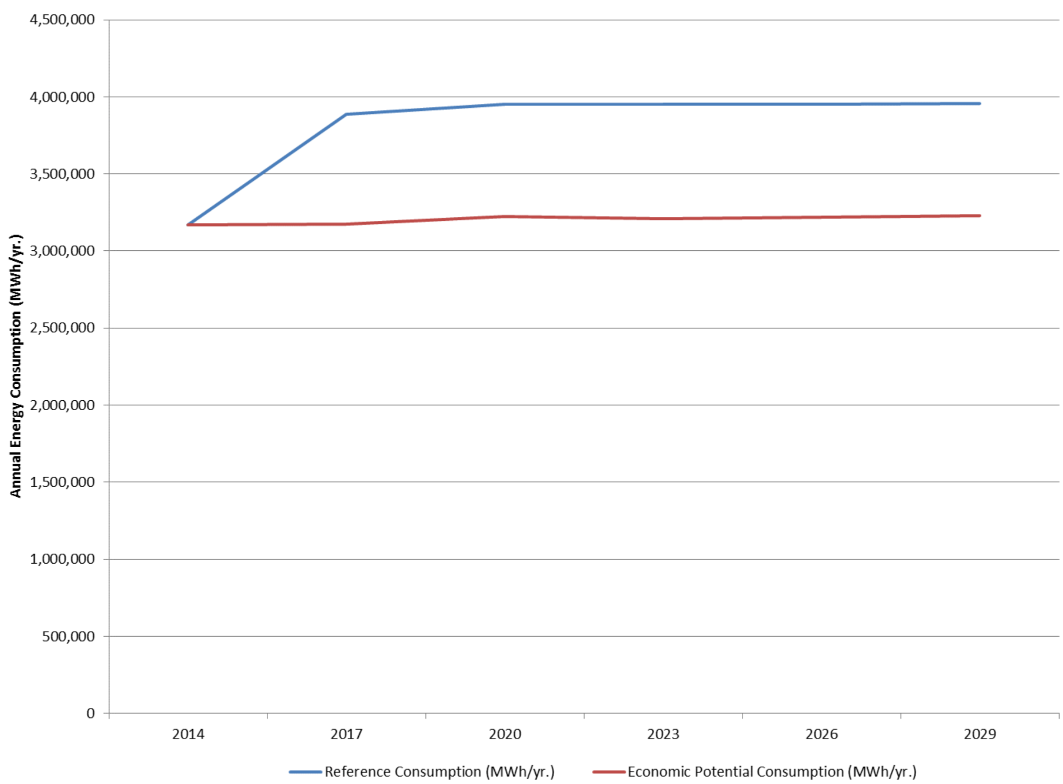
Exhibit 35 Load Reduction Technologies Included in Economic Potential Forecast

End Use Category	Upgrade Option	Sub-Sector	Rate of Introduction
System (all)	Operating changes for reduced peak load (DR Curtailments)	All except refining and fishing/fish processing	Immediate
	Power factor correction equipment	All	Immediate
Process Specific	Peak shifting through on-site storage	Pulp and Paper	Immediate
Cooling / Refrigeration	Peak shifting through on-site storage	Fishing/Fish Processing	Immediate
HVAC	Peak shifting through on-site storage	Manufacturing	Immediate
Pumps	Peak shifting through on-site storage	Water Systems and Other	Immediate

8.5 Summary of Electric Energy Savings

Exhibit 36 compares the Reference Case and Economic Potential Electric Energy Forecast levels of industrial electricity consumption.[16] As illustrated, under the Reference Case industrial electricity use would grow from the Base Year level of 3,169,000 MWh/yr. to approximately 3,956,000 MWh/yr. by 2029. This contrasts with the Economic Potential Forecast in which electricity use would decrease to approximately 3,243,800 MWh/yr. for the same period, a difference of approximately 712,000 MWh/yr., or about 18%. Exhibit 36 shows that the large jump in Reference Case consumption by 2017 (blue line) could largely be negated by the similarly sized Economic Potential savings (red line), with the bulk of these Economic Potential savings available immediately.

Exhibit 36 Reference Case versus Economic Potential Electric Energy Consumption in the Industrial Sector (MWh/yr.)



8.5.1 Electric Energy Savings

Further detail on the total potential electric energy savings provided by the Economic Potential Forecast is provided in the following exhibits:[17]

- Exhibit 37 presents the results by end use, sub-sector type and milestone year
- Exhibit 38 provides a further disaggregation of the savings by technology, and milestone year
- Exhibit 39 presents savings by end use
- Exhibit 40 and Exhibit 41 present savings by end use, and sub-sector

[16] All results are reported at the customer's point-of-use and do not include line losses.
[17] MWh/yr. savings shown in the following exhibits are not incremental. For example, the pumping savings in 2029 are not in addition to the pumping savings from the previous milestone years. Rather, they are the difference between the Reference Case pumping consumption in 2029 and the pumping consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 37 Total Economic Potential Electricity Savings by End Use, Sub-Sector and Milestone Year (MWh/yr.)

Sub-Sectors	Year	Annual Economic Potential Savings (MWh/yr.)					
		Pumps	Fans and blowers	Process specific	Lighting	Other motors	Air compressors
Large Industry	2017	215,615	130,543	80,463	42,628	43,378	45,423
	2020	215,814	130,459	80,032	56,379	45,023	46,371
	2023	213,155	135,669	78,568	54,069	46,534	45,706
	2026	210,485	133,962	77,096	51,780	48,049	45,038
	2029	207,799	132,261	75,613	49,505	49,571	44,365
Manufacturing	2017	4,184	5,064	456	12,453	5,152	5,875
	2020	4,162	5,033	451	11,992	5,279	5,827
	2023	4,140	5,019	447	11,732	5,406	5,779
	2026	4,118	4,993	442	11,272	5,534	5,727
	2029	4,098	4,970	439	10,821	5,677	5,676
Fishing and Fish Processing	2017	3,388	450	180	4,902	617	1,171
	2020	3,361	446	178	4,699	634	1,259
	2023	3,353	443	176	4,498	652	1,351
	2026	3,335	439	174	4,299	669	1,441
	2029	3,318	558	172	4,101	686	1,533
Water Systems and Other	2017	13,663	3,287	575	1,559	1,027	341
	2020	13,747	3,312	577	1,524	1,065	344
	2023	13,853	3,341	579	1,492	1,105	346
	2026	13,899	3,408	579	1,452	1,142	346
	2029	13,960	3,427	580	1,414	1,181	346
Grand Total	2017	236,849	139,344	81,674	61,542	50,174	52,810
	2020	237,084	139,249	81,238	74,594	52,001	53,801
	2023	234,501	144,471	79,770	71,791	53,697	53,182
	2026	231,837	142,802	78,291	68,803	55,395	52,552
	2029	229,175	141,216	76,804	65,841	57,116	51,921

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) MWh/yr. savings are not incremental. The pumping savings in 2029 are not in addition to the savings from the previous milestone years. Rather, they are the difference between the Reference Case space heating consumption in 2029 and the pumping consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 37 Continued: Total Economic Potential Electricity Savings by End Use, Sub-Sector and Milestone Year (MWh/yr.)

Sub-Sectors	Year	Annual Economic Potential Savings (MWh/yr.)					
		Process heating	Process cooling	Comfort HVAC	Conveyors	Other	Grand Total
Large Industry	2017	28,214	2,751	12,836	12,884	-	614,733
	2020	28,401	2,918	13,709	15,926	-	635,032
	2023	42,160	2,882	14,284	16,046	-	649,073
	2026	41,741	2,845	14,864	16,167	-	642,026
	2029	41,318	2,808	15,448	16,288	-	634,977
Manufacturing	2017	397	1,849	3,933	306	-	39,669
	2020	393	1,827	4,094	308	-	39,366
	2023	389	1,805	4,243	310	-	39,270
	2026	386	1,917	4,395	312	-	39,097
	2029	384	1,948	4,558	315	-	38,886
Fishing and Fish Processing	2017	842	20,105	1,681	563	-	33,899
	2020	833	19,894	1,644	559	-	33,507
	2023	824	19,683	1,603	573	-	33,155
	2026	815	19,471	1,569	577	-	32,790
	2029	806	19,258	1,536	581	-	32,549
Water Systems and Other	2017	408	-	290	4	-	21,154
	2020	413	-	292	4	-	21,278
	2023	426	-	293	4	-	21,438
	2026	430	-	293	4	-	21,552
	2029	434	-	293	4	-	21,638
Grand Total	2017	29,861	24,704	18,741	13,757	-	709,454
	2020	30,040	24,639	19,738	16,797	-	729,182
	2023	43,798	24,370	20,424	16,933	-	742,937
	2026	43,371	24,233	21,121	17,060	-	735,465
	2029	42,942	24,013	21,834	17,189	-	728,050

Notes:
1) Minimal consumption and no measures are targeted towards the 'Other' category for Industry.

Exhibit 38 Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Premium Efficiency Pump Control with ASDs	90,015	90,075	88,829	87,555	86,272
Energy Management Information System (EMIS)	74,019	74,175	73,262	72,342	71,478
Premium Efficiency Fan Control with ASDs	66,665	66,393	65,736	65,072	64,404
Optimization of Pumping System	59,901	59,574	58,658	57,730	56,801
Organizational Energy Management (EM Team)	55,193	55,182	54,318	53,446	52,574
High Efficiency Lights (LEDs)	45,301	56,287	53,862	51,256	48,655
Correctly Sized Pumps: Impeller Trimming or Pump Selection	44,537	43,867	42,916	41,961	41,006
Sub-Metering	37,227	36,784	35,712	34,629	33,548
Operation and Maintenance (O&M) Program Supporting Efficiency	35,015	34,411	33,508	32,600	31,690
Correctly Sized Fans: Impeller Trimming or Fan Selection	28,492	27,946	27,301	26,653	26,018
Integrated Plant Control System	22,209	21,739	21,269	20,794	20,320
Process Optimization Efforts - Pulp and Paper	16,727	16,615	16,501	16,387	16,272
Premium Efficiency ASD Compressor	15,593	15,971	15,912	15,853	15,792
Air Leak Survey and Repair	13,594	13,876	13,715	13,553	13,389
Advanced 'Predictive' Process Control Systems	13,524	13,437	13,349	13,260	13,170
Optimized Distribution System (Incl. Pressure Losses)	9,915	9,993	16,119	15,366	14,681
Process Heat Recovery to Preheat Makeup Water	3,586	3,807	17,859	17,741	17,622
Optimized Motor Control	10,156	9,968	9,756	9,543	9,331
Optimized Distribution System (Incl. Pressure and Air End-Uses)	8,929	9,187	9,082	8,973	8,861
High-Efficiency Lighting Design	5,230	5,364	5,324	5,285	5,249
Insulation	5,010	4,983	4,948	4,912	4,876
Automated Lighting Controls	3,243	5,344	5,310	5,262	5,216
Process Optimization Efforts - Mining and Processing	4,785	4,851	4,730	4,608	4,485
Premium Efficiency Pump Motor	1,301	2,599	3,923	5,231	6,543
Premium Efficiency Refrigeration Control System and Compressor Sequencing	3,907	3,893	3,856	3,811	3,770
Correctly Sized Motors	1,280	2,559	3,839	5,121	6,406
Reduced Temperature Settings	3,946	3,906	3,811	3,716	3,622
Premium Efficiency Motors	1,145	2,299	3,458	4,624	5,797
Free Cooling	3,458	3,454	3,426	3,392	3,362
Optimized Conveyor Motor Control	1,373	4,019	3,953	3,886	3,819
Automated Temperature Control	3,429	3,464	3,373	3,283	3,193
High-Efficiency Packaged HVAC	1,043	2,110	3,158	4,218	5,283
Use Cooler Air from Outside for Make Up Air	2,938	2,955	2,915	2,875	2,835
Premium Efficiency Motors for Fans and Blowers	927	1,863	2,797	3,733	4,671
High Efficiency Chiller	1,833	1,832	1,830	1,981	2,035
Improve Insulation of Refrigeration System	1,725	1,746	1,717	1,687	1,658
Synchronous Belts	1,479	1,470	1,454	1,438	1,422
Optimized Sizes of Air Receiver Tanks	1,460	1,458	1,406	1,354	1,301

Exhibit 38 Continued: Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Smart Defrost Controls	1,414	1,402	1,390	1,376	1,362
Optimized Distribution System	1,400	1,386	1,372	1,357	1,343
Chiller Economizer	1,284	1,278	1,265	1,253	1,240
Improved Ice Production System	1,231	1,220	1,210	1,200	1,189
Premium Efficiency Conveyor Motors	371	752	1,146	1,532	1,921
Heat Pumps	1,011	1,073	1,068	1,062	1,057
Air Compressor Heat Recovery	812	798	778	758	738
Ventilation Optimization	664	646	629	611	594
Sequencing Control	488	497	490	479	468
Floating Head Pressure Controls	339	337	332	327	322
Air Curtains	308	310	305	300	295
High Efficiency Oven/Dryer/Furnace/Kiln	15	17	48	65	82
Process Optimization Efforts - Fishing and Fish Processing	8	8	8	7	7
Ventilation Heat Recovery	4	4	4	4	4
Warehouse Loading Dock Seals	0	0	0	0	0
High Efficiency Water Heater	-	-	-	-	-
HVAC Air Curtains	-	-	-	-	-
Improved Building Insulation	-	-	-	-	-
Process Optimization Efforts - Oil Refining	-	-	-	-	-
Grand Total	709,454	729,182	742,937	735,465	728,050

Note: In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

Exhibit 39 Economic Potential Savings by Major End Use (2029)

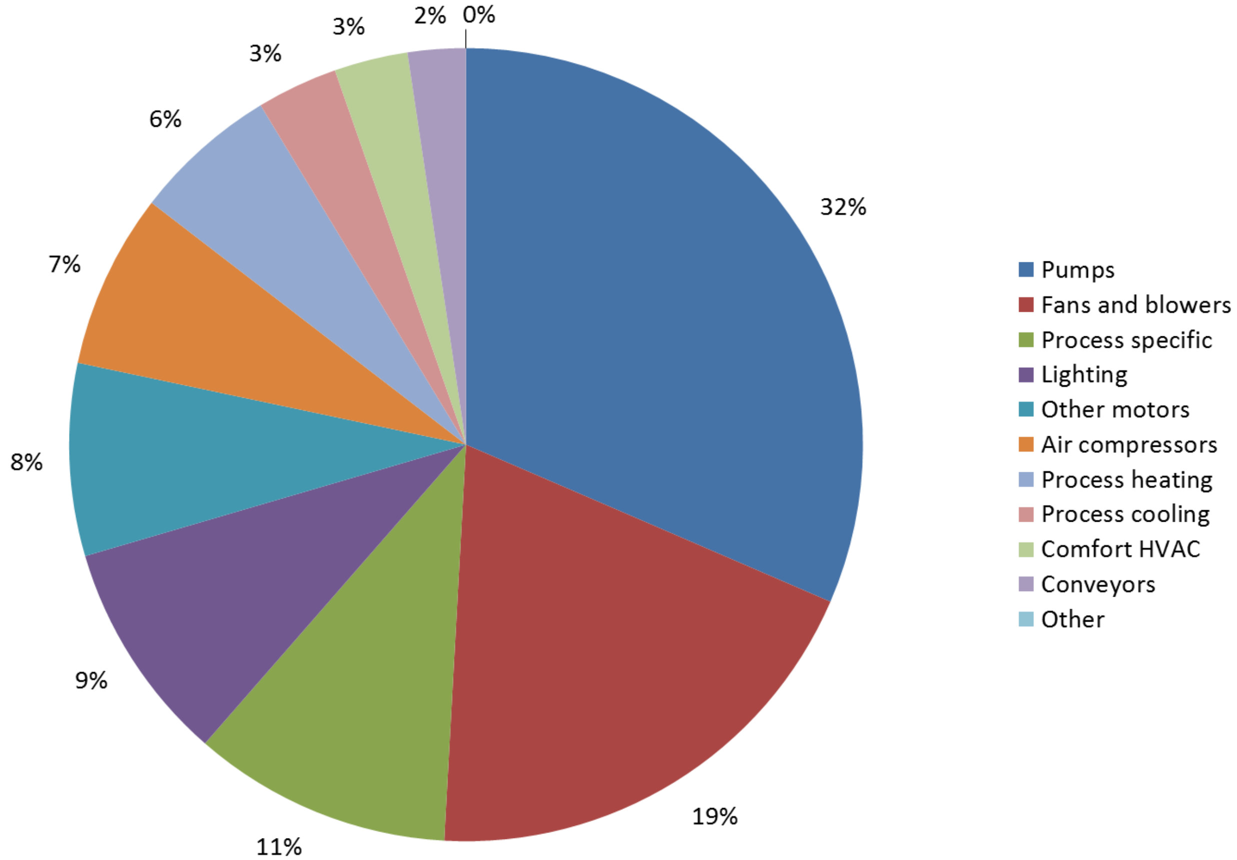


Exhibit 40 Economic Potential Savings by Major End Use and Sub-Sector, 2029 (MWh/yr.)

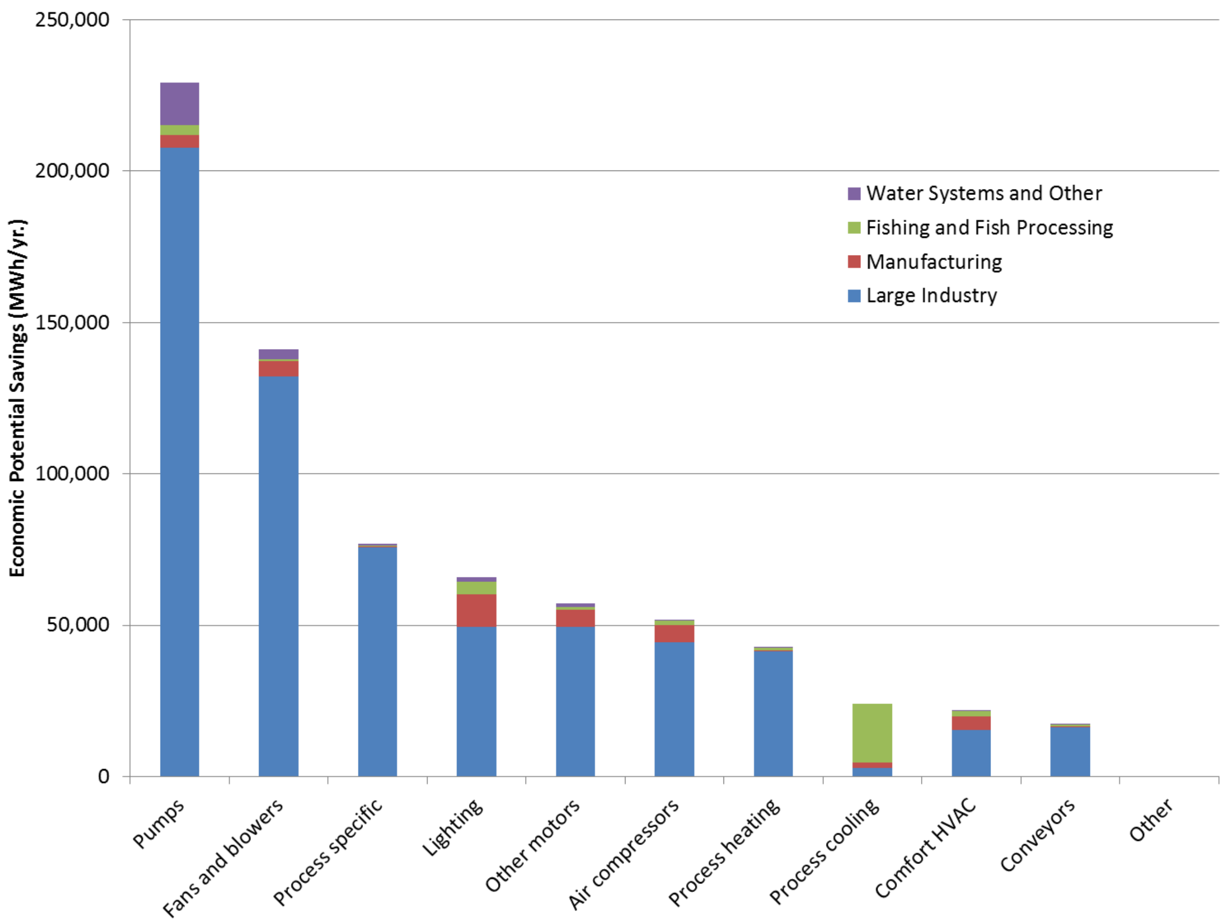
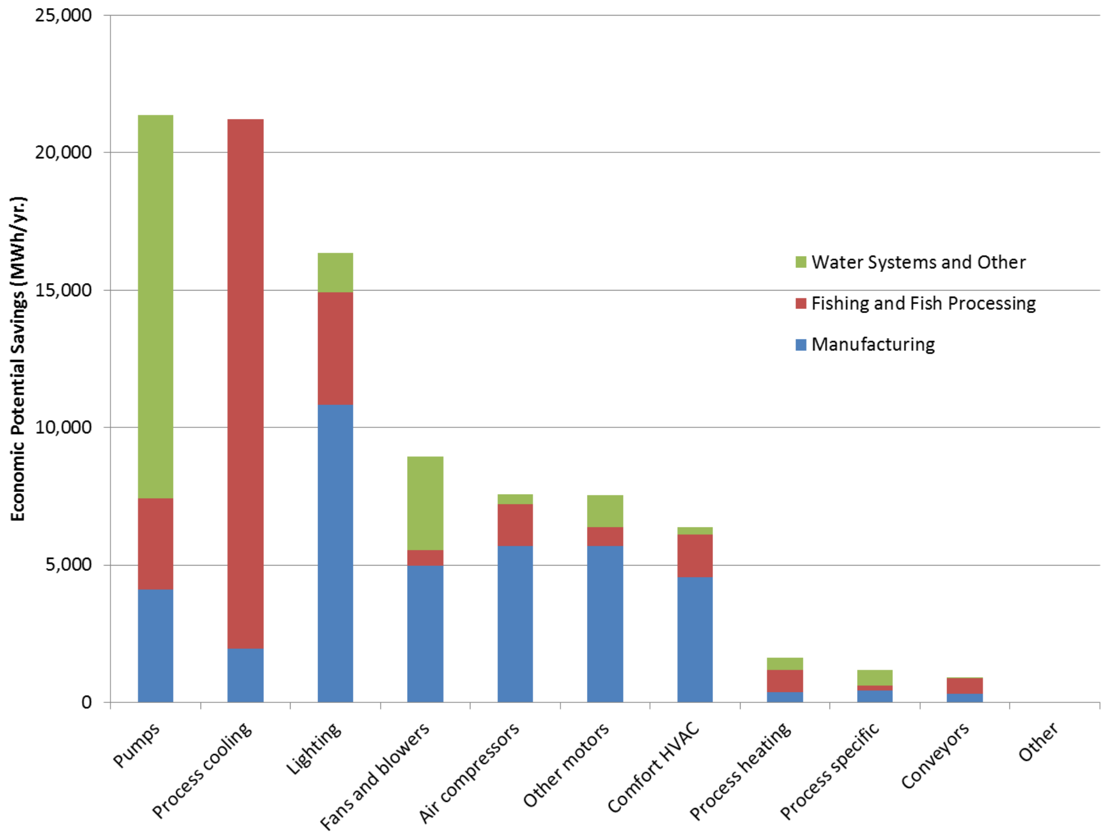


Exhibit 41 Economic Potential Savings by Major End Use and Sub-Sector for Small-Medium Industry, 2029, (MWh/yr)



8.5.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Electric Energy Savings by Milestone Year

The Economic Potential savings remains relatively level across the period of the study, increasing slightly from 3,177,000 MWh/yr. in 2017 to 3,228,000 MWh/yr. in 2029. Approximately 100% of the savings possible at the end of the study period are already economically viable within the first milestone period. There are main reasons for this high percentage of savings that occur at the beginning of the study period:

- Many of the measures pass the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year. Of the 57 measures included in the analysis, 48 pass the economic screens on a full-cost basis, and can therefore be implemented immediately. These measures are also the largest savings opportunities, so almost all of the savings possible at the end of the study period are already economically viable within the first milestone period.
- While the explanation above accounts for why the bulk of the savings could be achieved by 2017, it does not explain the slight decrease in economic potential savings over the milestone years. This is as a result of natural adoption eroding savings within the economic potential scenario. While there are end uses where the opportunities for savings expand, there are other end uses where the opportunities contract, such as lighting. Lighting in the Reference Case includes the assumption that a significant portion of the market moves to LEDs by 2029. So while savings from LEDs are expected to keep growing throughout the study period, as time progresses more of these savings are credited to natural adoption and not shown in the economic potential savings. The effect ties back into the previous point, since most of the measures are considered to be adopted at the first milestone; the remaining measures that are adopted from 2017 to 2019 produce less savings than are eroded by natural changes.
- For industry, where CCE values are for the most part well below the Utilities' requirements, the changes in avoided costs throughout the milestone periods have less impact than the factors mentioned above. There are still some minor impacts from the avoided costs in the Island Interconnected region being expected to fall significantly after the interconnection is made with Labrador. Consequently, a few measures that pass in the first milestone period fail the economic screen later in the study, so that any further adoption of them is curtailed.

Once again, the shape of this curve is driven by many of the measures passing the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year. During the next chapter of this report, the achievable potential will factor in more realistic adoption timelines, and will result in increasing savings over the milestones.

Electric Energy Savings by Sub-Sector

The Large Industrial plants account for over 87% of the potential savings; this reflects their use of the bulk of industrial consumption. Savings in manufacturing account for over 5% of the potential savings. Savings in fishing and fish processing facilities account for almost 5% of the potential savings, while savings in water systems and other facilities account for almost 3% of the potential savings.

By Region

Regional differences in electricity savings are driven largely by the types and sizes of facilities present in each region. Although such breakdowns are not shown here, in order to protect the confidentiality of certain facilities, the breakdown of savings by region closely follows the differences between the primary energy consuming industries in each region. Such breakdowns can be viewed in the Data Manager files.

Electric Energy Savings by End Use

Savings in the pumping end use account for approximately 31% of the total electricity savings in the Economic Potential Forecast. Of this, 38% is from upgrades to pump controls (ASDs), 25% is from pumping system optimization, 19% is from right-sizing of pumps, and 15% is from various system-level measures applied to this end use (Organization Energy Management, EMIS, sub-metering, O&M, etc).

The next largest end use for savings is fans and blowers, representing approximately 19% of the total electricity savings in the Economic Potential Forecast. Of this, approximately 50% is from upgrades to fan controls (ASDs), 18% is from right-sizing of fans, 10% is from optimizing distribution systems, and 18% is from various system-level measures applied to this end use.
The third largest end use for savings is process specific, representing approximately 11% of the total electricity savings in the Economic Potential Forecast. Savings in this end use are made up of process optimization efforts specific to different sub-sectors, advanced process controls, and system-level savings.

Lighting is the fourth largest end use for savings, representing 9% of the total electricity savings in the Economic Potential Forecast, with approximately 70% of these savings coming from upgrades to LED lights. Other motors and air compressors rank next in terms of savings, with approximately 8% and 7%, respectively.

Savings in the remaining end uses represent smaller portions electricity savings in the Economic Potential Forecast, and include process heating (6%), comfort HVAC (3%), process cooling (3%), process heating (3%), and conveyors (2%). While these savings may represent smaller amounts of the overall industrial economic potential, they can make up significant portions of the potential within individual sub-sectors. This is particularly true for end uses that are important to Small-Medium industrial sub-sectors, but not the Large industrial facilities that make up the bulk of the reference case consumption and economic potential savings.

8.5.3 Caveats on Interpretation of Results

A systems approach was used to model the energy impacts of the efficiency upgrades presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible. More specifically, there are two particularly important considerations:

- **More than one upgrade may affect a given end use.** For example, installing an adjustable speed drive will reduce the electricity use of a compressed air system, as will optimizing the compressed air distribution system. On its own, each measure will reduce overall air compressor electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to model system-level measures first (Organizational Energy Management, EMIS, etc.), followed by major retrofits to maximize their chances of inclusion in the model, and then finally lower-cost measures. This was done to get a sense of the maximum potential savings for industry. In our experience the total potential is maximized when the expensive measures are applied first. Having the low CCE measures at the beginning will reduce subsequent measure savings, and can make the high CCE measures fail, while low CCE measures at the end will still pass the economic screens.

- **There are interactive effects among end uses.** For example, the electricity savings from more efficient motors or lighting results in reduced waste heat. During the space heating season, motor and lighting waste heat contributes to a building's internal heat gains, which lowers the amount of heat that must be provided by the HVAC system. However, these interactive effects are minimal for the Industrial sector, where process loads typically dominate, and HVAC makes up a relatively small portion of consumption. As such, interactive effects are not modeled for the Industrial sector in this study.

8.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 42 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Economic Potential Forecast. The reductions are shown by milestone year and sub-sector. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6.

Exhibit 43 shows the peak load reductions that would occur as a result of electric energy savings, by milestone year, end use, and sub-sector in the winter peak period. Exhibit 44 shows the same information for the small and medium industrial sub-sectors.

These exhibits only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct.

Exhibit 45 shows the demand reductions associated with each electric energy savings measure contained in the Economic Potential Forecast for the milestone year 2029.

Electric peak load reductions related to capacity-only measures are presented separately in Section 8.7.

Exhibit 42 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year and Sub-Sector (MW)

Sub-Sector	2017	2020	2023	2026	2029
Large Industry	58.5	60.19	61.68	61.04	60.39
Manufacturing	2.9	2.92	2.93	2.92	2.92
Fishing and Fish Processing	2.7	2.67	2.63	2.59	2.56
Water Systems and Other	1.3	1.26	1.27	1.28	1.28
Grand Total	65.4	67.05	68.51	67.83	67.15

Exhibit 43 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year, End Use, and Sub-Sector, Winter Peak Period (MW)

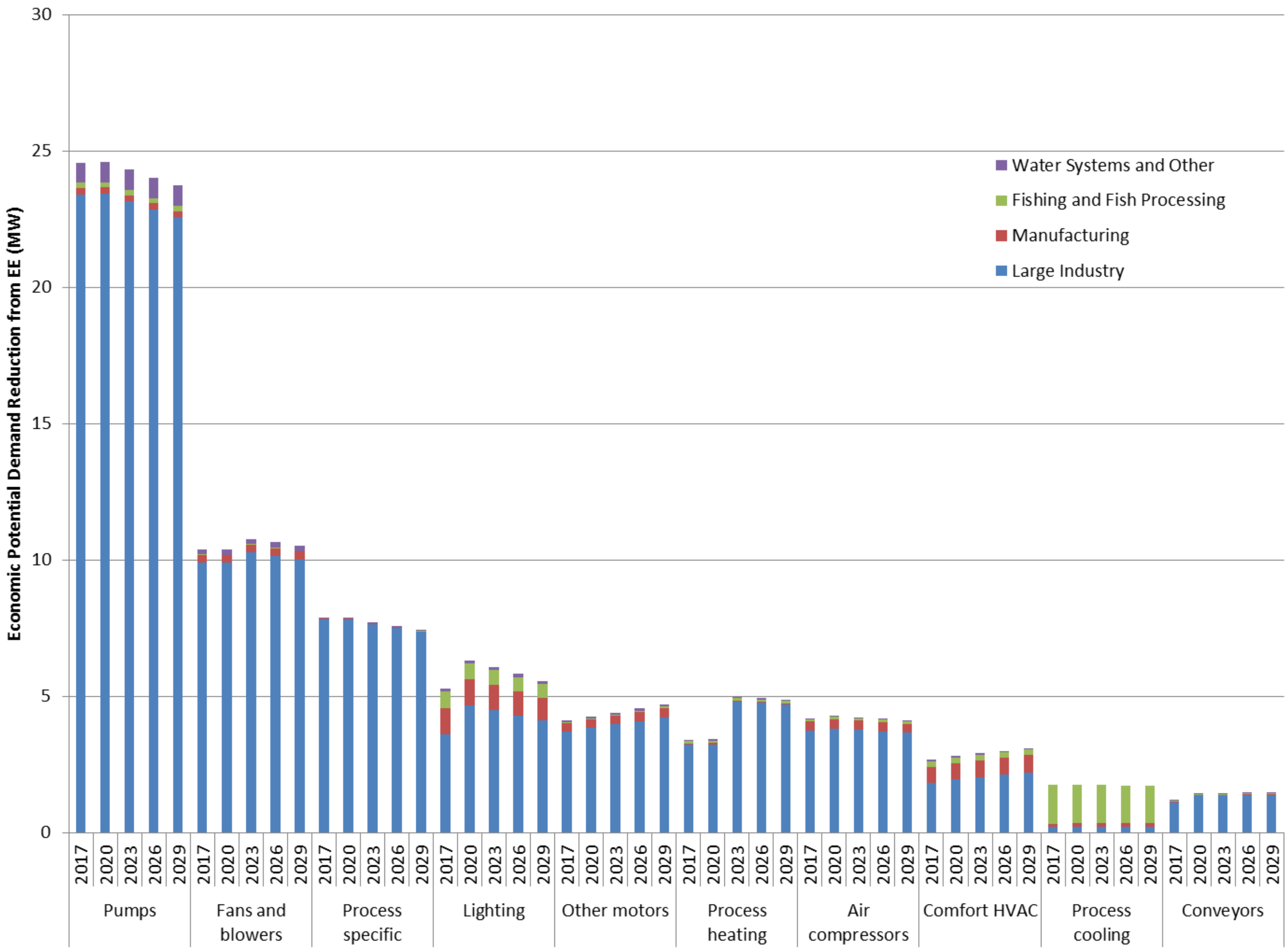


Exhibit 44 Electric Peak Load Reductions from Economic Energy Savings Measures for Small-Medium Industry, by Milestone Year, End Use, and Sub-Sector, Winter Peak Period (MW)

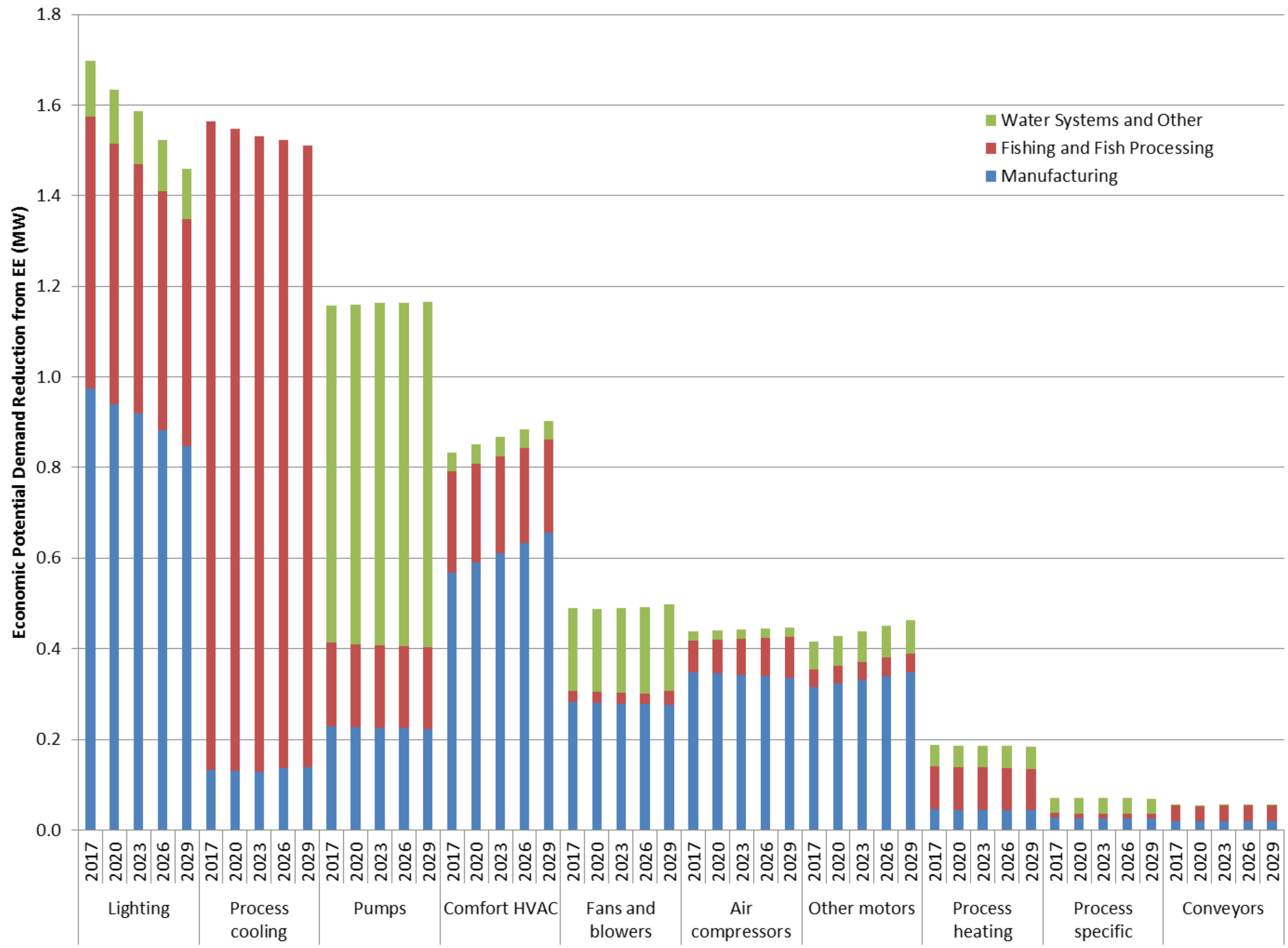


Exhibit 45 Electric Peak Load Reductions from Economic Energy Savings Measures, 2029 (MW)

Measure	All Regions
Premium Efficiency Pump Control with ASDs	9.0
Energy Management Information System (EMIS)	6.8
Optimization of Pumping System	5.9
Organizational Energy Management (EM Team)	4.9
Premium Efficiency Fan Control with ASDs	4.8
Correctly Sized Pumps: Impeller Trimming or Pump Selection	4.3
High Efficiency Lights (LEDs)	4.1
Sub-Metering	3.1
Operation and Maintenance (O&M) Program Supporting Efficiency	2.9
Process Heat Recovery to Preheat Makeup Water	2.0
Correctly Sized Fans: Impeller Trimming or Fan Selection	1.9
Integrated Plant Control System	1.8
Process Optimization Efforts - Pulp and Paper	1.3
Premium Efficiency ASD Compressor	1.2
Advanced 'Predictive' Process Control Systems	1.1
Air Leak Survey and Repair	1.1
Optimized Distribution System (Incl. Pressure Losses)	1.1
Optimized Motor Control	0.8
High-Efficiency Packaged HVAC	0.8
Optimized Distribution System (Incl. Pressure and Air End-Uses)	0.7
Premium Efficiency Pump Motor	0.7
Process Optimization Efforts - Mining and Processing	0.6
Insulation	0.6
Correctly Sized Motors	0.5
Reduced Temperature Settings	0.5
Premium Efficiency Motors	0.5
Automated Temperature Control	0.5
High-Efficiency Lighting Design	0.4
Automated Lighting Controls	0.4

Measure	All Regions
Premium Efficiency Motors for Fans and Blowers	0.3
Optimized Conveyor Motor Control	0.3
Premium Efficiency Refrigeration Control System and	0.3
Free Cooling	0.2
Use Cooler Air from Outside for Make Up Air	0.2
Premium Efficiency Conveyor Motors	0.2
High Efficiency Chiller	0.1
Heat Pumps	0.1
Improve Insulation of Refrigeration System	0.1
Synchronous Belts	0.1
Air Compressor Heat Recovery	0.1
Smart Defrost Controls	0.1
Optimized Sizes of Air Receiver Tanks	0.1
Optimized Distribution System	0.1
Chiller Economizer	0.1
Ventilation Optimization	0.1
Improved Ice Production System	0.1
Sequencing Control	0.0
Floating Head Pressure Controls	0.0
Air Curtains	0.0
High Efficiency Oven/Dryer/Furnace/Kiln	0.0
Ventilation Heat Recovery	0.0
Process Optimization Efforts - Fishing and Fish Proce	0.0
Warehouse Loading Dock Seals	0.0
Improved Building Insulation	-
HVAC Air Curtains	-
Process Optimization Efforts - Oil Refining	-
High Efficiency Water Heater	-
Grand Total	67

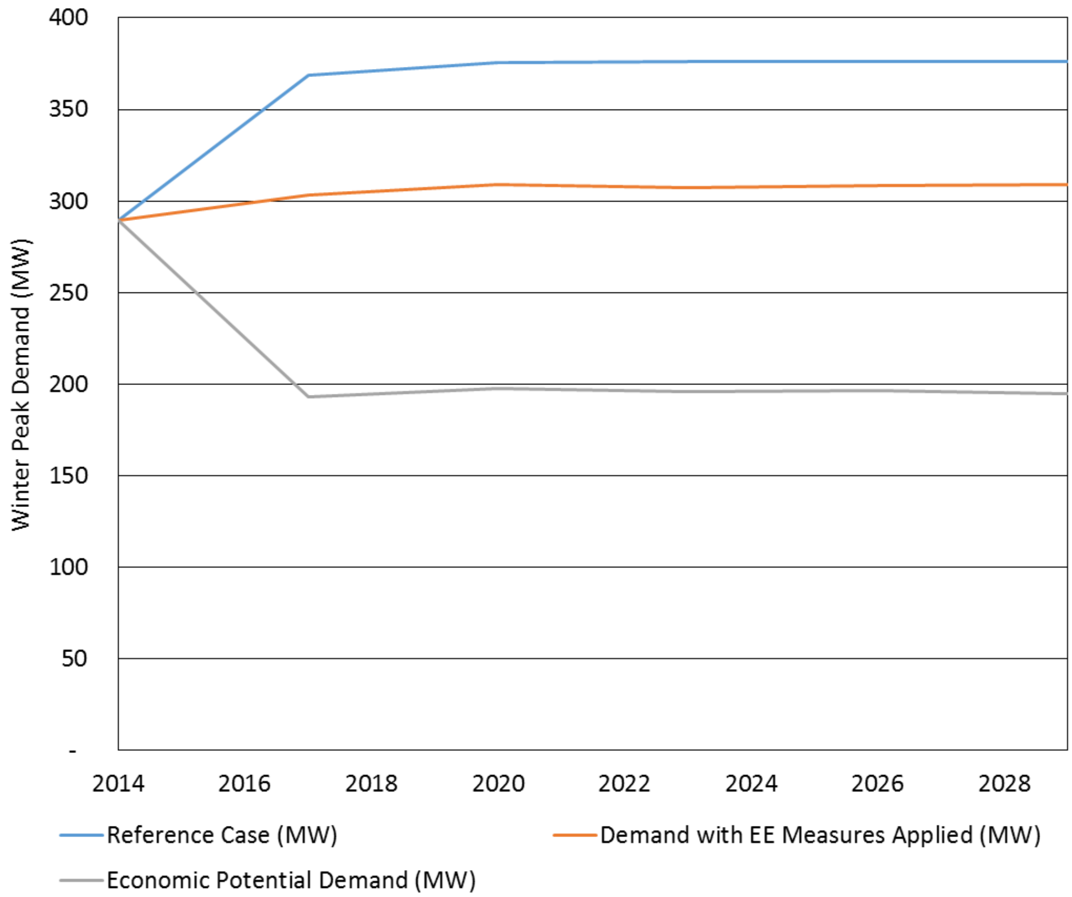
8.7 Summary of Peak Load Reduction

Exhibit 46 compares the Reference Case and Economic Potential Peak Demand Forecast levels of winter peak demand.[18] As illustrated, under the Reference Case industrial peak demand would grow from the Base Year level of 289 MW to approximately 376 MW by 2029. This contrasts with the Economic Potential Forecast in which peak demand would decrease to approximately 189 MW for the same period, a difference of approximately 187 MW or about 50%. The middle line on the chart shows the peak demand that would result if all the energy efficiency measures were applied but none of the demand reduction measures. As illustrated in the exhibit, approximately 36% of this reduction comes from the impact of energy efficiency measures.

As noted in Section 7.6, all of the demand reductions from Newfoundland Power's curtailment program will be captured in the Industrial report, including curtailment from some general service customers that would otherwise be classified as 'commercial' facilities in this study. These 'non-industrial' peak demand curtailments are included with reductions for the manufacturing sub-sector. As such, the results for this sub-sector will overestimate the potential curtailment specific to that sub-sector when these results are considered in isolation.

[18] All results are reported at the customer's point-of-use and do not include line losses.

Exhibit 46 Reference Case Peak Demand versus Economic Potential Peak Demand in Industrial Sector (MW)



8.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Economic Potential Forecast is provided in the following exhibits:[19]

- Exhibit 47 presents the results by end use, sub-sector and milestone year
- Exhibit 48 provides a further disaggregation of the peak demand reduction by technology and milestone year
- Exhibit 49 presents peak demand reduction by major end use, milestone year and sub-sector
- Exhibit 50 presents peak demand reduction by major end use, milestone year and sub-sector, for small-medium industry

[19] MW reductions shown in the following exhibits are not incremental. For example, the process heating reductions in 2029 are not in addition to the process heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case process heating peak demand in 2029 and the process heating peak demand if all the measures included in the Economic Potential scenario are implemented.

Exhibit 47 Total Economic Potential Peak Demand Reduction by End Use, Sub-Sector, and Milestone Year (MW)

Sub-Sectors	Year	Air comp-ressors	Comfort HVAC	Convey-ors	Fans and blowers	Lighting	Other motors	Process cooling	Process heating	Process specific	Pumps	Grand Total
Large Industry	2017	1	2	1	3	1	7	0	19	51	14	98
	2020	1	2	1	3	1	7	0	18	51	14	99
	2023	1	2	1	3	1	7	0	18	51	15	99
	2026	1	2	1	3	1	7	0	19	52	15	99
	2029	1	2	1	3	1	7	0	21	52	15	102
Manufacturing	2017	0	3	0	0	1	2	0	0	0	0	8
	2020	0	3	0	0	1	2	0	0	0	0	8
	2023	0	3	0	0	1	2	0	0	0	0	8
	2026	0	3	0	0	1	2	0	0	0	0	8
	2029	0	3	0	0	1	2	0	0	0	0	8
Fishing and Fish Processing	2017	0	0	0	0	0	0	1	0	0	0	1
	2020	0	0	0	0	0	0	1	0	0	0	1
	2023	0	0	0	0	0	0	1	0	0	0	1
	2026	0	0	0	0	0	0	1	0	0	0	1
	2029	0	0	0	0	0	0	1	0	0	0	1
Water Systems and Other	2017	0	0	0	0	0	0	0	0	0	2	3
	2020	0	0	0	0	0	0	0	0	0	2	3
	2023	0	0	0	0	0	0	0	0	0	2	4
	2026	0	0	0	0	0	0	0	0	0	2	4
	2029	0	0	0	0	0	0	0	0	0	2	4
Grand Total	**2017**	1	5	1	3	1	9	2	20	51	16	110
	2020	2	5	1	3	2	9	2	19	52	17	111
	2023	2	5	1	3	2	9	2	19	52	17	112
	2026	2	5	1	3	2	9	2	19	52	17	112
	2029	2	5	1	3	2	9	2	22	52	17	114

Notes:
1) The values in this exhibit do not include peak demand reductions from energy efficiency measures.
2) The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered 'commercial' facilities.
3) Results are measured at the customer's point-of-use and do not include line losses.
4) Any differences in totals are due to rounding.
5) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
6) MW reductions are not incremental. The process heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case process heating peak demand in 2029 and the process heating peak demand if all the measures included in the Economic Potential scenario are implemented.

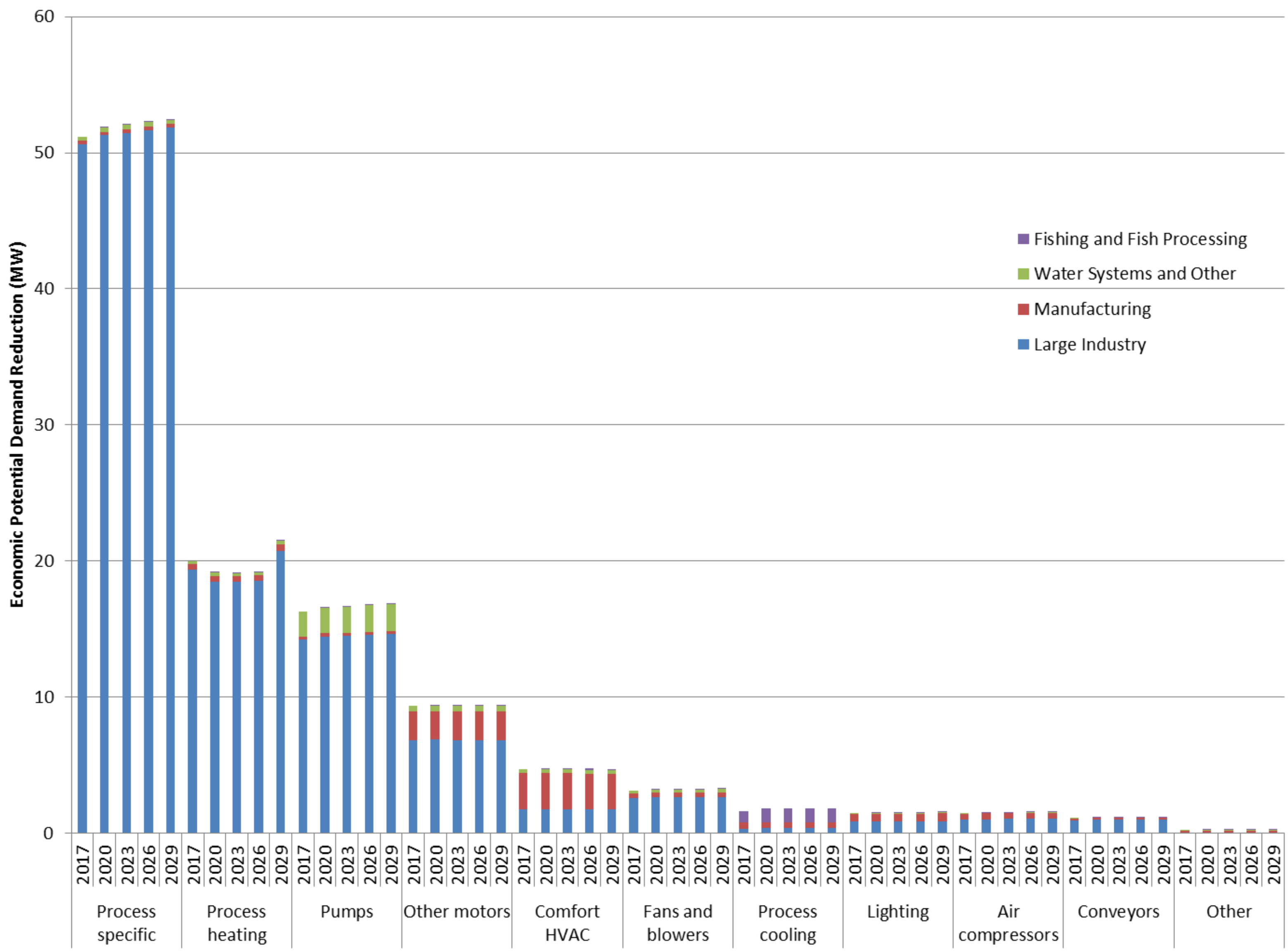
Exhibit 48 Economic Potential Peak Demand Reduction by Measure and Milestone Year (MW)

Measure	Peak Demand Reduction, 2017 (MW)	Peak Demand Reduction 2020 (MW)	Peak Demand Reduction 2023 (MW)	Peak Demand Reduction 2026 (MW)	Peak Demand Reduction 2029 (MW)
Operational changes for reduced peak load (DR Curtailments)	103	104	103	104	106
Power factor correction equipment	6	7	7	7	7
Peak Shifting through on-site storage	1	1	2	2	2
Grand Total	110	111	112	112	114

As with some previous conservation exhibits, Exhibit 48 provides results at a sufficient level of detail that some modeling issues require explanation:

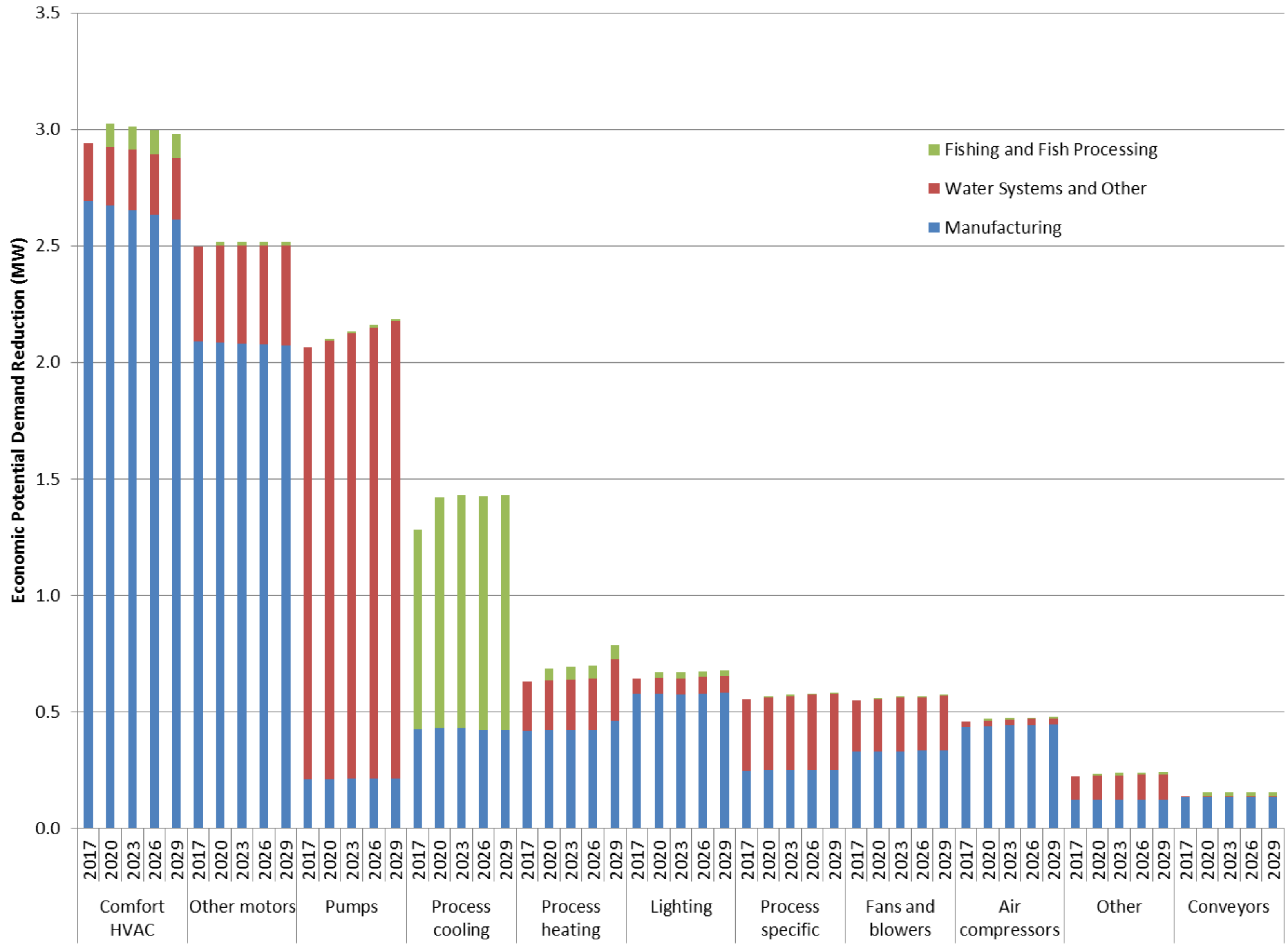
- Demand-specific measure savings are impacted by the demand savings from conservation measures. The demand reference case to which demand-specific measures are applied already factors in the corresponding Economic Potential demand savings from conservation measures. So the more peak demand reductions are generated through conservation measures, the less peak demand remains for demand-specific measures to reduce.
- This is particularly noteworthy for the curtailment demand measure, since cascading impacts could reduce the demand reduction levels shown here below what is expected based on current peak demand reduction arrangements. It is important to note that the model produce total demand reduction potentials in excessive of current curtailment arrangements, but that the model's cascade order will result in more of the total demand reduction potential being credited towards conservation measures and the demand-specific measures that precede curtailment in the cascade order.

Exhibit 49 Economic Potential Peak Demand Reduction by Major End Use, Year and Sub-Sector (MW)



Note: The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered ‘commercial’ facilities.

Exhibit 50 Economic Potential Peak Demand Reduction for Small-Medium Industry, by Major End Use, Year and Sub-Sector (MW)



Note: The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered 'commercial' facilities.

8.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Measure

The largest portion of peak demand reductions is from a demand response curtailment program. This represents 93% of the peak reductions achieved by demand-specific measures. Power factor correction equipment accounts for about 6% of the remaining demand-specific measure reductions, with remainder coming from peak shifting / storage measures.

Peak Demand Reduction by Milestone Year

The Economic Potential peak load reductions increase very little, rising from 110 MW in 2017 to 114 MW in 2029. Approximately 96% of the peak reduction possible at the end of the study period is already economically viable within the first milestone period. Most of the measures pass the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year.

Peak Demand Reduction by Sub-sector

Large industry account for 89% of the potential peak load reductions; this reflects their larger share of industrial energy consumption, and their suitability for demand measures. Peak load reductions in the manufacturing sub-sector account for 7% of the potential savings, however a significant portion of these savings can be attributed to general service customers participating in Newfoundland Power's curtailment program, which are captured here but otherwise considered 'commercial' facilities in this study. Peak load reductions in water systems & other industrial facilities account for 3% of the potential savings. Peak load reductions in fishing and fish processing facilities account for 1% of the potential savings.

Peak Demand Reduction by End Use

Process specific load reductions account for approximately 46% of the total load reductions in the Economic Potential Forecast, not including load reductions from energy efficiency measures. Other motors account for 8% of the total load reduction, pumps account for 15%, and process heating accounts for 18%. The remaining 13% of the total load reduction is from fans and blowers, conveyors, HVAC, air compressors, lighting, and process cooling. These divisions are largely driven by the breakdown of energy consumption in each sub-sector, as most of the demand measures are applied at the system level (to all end-uses).

8.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Economic Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

Exhibit 51 shows that the industrial results are not sensitive to this range of avoided costs, as results remain similar in each scenario. By 2029, the exhibit shows almost unchanged energy savings and demand reductions in both upper and lower ranges. The lack of change in energy savings potential with different avoided costs is mainly because the cost of conserved energy for most industrial measures is well below the avoided costs in all three scenarios. This was illustrated by the supply curves in Sections 7.5 and 7.6.

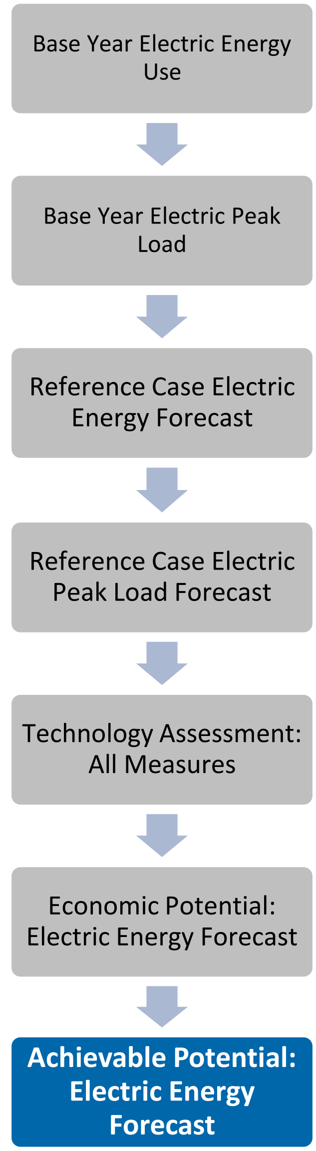
Exhibit 51 Sensitivity of the Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
All Regions	2017	703,176	175	709,454	176	750,447	180
	2020	712,998	177	729,182	178	752,776	181
	2023	725,967	178	742,937	180	745,329	180
	2026	732,749	179	735,465	180	737,832	180
	2029	725,334	181	728,050	182	730,325	182

The Data Manager file contains a sensitivity analysis by region, with similar findings that there are only small variations between scenarios in all regions. The results from the regional sensitivity analysis show the following changes in potential:

- The lower range of reasonableness produces energy savings that are 1% lower in the Island Interconnected region and almost unchanged in the Labrador and Isolated regions.
- The lower range of reasonableness produces peak demand savings that are almost unchanged in all regions.
- The upper range of reasonableness produces energy savings that are around 1% higher in the Island Interconnected region, around 2% higher in the Isolated region, and almost unchanged in the Labrador region.
- The upper and lower ranges of reasonableness produce peak demand reductions that are almost unchanged in all regions.
- The upper range of reasonableness produces peak demand savings that are around 2% higher in the Isolated region, and almost unchanged in the Island and Labrador regions.

9 Achievable Potential: Electric Energy Forecast



9.1 Introduction

This section presents the Industrial sector Achievable Potential for the study period (2014 to 2029). The Achievable Potential is defined as the proportion of the energy-efficiency opportunities identified in the Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to the estimation of Achievable Potential
- Achievable Potential Workshop results
- Summary of potential electric energy savings
- Electric peak load reductions for energy efficiency measures
- Summary of peak load reductions
- Sensitivity of the results to changes in avoided cost
- Description of the application of net-to-gross ratios.

9.2 Description of Achievable Potential

Achievable Potential recognizes that, in many instances, it is difficult to induce all customers to purchase and install all the energy-efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

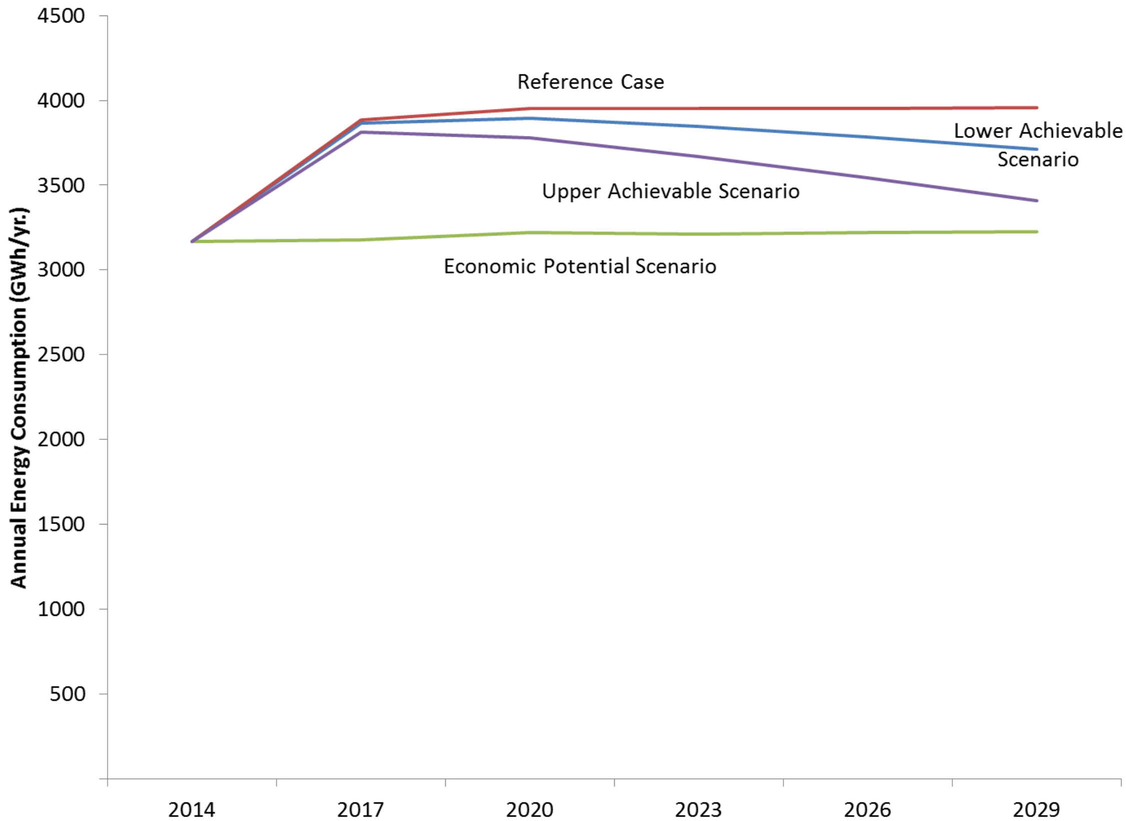
- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability.

The rate at which customers accept and purchase energy-efficiency products will be influenced by the level of financial incentives, information and other measures put in place by the Utilities and the Government of Newfoundland, other levels of government, and the private sector to remove barriers such as those noted above.

Exhibit 52 presents the levels of electricity consumption that are estimated in the Achievable Potential scenario. As illustrated, the Achievable Potential scenarios are banded by the two forecasts presented in previous sections: the Economic Potential Forecast and the Reference Case.

As illustrated in Exhibit 52 electric energy savings under the Achievable Potential scenario are less than in the Economic Potential Forecast. In this CDM study, the primary factor that contributes to the outcome shown in Exhibit 52 is the rate of market penetration. In the Economic Potential Forecast, efficient new technologies are assumed to fully penetrate the market as soon as it is economically attractive to do so. However, the Achievable Potential recognizes that under real world conditions, the rate at which customers are likely to implement new technologies will be influenced by additional practical considerations and will, therefore, occur more slowly than under the assumptions employed in the Economic Potential Forecast.

Exhibit 52 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Industrial Sector (GWh/yr.)



As also illustrated in Exhibit 52 the Achievable Potential results are presented as a band of possibilities, rather than a single line. This is because any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty. Consequently, two Achievable Potential scenarios are presented: lower and upper.

The lower Achievable Potential assumes NL market conditions that are similar to those contained in the Reference Case. That is, the customers' awareness of energy-efficiency options and their motivation levels remain similar to those in the recent past, technology improvements continue at historical levels, and new energy performance standards continue as per current known schedules. It also assumes that the ability of the NL utilities to influence customers' decisions towards increased investments in energy-efficiency options remains roughly in line with previous CDM experience.

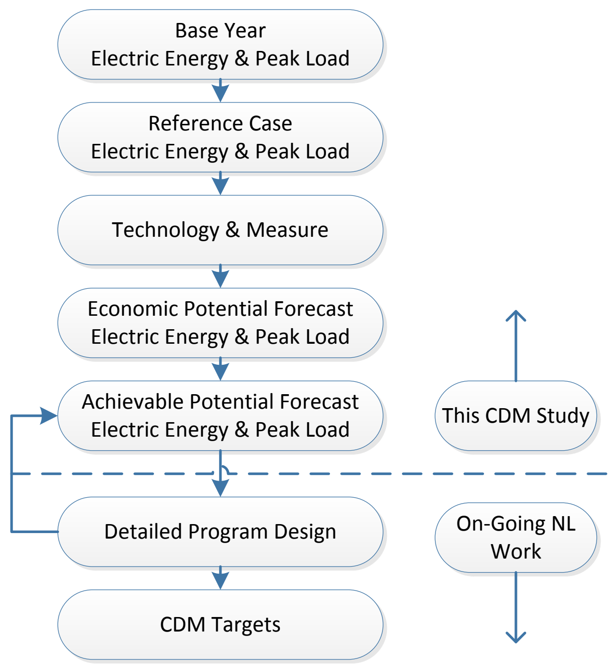
The upper Achievable Potential assumes NL market conditions that aggressively support investment in energy efficiency. For example, this scenario assumes that real electricity prices increase over the study period. It also assumes that federal and provincial government actions to mitigate climate change result in increased levels of complementary energy-efficiency initiatives. The upper Achievable Potential typically does not reach economic potential levels; this recognizes that some portion of the market is typically constrained by barriers that cannot realistically be affected by CDM programs within the study period.

9.2.1 Achievable Potential versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.

Exhibit 53 illustrates the relationship between Achievable Potential and the more detailed program design.

Exhibit 53 Achievable Potential versus Detailed Program Design



This study examined more than 50 technologies applicable to industrial electric end uses. Although considerable effort has been made to obtain up-to-date information on each technology and to tailor it to the local market in Newfoundland, this is not a substitute for the type of detailed groundwork needed to prepare a utility program. For each of the technologies selected for further investigation, it will be important to obtain further information on the technical viability and durability of the products in the Newfoundland climate, on the costs in the Newfoundland marketplace, and on real savings under local conditions. If the viability of the technology is confirmed, an assessment of the market barriers is required, leading to the development of program strategies to overcome these barriers.

9.3 Approach to the Estimation of Achievable Potential

Achievable Potential was estimated in a five-step approach.

- Priority opportunities were selected
- Opportunity profiles were created
- Opportunity worksheets were prepared
- A full-day workshop was held

- Workshop results were aggregated and applied along with information from additional sources to the remaining opportunities.

Further discussion is provided below.

Step 1 Select Priority Opportunities

The first step in developing the Achievable Potential estimates required selection of the energy-saving opportunities identified in the Economic Potential Forecasts to be discussed during the Achievable workshop. The workshop was targeted towards Utility customers that are not transmission-connected. The main focus was on the larger customers in the small-medium sub-sectors, as well as mining customers that are not transmission-connected. For these customers, several criteria determined selection, including:

- The priority measures should represent several different energy end uses
- The priority measures should assist in discussing and understanding the achievable potential for other measures in the same end use
- The priority measures should represent a significant portion of the overall economic potential
- The priority measures should have a variety of different likely patterns of market adoption, so the discussions will be widely varied.

A summary of the selected energy-efficiency actions, along with the approximate percentage that it represents in the Economic Potential Forecast for small-medium sub-sectors, is provided in Exhibit 54.

Exhibit 54 Industrial Sector Actions – Energy Efficiency

Measure #	Measure	End Use	Percentage of 2029 Economic Potential [20]	
			Consumption Savings	Demand Savings [21]
I-1	LED Lighting	Lighting	12.4%	0%
I-2	Optimization of Pumping Systems	Pumping	5%	0%
I-3	Roving Energy Managers	System (all)	7.3%	0%
I-4	Premium Efficiency Refrigeration Control Systems and Compressor Sequencing	Process Cooling / Refrigeration / Freezing	3.7%	0%
I-5*	Demand Response Curtailments	System (all) *	0%	93%
I-6	Optimization of Compressed Air Distribution Systems and End-uses	Compressed Air	0.9%	0%
I-7	Optimized Motor Control	Other Motors	1.6%	0%
I-8	Process Heat Recovery for HVAC	HVAC	0.6%	0%
Total			**31.5%**	**93%**

* Demand (kW) measures

Step 2 Create Opportunity Assessment Profiles

The next step involved the development of brief profiles for each of the opportunities noted above in Exhibit 54, in the form of PowerPoint slides. The slides are presented in Appendix G.

[20] Economic potential results for small-medium sub-sectors.
[21] Portion of savings from demand-specific measures only. Demand savings from EE measures not compared here.

The purpose of the opportunity profiles was to provide a high-level logic framework that would serve as a guide for participant discussions in the Achievable workshop (see Step 4 below). The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project. As illustrated in Appendix G, each opportunity profile addresses the following areas:

- **Technology Description** – provides a summary statement of the broad goal and rationale for the action.
- **Target Sub-Sector Type and Typical Application —** highlights the sub-sectors and applications offering the most significant opportunities, and which provide a good starting point for discussion of the technology.
- **Financial and Economic Indicators —** provides estimates of average simple payback, cost of conserved electricity (CCE) and basis of assessment (full-cost versus incremental).
- **Eligible Participants —** provides the reference case 2029 energy consumption for this end use and an estimate of the technical applicability of the measure, which gives some context to the potential savings from the measure.
- **Economic Potential versus Time —** shows the pattern of the changing size of the opportunity over the study period. Most industrial opportunities are economic to capture immediately, so growth over time is limited to other measures that are implemented at equipment end of life. Also, opportunities decline with time as they are eroded by natural conservation activities.

Step 3 Prepare Opportunity Worksheets

A draft assessment worksheet was also prepared for each opportunity profile in advance of the Achievable workshop. The assessment worksheets complemented the information contained in the opportunity profiles by providing quantitative data on the potential electric energy savings for each opportunity as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

The worksheets, including the results recorded during the workshop discussions, are provided in Appendix H. As illustrated in Appendix H, each opportunity assessment worksheet addresses the following areas:

- **Approximate Cost of Conserved Electricity —** shows the approximate levelized cost of saving each kWh of electricity saved by the measure. For the purposes of the workshop, this information provided participants with an indication of the scope for using financial incentives to influence customer participation rates.
- **Customer Payback —** shows the simple payback from the customer's perspective for the package of energy-efficiency measures included in the opportunity. This information provided an indication of the level of attractiveness that the opportunity would present to customers.
- **Economic Potential in Terms of Consumption (MWh) —** shows the total consumption that could theoretically be targeted by the opportunity, and provides the savings percentage being considered for this measure.

- **Participation Rates (%) —** these fields were filled in during the workshops (described below in the following step), based on input from the participants. They show the percentage of economic savings that workshop participants concluded could be achievable in the last milestone period.

- **Achievable Potential in Terms of Consumption Savings (MWh) —** these fields were calculated by the spreadsheet based on the participation rates provided by the participants.

- **Participation Rates Relative to the Discussion Scenario —** these fields were filled in during the workshops to provide guidance to the consulting team on how participation might differ in other regions or sub-sectors, or for related or similar technologies.

- **Other Parameters —** these fields were filled in during the workshop to capture highlights of the discussion.

Step 4 Conduct Achievable Workshop

The most critical step in developing the estimates of Achievable Potential was a one-day Achievable Potential workshop that was held on April 23, 2015. Workshop participants consisted of core members of the consultant team, CDM program and technical personnel from the Utilities, industry representatives, and representatives of other stakeholders. Together, the participating personnel brought many years of experience to the workshop related to the technologies and markets.

The purpose of this workshop was to:

- Promote discussion regarding the technical and market constraints confronting the identified energy-efficiency opportunities
- Identify potential strategies for addressing the identified constraints, including potential partners and delivery channels
- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

Following a brief consultant presentation that summarized the Industrial sector study results to date, the workshop provided a structured assessment of each of the selected opportunities. Opportunity assessment consisted of a facilitated discussion of the key elements affecting successful promotion and implementation of the CDM opportunity. More specifically:

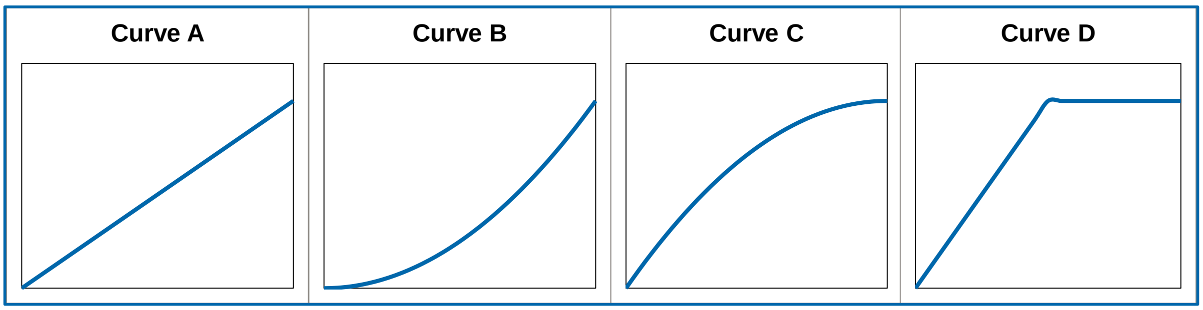
- What are the major constraints/challenges constraining customer adoption of the identified energy-efficiency opportunities?
  - How big is the “won’t” portion of the market for this opportunity?
- Preferred strategies and potential partners for addressing identified constraints (high level only)
  - Key criteria that determine customers’ willingness to proceed
  - Key potential channel partners
  - Optimum intervention strategies e.g., push, pull, combination
  - How sensitive is this opportunity to incentive levels?

Following discussion of market constraints and potential intervention strategies, the participants’ views on potential participation rates were recorded. The process involved the following steps:

- The participation rate for the upper Achievable scenario in 2029 was estimated.
- The shape of the adoption curve was selected for the upper Achievable scenario. Rather than seek consensus on the specific values to be employed in each of the intervening years, workshop participants selected one of four curve shapes that best matched their view of the appropriate “ramp-up” rate for each opportunity (see Exhibit 55 below).

- The process was then repeated for the lower Achievable scenario.
- Once participation rates had been established for the specific technology, sub-sector and service region selected for the opportunity discussion, workshop participants provided the consultants with guidelines for extrapolating the discussion results to the other sub-sectors and service regions included in the opportunity, but not discussed in detail during the workshop. Where time permitted, participants also discussed how the adoption of similar, related technologies might differ from the technology being discussed.

Exhibit 55 Participation Rate "Ramp Up" Curves



Curve A represents a steady increase in the expected participation rate over the study period

Curve B represents a relatively slow participation rate during the first half of the study period followed by a rapid growth in participation during the second half of the 15-year study period

Curve C represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the study period

Curve D represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first half of the study period.

Step 5 Aggregate and Extend Opportunity Results

The final step involved aggregating and applying the results of the individual opportunities, along with information from additional sources, to the remaining opportunities to provide a view of the potential Achievable in the Industrial sector.

9.4 Achievable Workshop Results

The following sub-sections present a summary of the workshop discussions for each of the industrial opportunities listed in Exhibit 54 above. The adoption rates and curves selected by the participant are summarized in Section 9.4.10. Included for each opportunity are:

- Participation estimates (for 2029) made by workshop participants, with comments, where needed, about values assumed in the calculations (presented in Section 9.5)
- Where needed, additional participation estimates made after the workshop for the purposes of the calculations (presented in Section 9.5)
- Selected highlights that attempt to capture key discussion themes related to the opportunity.

Appendix H provides copies of the assessment worksheets used during the workshop.

9.4.1 Cross-Cutting Barriers and Strategies

This section presents barriers and strategies that apply broadly to industrial energy efficiency measures in Newfoundland and Labrador. Many of the barriers and challenges cited by workshop participants in the measure discussions applied to most other measures as well, and were often repeated. Many of the potential strategies and solutions discussed were also broadly applicable to industrial energy efficiency opportunities. So, this section presents some of the recurring themes from the workshop, while some opportunity specific barriers and challenges are noted in the ensuing sections.

Barriers and Challenges:

- **Capital costs** – energy efficiency investments compete with other production investments and low paybacks are required for action.
- **Competing priorities** – industry is often focused on production and not considering energy consumption. Many facilities do not have the technical staff to identify, quantify, and act on energy efficiency opportunities.
- **Awareness** – energy are bills often just accepted, without recognizing energy waste as an issue that can be improved. Even when people know of a particular technology, they do not often understand the potential savings.
- **Isolated communities** – significant travel distances and expenses to some isolated Labrador and Island communities make it harder to get the contractors, equipment, and personnel required to support energy efficiency.
- **Key decision makers** – plant employees understanding that there is an opportunity to improve energy consumption is not enough to drive adoption. Key upper management decision makers need to be informed about the opportunities and trust in the business cases presented to them.

Strategies and Solutions:

- **Improved programming options** – utilities can leverage new program strategies to overcome barriers, such as simplified application processes, direct install / “boots on the ground” programs, larger incentives, and roving energy managers.
- **Increased technical support** – utilities should facilitate increased external technical support for facilities. There is a need for support identifying the key opportunities for improvement specific to individual facilities. This could include energy audits, engineering studies, support justifying business case, and support installing equipment. This could include working through trade allies, contractors, and vendors.
- **Success stories** – utilities need to demonstrate projects, develop case studies, and recognize company achievements. Real life people telling real life success stories. This also gives an opportunity to promote non-energy benefits of many retrofits, such as O&M costs, reliability, safety, improved lighting quality, production, power quality.
- **Trusted broker** – utilities should try to become a “trusted broker” and a one-stop shop for industry to help overcome industry concerns with equipment standards, power quality, production, reliability, prequalification of products and contractors etc.

- **Build relationships and partnerships** – increased outreach to large customers and contact with the key decision makers to put energy management on their radar. Partnerships with industry associations can also help support industry in achieving energy efficiency goals.

- **Education and training -** opportunity for increased energy awareness through education and training for industry, operators, and channel partners.

9.4.2 LED Lighting

Achievable workshop participants provided 2029 participation rate estimates of 95% for the upper Achievable Potential scenario and 85% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in the upper Achievable Potential scenario would be C, while in the lower Achievable Potential scenario it would most likely be A. These high expectations for LED lighting reflect the participants' views on the technology's strong momentum; backed by significant cost-effective savings, distributor support, and customer demand.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that there is generally an awareness of LED lighting opportunities, but the upfront costs remain prohibitive. It was indicated however that the trend is strongly towards LEDs and that distributors will be pushing these instead of fixtures like metal halides, which may not even be available anymore. The cost of an electrician to come out and put up the lights was another barrier cited, with strong preferences towards simplified incentive program applications and direct install programs.

The initial discussion focused on the Manufacturing sub-sector on the Island. Participants believed participation would be similar for Fishing and Fish Processing as well as Mining and Processing, and maybe slightly lower for Water Systems and Other. Participants expected that participation in Labrador would be similar to the Island, but lower for the Isolated regions where availability of electricians and costs of materials are more prohibitive. Participants also discussed some of the other lighting measures briefly. Automated lighting controls were thought to likely proceed slightly below LED levels, and high efficiency lighting design was expected to be adopted less frequently than LEDs.

9.4.3 Optimization of Pumping Systems

Achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 10% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be B. This wide gap between upper and lower Achievable Potential levels represents participant expectations that more aggressive CDM strategies, including significant technical support, could make significant inroads towards improving pumping efficiency, but that current CDM programs fail to overcome significant barriers such as lack of understanding or awareness of the opportunity.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that a lot of people do not understand their actual pumping requirements. Furthermore, there is a lot of overdesign in pumping systems, since no one complains about overdesign but under design risks process failure. Technical support to provide facilities with a better understanding of the pumping optimization opportunities specific to their facility was seen as an important area for improvement. Some pump suppliers will provide such information, but industry typically prefers unbiased opinions. It was also noted that VFDs are often used in pumping systems to cover up aspects of poor system design.

The initial discussion focused on the Water Systems and Other sub-sector on the Island. Participants believed participation would be similar for Fishing and Fish Processing as well as Manufacturing, and higher for Mining and Processing. Participants expected that participation in Labrador would be similar to the Island, but lower for the Isolated regions, where logistics are an issue. Participants also discussed some of the other pumping measures briefly. Pump control with ASDs was expected to achieve higher participation rates, premium efficiency pump motors were thought likely to proceed similarly to pumping optimization levels, and correctly sizing pumps was expected to be implemented less frequently.

9.4.4 Roving Energy Managers

Achievable workshop participants provided 2029 participation rate estimates of 70% for the upper Achievable Potential scenario and 0% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in the upper Achievable Potential scenario would be B. This wide gap between upper and lower achievable potential levels represents participant expectations that a new program to provide industry energy management personnel support would be well received, but that this level of support does not exist in current CDM programs.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that only a handful of companies on the island would hire someone for energy management on their own. However, participants felt that many facilities would participate if they had access to shared energy managers through the Utilities. It was also noted that as plants interact with energy managers, their awareness of energy management will grow, and their adoption of energy efficiency practices will progress more naturally. One potential challenge cited by participants was the availability of qualified people to fill these roles, as many of the people in the province who would be a good fit might not be interested in leaving their current employment. Training opportunities could be offered to help develop a larger pool of potential energy managers.

The initial discussion focused on the Fishing and Fish Processing sub-sector on the Island. Participants believed participation would be similar for other sub-sectors. Participants expected that participation in Labrador might be lower than the Island, and much lower for the Isolated regions, given that these regions are more difficult to access. Participants also discussed some of the other system-level measures briefly. Operation and maintenance (O&M) programs for efficiency were thought likely to achieve lower levels than roving energy managers, while expectations for adoption of sub-metering, EMIS systems, and integrated plant control systems was much lower.

9.4.5 Premium Efficiency Refrigeration Control and Compressor Sequencing

Achievable workshop participants provided 2029 participation rate estimates of 60% for the upper Achievable Potential scenario and 15% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be B. These expectations for upgrades to refrigeration control systems reflect that a significant portion of industry will resist changing this technology, but also acknowledge that there is some department of fisheries money going into this already.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that the transition to newer refrigeration control systems requires significant efforts to make operators comfortable with the newer technology. Operators are comfortable with the old technology, which are relatively easy to understand, and find newer computer-based systems harder to use. People resist change, and are hesitant to change something critical to the facility that they know works and is reliable. It was also noted that a careful approach must be taken to convince people it works, but not insult their previous ways. To succeed here, participants recommended a good hands-on training program for operators.

The initial discussion focused on the Fishing and Fish Processing sub-sector on the Island. Participants believed participation would be similar for other sub-sectors. Participants expected that participation in Labrador might be lower than the Island, and significantly lower for the Isolated regions, given that these regions are more remote. Participants also discussed some of the other refrigeration measures briefly. High efficiency VFD chillers were thought likely to achieve higher levels of adoption; floating head pressure controls and smart defrost controls were expected to reach similar levels of adoption; and improved ice production systems were expected to be adopted less.

9.4.6 Demand Response Curtailments

Achievable workshop participants provided 2029 participation rate estimates of 15% for the upper Achievable Potential scenario and 5% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in the upper Achievable Potential scenario would be B, while the lower Achievable Potential scenario adoption curve was selected as D, to reflect that some facilities are already participating in a demand curtailment program.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that back-up power does not usually cover 100% of a facility's requirements, and that dated transfer switches not intended for frequent use can also reduce a facility's ability to participate. It was noted that higher incentives could make participation more valuable and increase uptake. Another approach could be to help assess ways through which specific facilities could participate.

The initial discussion focused on the Manufacturing sub-sector on the Island. Participants believed participation for Water Systems based on facility size (larger facilities in St. Johns already participating), would be much lower for Mining and Processing, and not applicable to Fishing and Fish Processing. Participants also discussed some of the other demand reduction measures briefly. Peak shifting through on-site storage was thought likely to proceed similarly to DR curtailments, while power factor correction equipment was expected to have higher potential for adoption.

9.4.7 Optimization of Compressed Air Distribution Systems and End-uses

Achievable workshop participants provided 2029 participation rate estimates of 90% for the upper Achievable Potential scenario and 20% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be A. This wide gap between upper and lower achievable potential levels again represents participant expectations that more aggressive CDM strategies could achieve significantly more adoption.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that there is often a perception in industry that compressed air is free. Additionally, even facilities that understand there are likely opportunities to improve their compressed air system often lack the details required to prioritize and justify retrofit decisions. Participants felt that a direct approach to technical support is required, such as a compressed air audit program.

The initial discussion focused on the Mining and Processing sub-sector on the Island. Participants believed participation would be similar for all other sub-sectors. Participants expected that participation in Labrador would be similar to the Island, but lower for the Isolated regions where travel would be a barrier to compressed air auditors. Participants also discussed some of the other compressed air measures briefly. Participants felt that low capital cost measures like air leak surveys and repair, and using cooler air from outside for makeup air, would achieve similar levels of adoption. While higher capital cost measures like ASD compressors, optimized air receiver tanks, and sequencing controls would achieve low levels of adoption.

9.4.8 Optimized Motor Control

Achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 15% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in the upper Achievable Potential scenario would be A, while in the lower Achievable Potential scenario it would most likely be B. This wide gap between upper and lower achievable potential levels represents participant views that there is fairly low uptake as of now, and significant capital costs to overcome, but that the technology is mature and customers are interested in adopting it.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that supply channels and awareness of VFDs are well developed, but that some issues persist. For example, VFDs are sometimes incorrectly assumed to be the solution to a facility's problems, and the vendor is unlikely to turn down a customer asking for a VFD. Participants felt that Utility support at the commissioning stage would help support more effective implementation of the technology, and that lists of qualified suppliers would also be useful.

The initial discussion focused on the Manufacturing sub-sector on the Island. Participants believed participation would be similar for all other sub-sectors. Participants expected that participation in Labrador would be similar to the Island, but lower for the Isolated. Participants also discussed some of the other motor measures briefly. Correctly sized motors through a maintenance program, conveyor motor controls, and fan ASDs were all expected to achieve similar levels of adoption to optimized motor control. Premium efficiency motors were expected to achieve higher levels of adoption than optimized motor control.

9.4.9 Process Heat Recovery for HVAC

Achievable workshop participants provided 2029 participation rate estimates of 50% for the upper Achievable Potential scenario and 10% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be A. These expectations reflect that there is fairly low uptake as of now for this relatively mature opportunity, but that it might be possible to overcome some of the awareness hurdles through new program elements. The adoption levels here also factor in that the applicability for this measure is relatively low, meaning that many facilities where this would not be technically feasible have already been filtered out separately.

In addition to the cross-cutting barriers and strategies noted above in Section 9.4.1, workshop participants noted that the potential for recovering heat from air compressors largely depends on the existing layout of compressors within the facility, and as such is more common in new builds. The source and consistency of waste heat supply through seasonal temperature changes was also identified as an important consideration. A barrier highlighted by participants for HVAC measures in general was the lack of understanding of the concept of wasted energy, and that they can take steps to reduce their energy bill. Strategies suggested by participants included HVAC opportunity assessments, as well as more generally getting customers to re-consider their HVAC systems and not simply accept the status quo.

The initial discussion focused on the Manufacturing sub-sector on the Island. Participants believed participation would be similar for all other sub-sectors. Participants expected that participation in Labrador would be the similar to the Island, but lower for the Isolated. Participants also discussed some of the other HVAC measures briefly. Automated temperature controls and reduced temperature settings were expected to achieve higher levels of adoption than process heat recovery, while high-efficiency HVAC systems were expected to have similar adoption levels to process heat recovery. Ventilation optimization, ventilation heat recovery, warehouse loading seals, improved building insulation, and HVAC air curtains were all expected to have lower participation rates.

9.4.10 Aggregate Results

Exhibit 56 summarizes the participant rate and “ramp up” curve assumptions discussed above.

Exhibit 56 Summary of Achievable Potential Participation Rates and Curves

	Lower Achievable Potential		Upper Achievable Potential	
Technology	2029 Participation Factor	Adoption Curve	2029 Participation Factor	Adoption Curve
I-1: LED Lighting	85%	Curve A	95%	Curve C
I-2: Optimization of Pumping Systems	10%	Curve B	80%	Curve B
I-3: Roving Energy Managers	0%	N/A	70%	Curve B
I-4: Premium Efficiency Refrigeration Control Systems and Compressor Sequencing	15%	Curve B	60%	Curve B
I-5: Demand Response Curtailments	5%	Curve D	15%	Curve B
I-6: Optimization of Compressed Air Distribution Systems and End-uses	20%	Curve A	90%	Curve A

Exhibit 56 Continued: Summary of Achievable Potential Participation Rates and Curves

Technology	Lower Achievable Potential		Upper Achievable Potential	
	2029 Participation Factor	Adoption Curve	2029 Participation Factor	Adoption Curve
I-7: Optimized Motor Control	15%	Curve B	80%	Curve A
I-8: Process Heat Recovery for HVAC	10%	Curve A	50%	Curve A

As noted earlier, it was not possible to fully address all opportunities in the one-day workshop. Consequently, the workshop focused on opportunities for small-medium sub-sectors selected based on the criteria described in Step 1. Estimated participation rates for the remaining opportunities were extrapolated from the workshop results shown above, and an aggregate set of results was prepared for small-medium sub-sectors, which included all of the eligible technologies.

For large industrial sub-sectors (transmission-connected facilities), which were not the focus of the workshops, estimated participation rates were developed with several additional information sources. Different forms of information were available for various facilities, but the key sources included the following:

- Facility energy audit reports
- Surveys completed by the facilities
- takeCHARGE Industrial Energy Efficiency Program reports and project tracking
- Conversations with a mining expert experienced in the province
- ICF experience in similar jurisdictions.

The results shown in the attached appendices and in the following summary section incorporate the results of all these inputs.

9.5 Summary of Potential Electric Energy Savings

This section presents a summary of the electric energy savings for the upper and lower achievable potential scenarios. The summary is organized and presented in the following sub-sections:

- Overview and selected highlights
- Electric energy savings – Upper Achievable scenario
- Electric energy savings – Lower Achievable scenario.

9.5.1 Overview and Selected Highlights

Exhibit 57 presents an overview of the results for the total Newfoundland service territory by milestone year, for three scenarios: Economic Potential, upper Achievable Potential and lower Achievable Potential.

Exhibit 57 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	709	18%	73	1.9%	19	0.5%
2020	729	19%	171	4.4%	57	1.5%
2023	743	19%	285	7.3%	108	2.8%
2026	735	19%	409	10.5%	170	4.4%
2029	728	19%	545	14.0%	244	6.3%

Selected Highlights – Potential Electric Energy Savings

Selected highlights of the potential electric energy savings for the upper and lower achievable potential scenarios shown in Exhibit 57 are summarized below. Further detail is provided in the following sub-sections and in the accompanying appendices.

One key highlight is that there is a large gap between the upper and lower Achievable Potential scenarios (14% vs. 6.3%). This is a factor of what each scenario represents. For many measures, that are not new technologies, the lower Achievable Potential represents that existing CDM programming has made limited progress towards the full potential for conservation. Conversely, the upper Achievable Potential represents that there is significant potential for further adoption of measures if expanded CDM programs can help overcome key barriers.

Savings by Milestone Year

Savings in both Achievable scenarios are reached somewhat more steadily throughout the period than in the Economic Potential scenario. In the upper Achievable Potential scenario, 31% of the 2029 savings would be achieved by 2020, rising to 52% in 2023 and 75% by 2026. In the lower Achievable Potential scenario, 23% of the 2029 savings would be achieved by 2020, rising to 44% in 2023 and 70% by 2026. Although there are some measures in both scenarios that can be implemented early in the study period, the majority are expected to follow an adoption curve that starts slowly and builds up towards 2029.

Savings by Sub-Sector

Large industry account for approximately 90% of each of the upper and lower Achievable Potential savings; this reflects their larger market share and their generally higher level of energy intensity per facility. Manufacturing, Fishing and Fish Processing, and Water Systems and Other sub-sectors make up 5%, 3%, and 2%, respectively of the 2029 upper and lower Achievable Potential savings.

Savings by End Use

Pump system savings account for 32% of the upper Achievable Potential savings in 2029 and 26% of the lower Achievable Potential savings. The most significant measures that save pump system electricity include premium efficiency pump control with ASDs, optimization of pumping systems, correctly sized pumps (impeller trimming or pump selection), and premium efficiency pump motors.

Fans and blowers account for 19% of 2029 upper Achievable Potential savings and 17% of lower Achievable Potential savings. The measure that saves the most fan and blower electricity is premium efficiency fan control with ASDs.

Lighting and process specific end uses each account for an average of 11% of 2029 upper Achievable Potential savings and 15% and 13% respectively of lower Achievable Potential. The reduction in lighting electricity comes principally from installing high efficiency lighting (LEDs), as well as a small portion is attributed to automated lighting controls and high-efficiency lighting design. Process specific savings are also expected to be significant, representing 11% of 2029 upper Achievable Potential savings and 13% of 2029 lower Achievable Potential savings.

The 6 remaining end uses are all under 10% in both scenarios. Together they account for 27% of upper Achievable Potential savings in 2029 and 29% of lower Achievable Potential savings in 2029.

Savings by Measure

The most significant savings in the Achievable Potential come from the following measures:

- Premium efficiency pump control with ASDs, which account for 14% of the upper Achievable Potential savings in 2029 and 12% of the lower Achievable Potential savings in 2029
- Premium efficiency fan control with ASDs, which accounts for 11% of the upper Achievable Potential savings in 2029 and 9% of the lower Achievable Potential savings in 2029
- Energy Management Information System (EMIS), which accounts for 10% of the upper Achievable Potential savings in 2029 and 12% of the lower Achievable Potential savings in 2029
- Optimization of pumping system, which accounts for 9% of the upper Achievable Potential savings in 2029 and 7% of the lower Achievable Potential savings in 2029
- High efficiency Lights (LED), which accounts for 8% of the upper Achievable Potential savings in 2029 and 12% of the lower Achievable Potential savings in 2029
- Organizational Energy Management (EM Team), which accounts for 8% of the upper Achievable Potential savings in 2029 and 4.6% of the lower Achievable Potential savings in 2029.

There are numerous other smaller measures that contribute to the overall Achievable Potential results.

9.5.2 Electric Energy Savings – Upper Achievable Scenario

The following exhibits present the potential electricity savings[22] under the upper Achievable Potential scenario. The results shown are relative to the Reference Case. The results for the total Newfoundland service territory[23] are broken down as follows:

- Exhibit 58 presents the results by milestone year
- Exhibit 59 presents the results by sub-sector and milestone year
- Exhibit 60 presents the results by end use and milestone year
- Exhibit 61 presents the results by measure and milestone year.

[22] Note: A value of "0" in the following exhibits means a relatively small number, not an absolute value of zero.
[23] To maintain customer confidentiality this section does not present a regional breakdown of results, but this is available in the Data Manager file.

Exhibit 58 Upper Achievable Electricity Savings, All Regions (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case
All Regions	72,541	170,535	284,877	409,407	545,014	14%

Exhibit 59 Upper Achievable Electricity Savings by Sub-Sector and Milestone Year (MWh/yr.)

Sub-Sector	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Large Industry	64,358	152,386	254,885	366,033	486,892	13%	89%
Manufacturing	5,532	10,785	15,970	21,000	25,902	19%	5%
Fishing and Fish Processing	1,721	4,568	8,459	13,234	18,801	15%	3%
Water Systems and Other	930	2,796	5,561	9,139	13,420	17%	2%
Grand Total	72,541	170,535	284,877	409,407	545,014	14%	100%

Note: Any difference in totals is due to rounding.

Exhibit 60 Upper Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Pumps	18,726	47,288	83,999	127,448	176,115	24%	32%
Fans and blowers	9,082	24,211	46,480	72,467	102,921	19%	19%
Lighting	13,628	30,943	42,146	50,786	57,284	48%	11%
Process specific	7,733	18,092	30,604	45,049	61,148	6%	11%
Air compressors	8,239	16,644	24,494	32,004	39,165	22%	7%
Other motors	6,705	14,050	21,969	30,427	39,364	6%	7%
Process heating	4,152	8,509	17,103	24,703	33,147	10%	6%
Conveyors	1,854	4,657	7,148	9,719	12,362	6%	2%
Comfort HVAC	1,834	3,943	6,205	8,639	11,224	8%	2%
Process cooling	588	2,198	4,729	8,164	12,283	12%	2%
Other	-	-	-	-	-	0%	0%
Grand Total	72,541	170,535	284,877	409,407	545,014	14%	100%

Note: Any difference in totals is due to rounding.

Exhibit 61 Upper Achievable Electricity Savings by Measure and Milestone Year (MWh/yr.)

End Use	Measure	Year					Adoption Curve[24]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Other motors	Correctly Sized Motors	220	670	1,350	2,257	3,377	A	-3.9 [25]	-3.4 [25]	13.5
Comfort HVAC	Reduced Temperature Settings	463	910	1,319	1,697	2,045	A	0	0	N/A
Pumps	Correctly Sized Pumps: Impeller Trimming or Pump Selection	4,782	9,623	14,451	19,214	23,857	B	0.1	0.1	0.1
Process heating	Insulation	945	1,862	2,749	3,608	4,439	B	0.2	0.2	0.3
Fans and blowers	Correctly Sized Fans: Impeller Trimming or Fan Selection	1,722	3,608	5,634	7,774	10,009	B	0.3	0.2	0.3
Process cooling	Smart Defrost Controls	43	167	364	621	923	B	0.3	0.8	0.3
Process specific	Advanced 'Predictive' Process Control Systems	407	1,597	3,517	6,113	9,326	N/A	0.6	N/A	N/A
System	Sub-Metering	2,071	5,293	9,465	14,439	20,060	B	0.7	0.3	2.6
Other motors	Optimized Motor Control	1,624	3,172	4,625	5,980	7,235	A	0.7	0.6	0.9
Air compressors	Use Cooler Air from Outside for Make Up Air	506	995	1,439	1,849	2,226	A	0.8	0.6	2.1
Process cooling	Floating Head Pressure Controls	9	37	80	138	207	B	0.8	1.5	0.7
Pumps	Premium Efficiency Pump Control with ASDs	3,611	13,991	29,958	50,424	74,234	B	1.0	1.0	1.5
Process cooling	Free Cooling	56	222	490	848	1,287	B	1.1	2.1	1.0
System	Operation and Maintenance (O&M) Program Supporting Efficiency	2,973	6,554	10,618	15,071	19,809	B	1.2	1.9	2.1

[24] Note that curves A, B, and C in this exhibit are as presented in Exhibit 55. While some measures follow different adoption curves for different sub-sectors, the most common curve is presented here.
[25] This CCE value is negative since the opportunity involves the selection of a smaller replacement motor at the equipment's end of life, which is actually less expensive than the default of purchasing a new oversized motor.

Exhibit 61 Continued: Upper Achievable Electricity Savings by Measure and Milestone Year (MWh/yr)

End Use	Measure	Year					Adoption Curve[24]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Process specific	Process Optimization Efforts - Pulp and Paper	3,439	6,784	10,020	13,136	16,123	N/A	1.3	N/A	N/A
Fans and blowers	Synchronous Belts	196	395	594	793	990	B	1.4	1.0	1.6
Fans and blowers	Premium Efficiency Fan Control with ASDs	2,661	10,450	22,948	39,774	60,528	B	1.7	1.5	2.0
Fans and blowers	Premium Efficiency Motors for Fans and Blowers	126	401	840	1,458	2,262	B	1.8	1.5	19.7
Conveyors	Premium Efficiency Conveyor Motors	64	197	406	676	1,010	A	2.0	1.5	24.1
Pumps	Premium Efficiency Pump Motor	168	537	1,141	1,988	3,099	B	2.1	2.0	14.7
Pumps	Optimization of Pumping System	6,222	14,344	24,097	35,260	47,588	B	2.2	2.1	3.3
System	Organizational Energy Management (EM Team)	7,786	16,042	24,382	32,873	41,470	B	2.2	3.4	4.3
Air compressors	Optimized Sizes of Air Receiver Tanks	220	427	599	745	865	A	2.4	2.9	3.6
Other motors	Premium Efficiency Motors	200	611	1,233	2,062	3,087	A	2.4	2.0	11.2
Process specific	Process Optimization Efforts - Mining and Processing	181	727	1,581	2,714	4,090	B	2.5	2.5	N/A
System	Integrated Plant Control System	2,684	5,533	8,517	11,601	14,750	B	2.8	1.9	10.3
System	Energy Management Information System (EMIS)	7,470	16,671	27,410	39,618	53,206	B	2.9	3.3	7.0
Air compressors	Air Leak Survey and Repair	2,715	5,341	7,625	9,666	11,475	A	3.0	2.4	8.2
Process cooling	Improved Ice Production System	21	83	183	318	486	B	3.5	N/A	3.5
Conveyors	Optimized Conveyor Motor Control	256	1,290	1,889	2,455	2,988	A	3.8	3.9	2.7
Comfort HVAC	Automated Temperature Control	454	914	1,330	1,716	2,070	A	4.0	3.5	7.0
Comfort HVAC	High-Efficiency Packaged HVAC	82	256	513	858	1,285	A	4.1	3.9	21.7
Air compressors	Optimized Distribution System (Incl. Pressure and Air End-Uses)	1,539	3,077	4,438	5,679	6,804	A	4.1	3.7	7.2

Exhibit 61 Continued: Upper Achievable Electricity Savings by Measure and Milestone Year (MWh/yr)

End Use	Measure	Year					Adoption Curve[24]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Air compressors	Premium Efficiency ASD Compressor	2,281	4,609	6,800	8,908	10,925	A	4.1	2.9	8.7
Lighting	Automated Lighting Controls	1,129	3,019	3,898	4,488	4,887	A	4.4	4.3	5.5
Lighting	High Efficiency Lights (LEDs)	10,691	24,383	33,141	39,688	44,304	A	4.4	4.3	5.4
Process heating	Process Heat Recovery to Preheat Makeup Water	550	1,165	5,916	9,594	14,047	B	5.0	4.9	4.9
Fans and blowers	Optimized Distribution System (Incl. Pressure Losses)	208	825	3,439	5,036	6,803	B	5.3	4.7	6.4
Process heating	High Efficiency Oven/Dryer/Furnace/Kiln	2	2	16	26	38	B	5.4	5.6	4.8
Air compressors	Sequencing Control	81	158	222	275	319	A	5.6	N/A	24.0
Process cooling	Premium Efficiency Refrigeration Control System and Compressor Sequencing	119	468	1,019	1,738	2,586	B	5.6	N/A	4.8
Process cooling	Optimized Distribution System	18	70	155	269	410	B	5.7	N/A	5.1
Process heating	Heat Pumps	14	59	128	219	330	B	5.8	N/A	9.7
Process cooling	Air Curtains	3	13	29	49	75	B	6.8	N/A	6.3
Process cooling	High Efficiency Chiller	59	230	507	959	1,470	B	7.0	6.2	7.2
Process cooling	Chiller Economizer	17	66	145	250	379	B	7.5	N/A	7.2
Process cooling	Improve Insulation of Refrigeration System	35	140	307	530	801	B	9.1	N/A	8.1
Comfort HVAC	Air Compressor Heat Recovery	92	181	264	341	411	A	9.4	N/A	14.1
Lighting	High-Efficiency Lighting Design	1,279	2,276	2,957	3,447	3,818	A	10.0	N/A	12.7
Comfort HVAC	Ventilation Optimization	45	87	127	163	195	A	11.7	N/A	20.2
Comfort HVAC	Ventilation Heat Recovery	0	0	1	1	1	A	N/A	N/A	21.6

Exhibit 61 Continued: Upper Achievable Electricity Savings by Measure and Milestone Year (MWh/yr)

End Use	Measure	Year					Adoption Curve[24]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Comfort HVAC	Warehouse Loading Dock Seals	0	0	0	0	0	A	N/A	N/A	21.4
Comfort HVAC	Improved Building Insulation	-	-	-	-	-	N/A	N/A	N/A	N/A
Comfort HVAC	HVAC Air Curtains	-	-	-	-	-	N/A	N/A	N/A	N/A
Process heating	High Efficiency Water Heater	-	-	-	-	-	N/A	N/A	N/A	N/A
Process specific	Process Optimization Efforts - Fishing and Fish Processing	1	3	4	5	6	B	N/A	N/A	21.1
Process specific	Process Optimization Efforts - Oil Refining	-	-	-	-	-	N/A	N/A	N/A	N/A

Note: In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

Exhibit 61 provides results at a sufficient level of detail that some modeling issues require explanation:

- In some cases, the potential shown in this exhibit is lower than for the same measure in Exhibit 65. This occurs for measures that are late in the “cascade” of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much higher savings in the Upper Achievable than in the Lower Achievable scenarios, leaving less energy to be saved by later measures in the sequence.
- The CCE values in Exhibit 61 do not always match those presented elsewhere in the report. The CCE values presented in these exhibits are calculated weighted averages, based on the particular mixture of sub-sectors and regions in which the measure is applied in this scenario. For most measures, the CCE varies by sub-sector and region, because of varying savings and costs. If the mixture of sub-sectors in the Upper Achievable scenario is different from the mixture in the Lower Achievable scenario, the weighted average CCE will be somewhat different. In general, the CCE values in this chapter will be lower than those presented in Chapter 7, because the economic screening removes the most expensive applications of most measures.

9.5.3 Electric Energy Savings – Lower Achievable Scenario

- The following exhibits present the potential electricity savings[26] under the lower Achievable Potential scenario. The results shown are relative to the Reference Case. The results for the total Newfoundland service territory[27] are broken down as follows:

- Exhibit 62 presents the results by milestone year
- Exhibit 63 presents the results by sub-sector and milestone year
- Exhibit 64 presents the results by end use and milestone year
- Exhibit 65 presents the results by measure and milestone year.

Exhibit 62 Lower Achievable Electricity Savings, All Regions (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case
All Regions	19,188	57,009	108,002	170,436	244,363	6%

Exhibit 63 Lower Achievable Electricity Savings by Sub-Sector and Milestone Year (MWh/yr.)

Sub-Sector	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Large Industry	15,759	49,569	95,880	153,151	221,429	6%	91%
Manufacturing	2,239	4,540	6,997	9,457	11,929	9%	5%
Fishing and Fish Processing	845	1,980	3,396	5,067	6,990	5%	3%
Water Systems and Other	345	920	1,729	2,761	4,015	5%	2%
Grand Total	19,188	57,009	108,002	170,436	244,363	6%	100%

Note: Any difference in totals is due to rounding.

[26] A value of "0" in the following exhibits means a relatively small number, not an absolute value of zero.
[27] To maintain customer confidentiality this section does not present a regional breakdown of results, but this is available in the Data Manager file.

Exhibit 64 Lower Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Pumps	2,748	10,910	24,009	41,618	63,230	9%	26%
Lighting	7,055	17,560	25,154	31,814	37,631	32%	15%
Fans and blowers	1,697	6,736	15,690	27,305	41,693	8%	17%
Process specific	1,350	5,359	11,835	20,627	31,558	3%	13%
Air compressors	4,303	8,830	13,224	17,578	21,875	12%	9%
Other motors	734	2,940	6,634	11,828	18,523	3%	8%
Process heating	426	1,695	5,362	9,388	14,429	4%	6%
Comfort HVAC	506	1,343	2,451	3,829	5,459	4%	2%
Conveyors	205	984	2,203	3,892	6,041	3%	2%
Process cooling	164	652	1,441	2,558	3,924	4%	2%
Other	-	-	-	-	-	0%	0%
Grand Total	19,188	57,009	108,002	170,436	244,363	6%	100%

Note: Any difference in totals is due to rounding.

Exhibit 65 Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

End Use	Measure	Year					Adoption Curve[28]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Other motors	Correctly Sized Motors	18	91	257	556	1,024	B	-3.8 [29]	-3.4 [29]	13.5
Comfort HVAC	Reduced Temperature Settings	139	368	670	1,041	1,476	A	0	0	N/A
Pumps	Correctly Sized Pumps: Impeller Trimming or Pump Selection	202	795	1,726	2,954	4,431	B	0.1	0.1	0.1
Process heating	Insulation	95	376	835	1,461	2,245	B	0.2	0.2	N/A
Fans and blowers	Correctly Sized Fans: Impeller Trimming or Fan Selection	141	552	1,207	2,080	3,147	B	0.3	0.2	0.3
Process cooling	Smart Defrost Controls	10	41	90	157	240	B	0.3	0.8	N/A
System	Sub-Metering	326	1,298	2,859	4,972	7,595	B	0.5	0.3	N/A
Process specific	Advanced 'Predictive' Process Control Systems	117	463	1,025	1,789	2,736	N/A	0.6	N/A	N/A
Other motors	Optimized Motor Control	140	549	1,206	2,087	3,168	B	0.7	0.6	0.9
Air compressors	Use Cooler Air from Outside for Make Up Air	298	592	866	1,125	1,367	A	0.8	0.6	2.1
Process cooling	Floating Head Pressure Controls	2	9	21	36	56	B	0.9	1.5	N/A
System	Operation and Maintenance (O&M) Program Supporting Efficiency	613	2,398	5,239	9,028	13,645	B	1.0	1.9	2.1
Pumps	Premium Efficiency Pump Control with ASDs	1,286	5,108	11,181	19,248	28,994	B	1.0	1.0	1.4

[28] Note that curves A, B, and C in this exhibit are as presented in Exhibit 55. While some measures follow different adoption curves for different sub-sectors, the most common curve is presented here.
[29] This CCE value is negative since the opportunity involves the selection of a smaller replacement motor at the equipment's end of life, which is actually less expensive than the default of purchasing a new oversized motor.

Exhibit 65 Continued: Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

End Use	Measure	Year					Adoption Curve[28]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Process cooling	Free Cooling	28	111	245	430	661	B	1.1	2.1	1.0
Fans and blowers	Synchronous Belts	19	76	168	293	448	B	1.2	1.0	1.6
Process specific	Process Optimization Efforts - Pulp and Paper	563	2,231	4,964	8,718	13,443	N/A	1.3	N/A	N/A
Fans and blowers	Premium Efficiency Fan Control with ASDs	974	3,865	8,551	14,910	22,793	B	1.6	1.5	1.9
Fans and blowers	Premium Efficiency Motors for Fans and Blowers	15	78	221	476	874	B	1.7	1.5	19.7
Conveyors	Premium Efficiency Conveyor Motors	8	40	116	249	458	B	1.9	1.5	24.1
System	Energy Management Information System (EMIS)	1,190	4,737	10,517	18,443	28,417	B	2.0	3.3	N/A
Pumps	Premium Efficiency Pump Motor	21	105	298	640	1,175	B	2.0	2.0	14.7
Pumps	Optimization of Pumping System	735	2,906	6,407	11,132	16,959	B	2.1	2.1	3.4
System	Organizational Energy Management (EM Team)	478	1,908	4,209	7,327	11,200	B	2.2	3.4	4.3
Air compressors	Optimized Sizes of Air Receiver Tanks	157	311	443	561	664	A	2.3	2.9	3.6
Other motors	Premium Efficiency Motors	24	121	342	740	1,363	B	2.3	2.0	12.1
Process specific	Process Optimization Efforts - Mining and Processing	121	489	1,068	1,840	2,779	B	2.5	2.5	N/A
Air compressors	Air Leak Survey and Repair	1,847	3,666	5,319	6,852	8,267	A	3.1	2.4	8.2
Process cooling	Improved Ice Production System	5	20	45	79	122	N/A	3.5	N/A	N/A
System	Integrated Plant Control System	282	1,103	2,425	4,208	6,408	B	3.6	1.9	11.6
Air compressors	Premium Efficiency ASD Compressor	1,022	2,066	3,058	4,018	4,945	A	3.8	2.9	8.7
Conveyors	Optimized Conveyor Motor Control	19	232	513	891	1,358	B	3.9	3.9	2.7

Exhibit 65 Continued: Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

End Use	Measure	Year					Adoption Curve[28]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Air compressors	Optimized Distribution System (Incl. Pressure and Air End-Uses)	816	1,646	2,404	3,117	3,785	A	4.0	3.7	7.2
Comfort HVAC	High-Efficiency Packaged HVAC	15	50	108	196	317	A	4.1	3.9	21.7
Comfort HVAC	Automated Temperature Control	242	527	824	1,136	1,461	A	4.1	3.5	7.1
Lighting	High Efficiency Lights (LEDs)	5,605	13,865	19,861	25,083	29,597	A	4.5	4.3	5.4
Lighting	Automated Lighting Controls	742	2,182	2,960	3,560	4,013	A	4.5	4.3	5.4
Process heating	Process Heat Recovery to Preheat Makeup Water	23	96	1,814	3,180	4,891	B	5.0	4.9	N/A
Process heating	High Efficiency Oven/Dryer/Furnace/Kiln	0	0	2	4	7	B	5.3	5.6	N/A
Air compressors	Sequencing Control	49	97	139	176	207	A	5.3	N/A	24.0
Fans and blowers	Optimized Distribution System (Incl. Pressure Losses)	61	240	1,287	2,117	3,047	B	5.3	4.7	6.4
Process cooling	Optimized Distribution System	6	23	51	90	139	B	5.7	N/A	N/A
Process cooling	Premium Efficiency Refrigeration Control System and Compressor Sequencing	31	121	267	464	707	B	5.7	N/A	N/A
Process heating	Heat Pumps	2	10	22	39	61	B	5.8	N/A	N/A
Process cooling	Air Curtains	1	3	8	13	20	B	6.2	N/A	N/A
Process cooling	High Efficiency Chiller	31	121	268	512	794	B	7.0	6.2	7.2
Process cooling	Chiller Economizer	5	22	48	84	129	B	7.5	N/A	N/A
Comfort HVAC	Air Compressor Heat Recovery	21	41	60	79	96	A	9.7	N/A	14.1

Exhibit 65 Continued: Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

End Use	Measure	Year					Adoption Curve[28]	Weighted Average CCE (¢/kWh)		
		2017	2020	2023	2026	2029		Island	Labrador	Isolated
Process cooling	Improve Insulation of Refrigeration System	7	29	64	111	170	B	9.7	N/A	N/A
Lighting	High-Efficiency Lighting Design	636	1,229	1,718	2,127	2,462	A	9.9	N/A	12.7
Comfort HVAC	Ventilation Heat Recovery	-	-	-	-	-	N/A	N/A	N/A	N/A
Comfort HVAC	Ventilation Optimization	-	-	-	-	-	N/A	N/A	N/A	N/A
Comfort HVAC	Warehouse Loading Dock Seals	0	0	0	0	0	A	N/A	N/A	21.4
Comfort HVAC	Improved Building Insulation	-	-	-	-	-	N/A	N/A	N/A	N/A
Comfort HVAC	HVAC Air Curtains	-	-	-	-	-	N/A	N/A	N/A	N/A
Process heating	High Efficiency Water Heater	-	-	-	-	-	N/A	N/A	N/A	N/A
Process specific	Process Optimization Efforts - Fishing and Fish Processing	0	1	2	3	4	B	N/A	N/A	21.1
Process specific	Process Optimization Efforts - Oil Refining	-	-	-	-	-	N/A	N/A	N/A	N/A

Note: In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

As with Exhibit 61, Exhibit 65 provides results at a sufficient level of detail that some modeling issues require explanation:

- As explained following Exhibit 61, in some cases, the potential shown in this exhibit is higher than for the same measure in Exhibit 61. This occurs for measures that are late in the “cascade” of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much lower savings in the Lower Achievable than in the Upper Achievable scenarios, leaving more energy to be saved by later measures in the sequence.
- The CCE values in Exhibit 65 do not always match those presented earlier in the report. As discussed earlier that is because the CCE values presented in these exhibits are calculated weighted averages, based on the particular mixture of sub-sectors and regions in which the measure is applied in this scenario.

9.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 66 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Achievable Potential Forecast. The reductions are shown by milestone year and sub-sector for both lower and upper achievable potential savings. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6.

Exhibit 67, Exhibit 68, Exhibit 69, and Exhibit 70 show the lower and upper Achievable Potential savings by sub-sector and principal end use for each milestone year.

Electric peak load reductions related to capacity-only measures are presented separately in Section 9.7.

Exhibit 66 Electric Peak Load Reductions from Lower and Upper Achievable Potential Energy Savings Measures, by Milestone Year and Sub-Sector, Winter Peak Period (MW)

Sub-Sector	Milestone Years	Lower	Upper
Large Industry	2017	1.4	6.1
	2020	4.5	14.3
	2023	8.9	24.1
	2026	14.3	34.7
	2029	20.8	46.2
Manufacturing	2017	0.2	0.4
	2020	0.3	0.8
	2023	0.5	1.2
	2026	0.7	1.5
	2029	0.9	1.9
Fishing and Fish Processing	2017	0.1	0.2
	2020	0.2	0.4
	2023	0.3	0.7
	2026	0.5	1.1
	2029	0.6	1.5
Water Systems and Other	2017	0.0	0.1
	2020	0.1	0.2
	2023	0.1	0.3
	2026	0.2	0.5
	2029	0.2	0.8

Exhibit 67 Electric Peak Load Reductions from Upper Achievable Potential Energy Savings Measures, by Milestone Year, End Use and Sub-Sector, Winter Peak Period (MW)

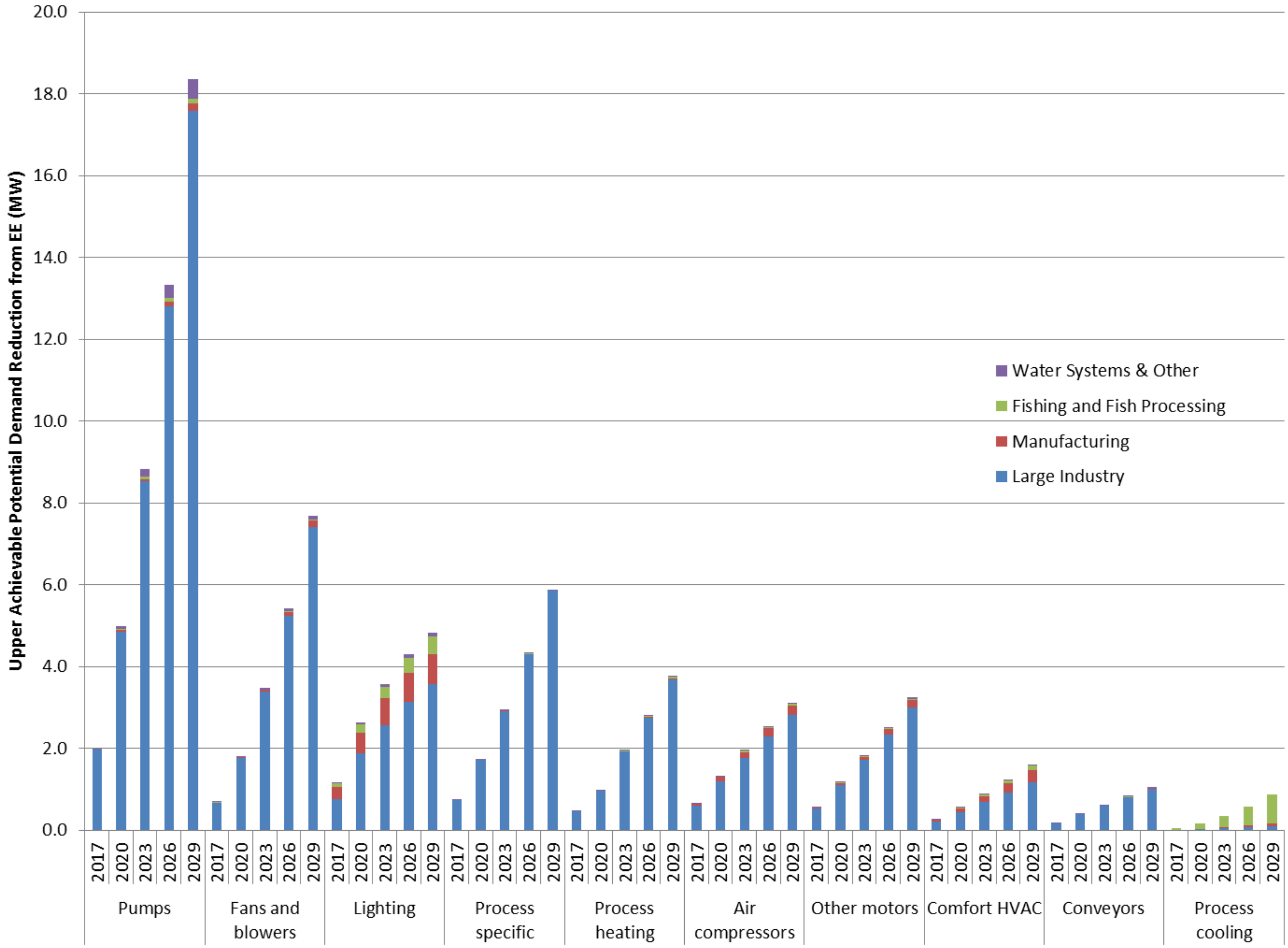


Exhibit 68 Electric Peak Load Reduction from Upper Achievable Potential Energy Saving Measures for Small-Medium Industry, by Milestone Year, End Use, and Sub-Sector, Winter Peak Period (MW)

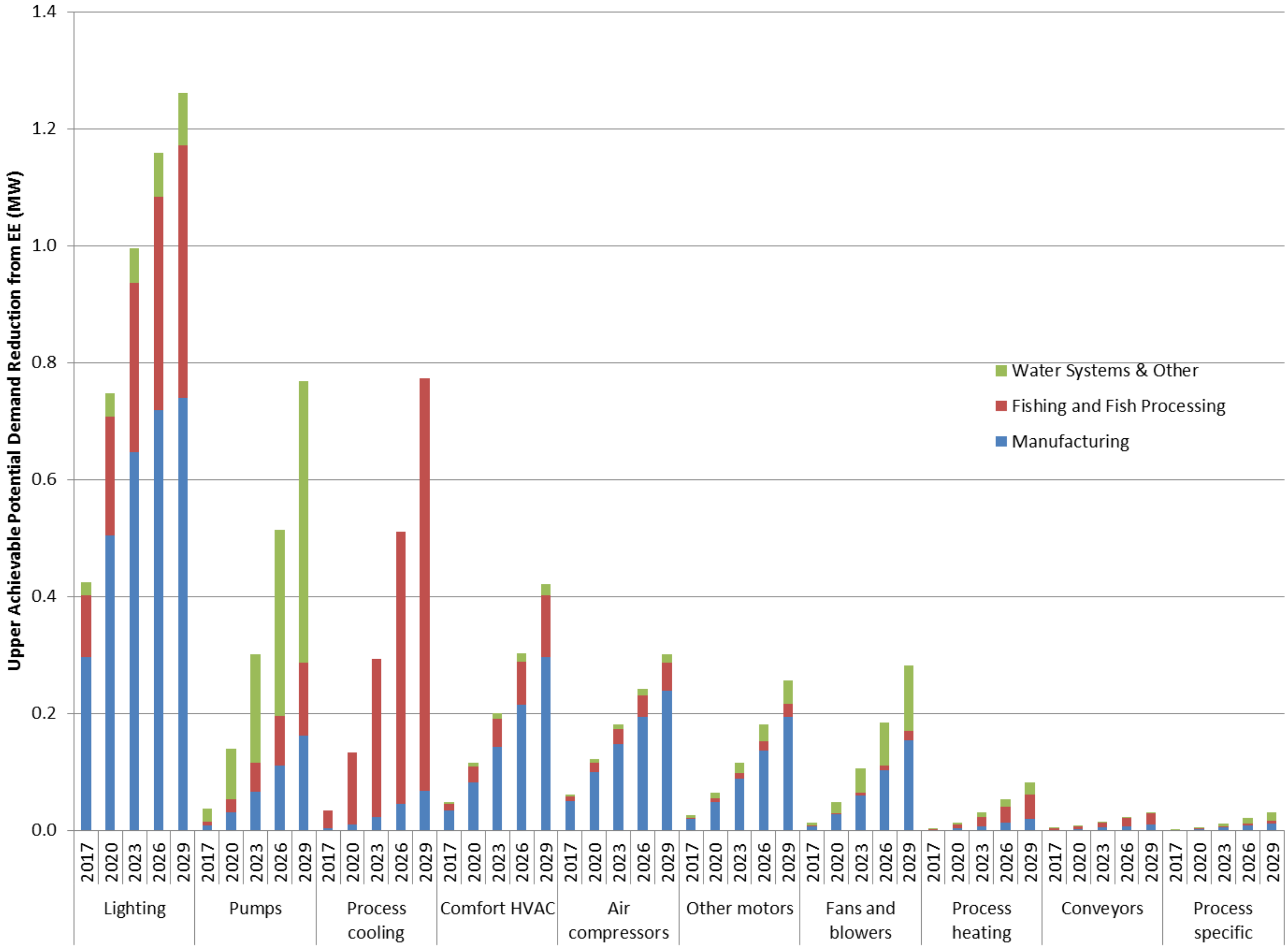


Exhibit 69 Electric Peak Load Reduction from Lower Achievable Potential Energy Saving Measures, by Milestone Year, End-Use, and Sub-Sector, Winter Peak Period (MW)

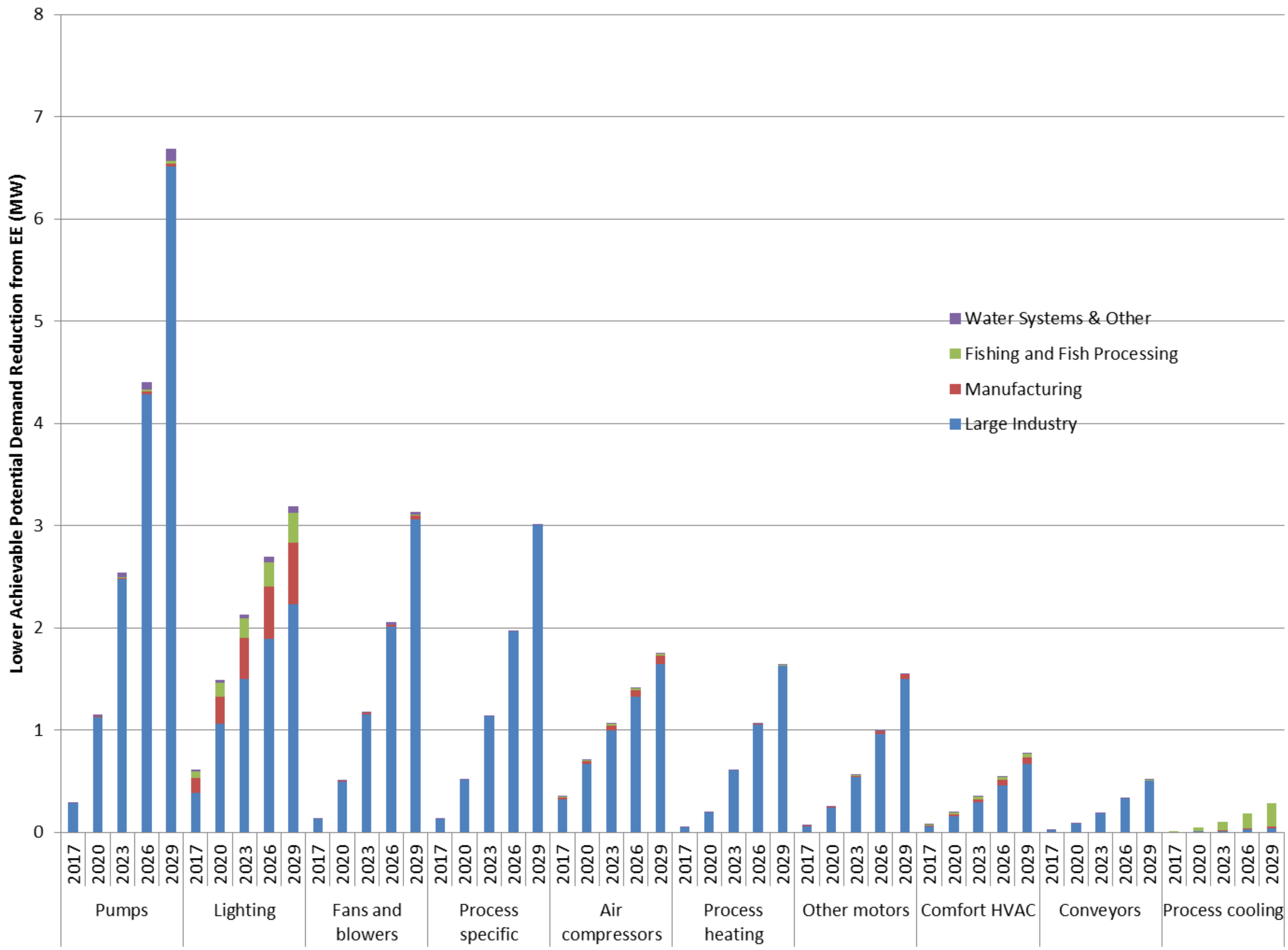


Exhibit 70 Electric Peak Load Reductions from Lower Achievable Potential Energy Savings Measures for Small-Medium Industry, by Milestone Year End Use and Sub-Sector, Winter Peak Period (MW)

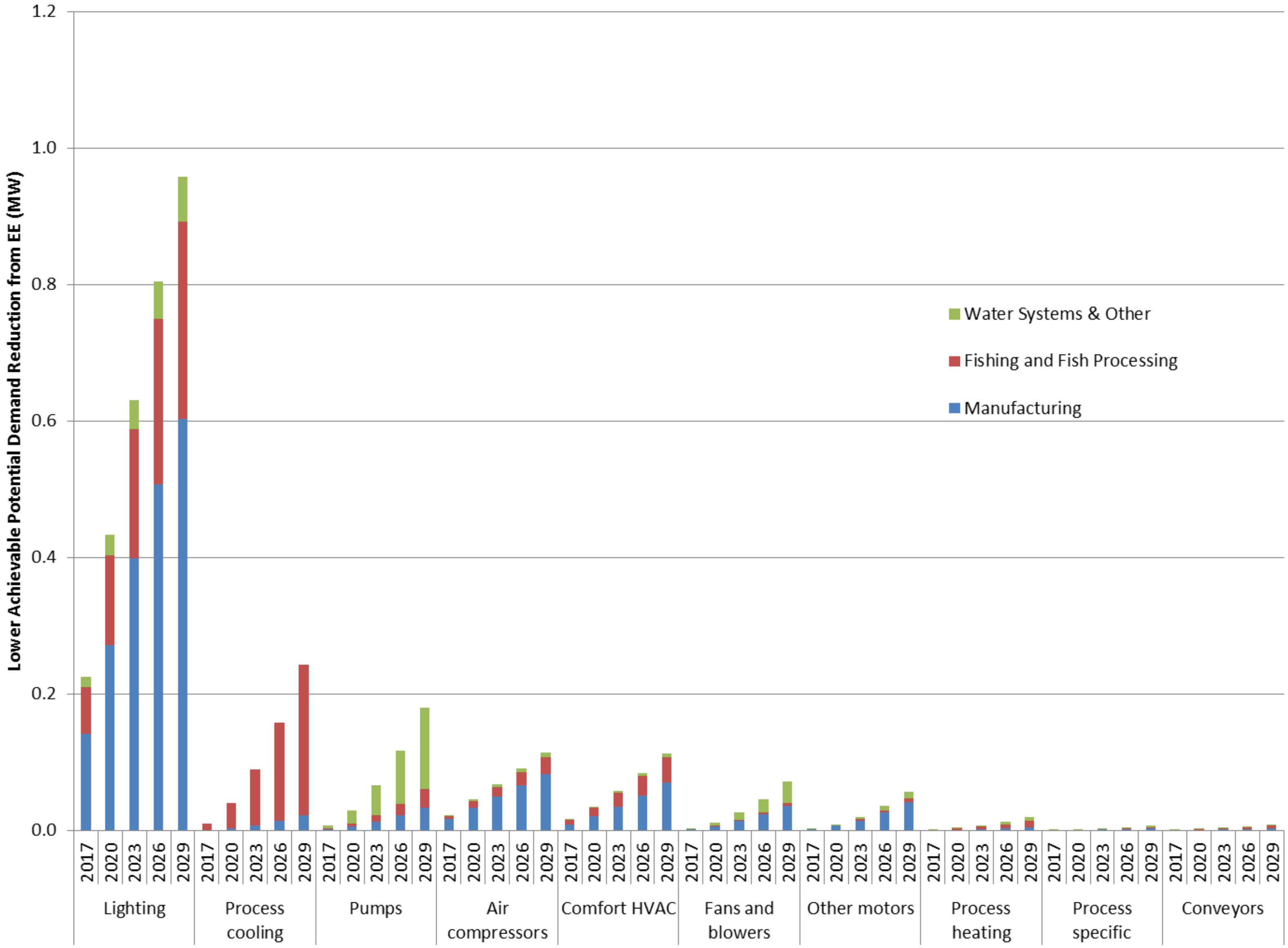


Exhibit 71 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct.

Exhibit 71 Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW)

Measure	Large Industry		S/M Industry		Total	
	Lower Achiev.	Upper Achiev.	Lower Achiev.	Upper Achiev.	Lower Achiev.	Upper Achiev.
Premium Efficiency Pump Control with ASDs	3.0	7.5	0.1	0.3	3.1	7.8
Energy Management Information System (EMIS)	2.7	4.9	0.0	0.2	2.7	5.1
High Efficiency Lights (LEDs)	1.7	2.7	0.8	1.0	2.5	3.7
Optimization of Pumping System	1.8	4.7	0.0	0.2	1.8	5.0
Premium Efficiency Fan Control with ASDs	1.7	4.4	0.0	0.1	1.7	4.5
Operation and Maintenance (O&M) Program Supporting Efficiency	1.2	1.7	0.1	0.1	1.3	1.9
Process Optimization Efforts - Pulp and Paper	1.1	1.3	-	-	1.1	1.3
Organizational Energy Management (EM Team)	1.0	3.5	0.1	0.4	1.1	3.9
Sub-Metering	0.7	1.6	0.0	0.3	0.7	1.9
Air Leak Survey and Repair	0.6	0.9	0.0	0.1	0.7	0.9
Integrated Plant Control System	0.6	1.3	0.0	0.1	0.6	1.4
Process Heat Recovery to Preheat Makeup Water	0.6	1.6	0.0	0.0	0.6	1.6
Correctly Sized Pumps: Impeller Trimming or Pump Selection	0.4	2.4	0.0	0.1	0.5	2.5
Premium Efficiency ASD Compressor	0.4	0.7	0.0	0.1	0.4	0.8
Process Optimization Efforts - Mining and Processing	0.4	0.6	-	-	0.4	0.6
Automated Lighting Controls	0.3	0.3	0.1	0.1	0.3	0.4
Optimized Distribution System (Incl. Pressure and Air End-Uses)	0.3	0.5	0.0	0.0	0.3	0.5
Optimized Motor Control	0.2	0.5	0.0	0.1	0.3	0.6
Insulation	0.3	0.5	0.0	0.0	0.3	0.5
Correctly Sized Fans: Impeller Trimming or Fan Selection	0.2	0.7	0.0	0.0	0.2	0.7
Advanced ‘Predictive’ Process Control Systems	0.2	0.8	-	-	0.2	0.8
Optimized Distribution System (Incl. Pressure Losses)	0.2	0.4	0.0	0.1	0.2	0.5
Reduced Temperature Settings	0.2	0.3	-	-	0.2	0.3
Automated Temperature Control	0.2	0.2	0.0	0.1	0.2	0.3
High-Efficiency Lighting Design	0.2	0.3	0.0	0.1	0.2	0.3
Premium Efficiency Pump Motor	0.1	0.3	0.0	0.0	0.1	0.3
Optimized Conveyor Motor Control	0.1	0.2	0.0	0.0	0.1	0.3

Exhibit 71 Continued: Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW)

Measure	Large Industry		S/M Industry		Total	
	Lower Achiev.	Upper Achiev.	Lower Achiev.	Upper Achiev.	Lower Achiev.	Upper Achiev.
Premium Efficiency Motors	0.1	0.2	0.0	0.0	0.1	0.3
Use Cooler Air from Outside for Make Up Air	0.1	0.2	0.0	0.0	0.1	0.2
Correctly Sized Motors	0.1	0.3	0.0	0.0	0.1	0.3
Premium Efficiency Motors for Fans and Blowers	0.1	0.2	0.0	0.0	0.1	0.2
High Efficiency Chiller	0.0	0.0	0.1	0.1	0.1	0.1
Premium Efficiency Refrigeration Control System and Compressor Sequencing	0.0	0.0	0.0	0.2	0.1	0.2
Optimized Sizes of Air Receiver Tanks	0.0	0.0	0.0	0.0	0.1	0.1
Free Cooling	0.0	0.0	0.0	0.1	0.0	0.1
High-Efficiency Packaged HVAC	0.0	0.1	0.0	0.1	0.0	0.2
Premium Efficiency Conveyor Motors	0.0	0.1	0.0	0.0	0.0	0.1
Synchronous Belts	0.0	0.1	0.0	0.0	0.0	0.1
Smart Defrost Controls	-	-	0.0	0.1	0.0	0.1
Sequencing Control	0.0	0.0	0.0	0.0	0.0	0.0
Air Compressor Heat Recovery	0.0	0.0	0.0	0.0	0.0	0.1
Improve Insulation of Refrigeration System	0.0	0.0	0.0	0.0	0.0	0.1
Optimized Distribution System	-	-	0.0	0.0	0.0	0.0
Chiller Economizer	0.0	0.0	0.0	0.0	0.0	0.0
Improved Ice Production System	-	-	0.0	0.0	0.0	0.0
Heat Pumps	0.0	0.0	0.0	0.0	0.0	0.0
Floating Head Pressure Controls	0.0	0.0	0.0	0.0	0.0	0.0
Air Curtains	-	0.0	0.0	0.0	0.0	0.0
High Efficiency Oven/Dryer/Furnace/Kiln	0.0	0.0	0.0	0.0	0.0	0.0
Process Optimization Efforts - Fishing and Fish Processing	-	-	0.0	0.0	0.0	0.0
Warehouse Loading Dock Seals	-	-	0.0	0.0	0.0	0.0
Ventilation Heat Recovery	-	-	-	0.0	-	0.0
High Efficiency Water Heater	-	-	-	-	-	-
Ventilation Optimization	-	-	-	0.0	-	0.0
Process Optimization Efforts - Oil Refining	-	-	-	-	-	-
Improved Building Insulation	-	-	-	-	-	-
HVAC Air Curtains	-	-	-	-	-	-
Grand Total	20.8	46.2	1.8	4.2	22.5	50.4

As with Exhibit 65, Exhibit 71 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct.

Exhibit 71 provides results at a sufficient level of detail that some modeling issues require explanation:

- In some cases, the potential shown for Lower Achievable is higher than for the same measure in Upper Achievable. This occurs for measures that are late in the “cascade” of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much lower savings in the Lower Achievable than in the Upper Achievable scenarios, leaving more energy to be saved by later measures in the sequence.

9.7 Summary of Peak Load Reductions

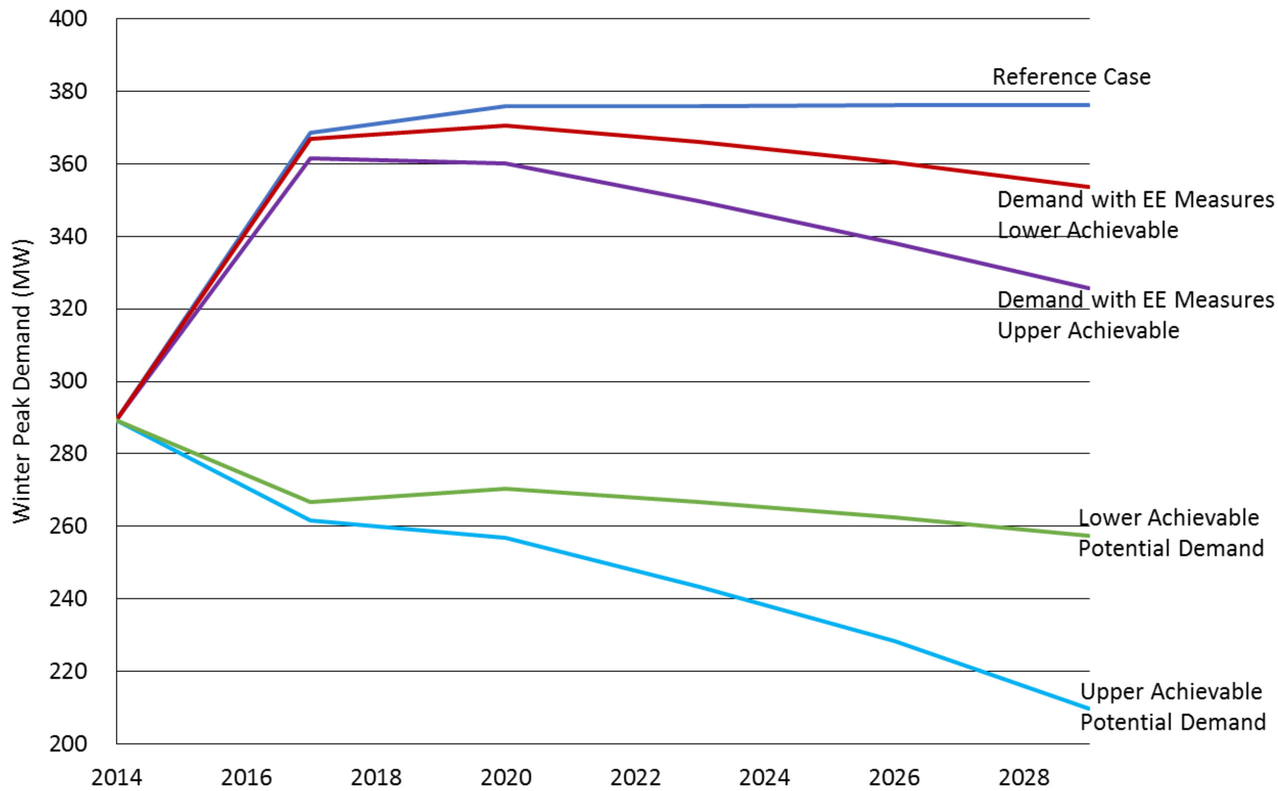
This section presents a summary of the electric peak load reductions that would result from the application of peak demand efficient measures. Exhibit 72 compares the Reference Case, Lower Achievable Potential and Upper Achievable Potential Peak Demand Forecast levels of winter peak demand.[30]

As illustrated, under the Reference Case industrial peak demand would grow from the Base Year level of 289 MW to approximately 376 MW by 2029. This contrasts with the Lower Achievable Potential Forecast in which peak demand would decrease to approximately 288 MW for the same period, a difference of approximately 88 MW or about 23%. The Upper Achievable Potential forecasts peak demand at 220 MW, a difference of approximately 156 MW or 41%. The other two lines on the chart show the peak demand that would result if all the energy efficiency measures were applied but none of the demand reduction measures in each of the Lower and Upper Achievable Potential scenarios. As illustrated in the exhibit, 13% of the upper Achievable Potential scenario reduction, and 6% of the lower Achievable Potential scenario reduction comes from the impact of energy efficiency measures.

As noted in Section 7.6, all of the demand reductions from Newfoundland Power’s curtailment program will be captured in the Industrial report, including curtailment from some general service customers that would otherwise be classified as ‘commercial’ facilities in this study. These ‘non-industrial’ peak demand curtailments are included with reductions for the manufacturing sub-sector. As such, the results for this sub-sector will overestimate the potential curtailment specific to that sub-sector when these results are considered in isolation.

[30] All results are reported at the customer’s point-of-use and do not include line losses.

Exhibit 72 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Industrial Sector (MW)



9.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Upper and Lower Achievable Potential Forecast is provided in the following exhibits:[31]

- Exhibit 73 presents the results by sub-sector, measure and milestone year
- Exhibit 74 and Exhibit 76 present peak demand reduction by major end use, milestone year and sub-sector
- Exhibit 75 and Exhibit 77 present peak demand reduction by major end use, milestone year and sub-sector for small-medium industry

[31] MW reductions shown in the following exhibits are not incremental. For example, the space heating reductions in 2029 are not in addition to the space heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Lower or Upper Achievable Potential scenario are implemented.

Exhibit 73 Total Lower Achievable Potential Peak Demand Reduction by Sub-Sector, Measure and Milestone Year (MW)

		Operational changes for reduced peak load (DR Curtailments)		Peak shifting through on-site storage		Power factor correction equipment		Grand Total	
Sub-sectors	Milestone Years	Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.
Large Industry	2017	88.83	87.97	0.01	0.02	0.67	1.33	89.51	89.32
	2020	88.28	89.01	0.01	0.04	1.37	2.65	89.66	91.70
	2023	86.68	90.19	0.02	0.06	2.03	3.85	88.72	94.10
	2026	84.75	92.16	0.02	0.07	2.66	4.95	87.43	97.18
	2029	82.52	96.81	0.03	0.09	3.26	6.00	85.80	102.90
Manufacturing	2017	6.70	6.50	0.00	0.00	0.03	0.09	6.73	6.59
	2020	6.55	7.01	0.00	0.00	0.05	0.17	6.60	7.18
	2023	6.38	7.28	0.03	0.23	0.08	0.24	6.49	7.75
	2026	6.22	7.59	0.05	0.29	0.10	0.31	6.38	8.19
	2029	6.06	7.86	0.08	0.35	0.13	0.37	6.26	8.59
Fishing and Fish Processing	2017	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09
	2020	0.00	0.00	0.01	0.18	0.05	0.17	0.06	0.35
	2023	0.00	0.00	0.02	0.26	0.08	0.25	0.10	0.51
	2026	0.00	0.00	0.04	0.33	0.10	0.32	0.14	0.65
	2029	0.00	0.00	0.05	0.39	0.13	0.38	0.18	0.77
Water Systems and Other	2017	3.94	3.85	0.00	0.00	0.01	0.04	3.95	3.90
	2020	3.94	3.80	0.00	0.01	0.02	0.08	3.97	3.89
	2023	3.94	3.74	0.00	0.01	0.04	0.11	3.99	3.87
	2026	3.92	3.66	0.01	0.02	0.05	0.14	3.97	3.82
	2029	3.89	3.59	0.01	0.02	0.06	0.17	3.96	3.78
Grand Total	2017	99.47	98.33	0.01	0.12	0.71	1.45	100.20	99.89
	2020	98.77	99.82	0.02	0.23	1.50	3.06	100.30	103.11
	2023	97.01	101.22	0.07	0.56	2.22	4.45	99.30	106.22
	2026	94.89	103.41	0.12	0.72	2.91	5.72	97.92	109.84
	2029	92.46	108.27	0.17	0.86	3.57	6.92	96.21	116.04

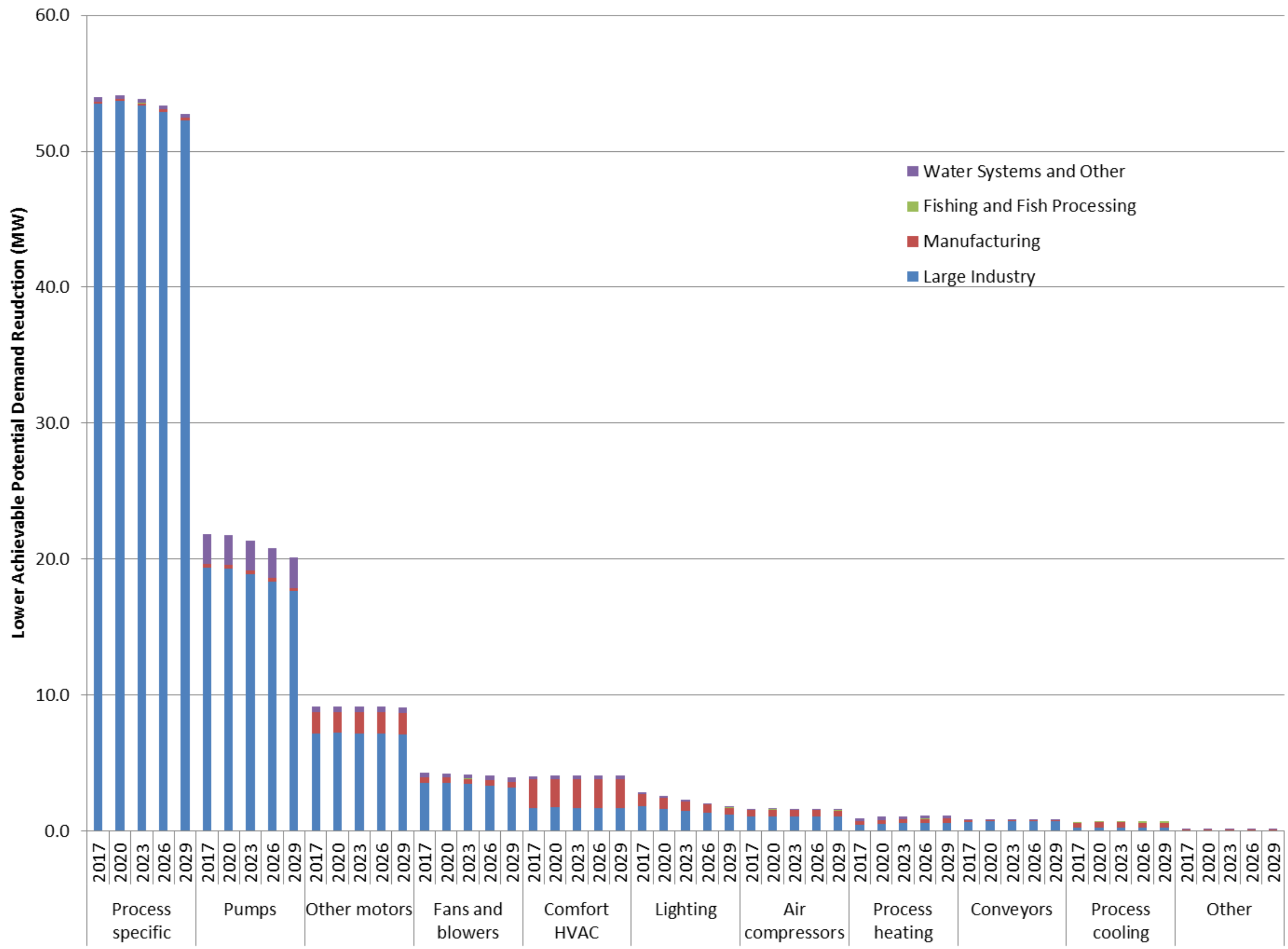
Notes:
1) The values in this exhibit do not include peak demand reductions from energy efficiency measures.
2) The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered 'commercial' facilities.

3) Results are measured at the customer's point-of-use and do not include line losses.
4) Any differences in totals are due to rounding.
5) Totals are calculated using the actual numerical value.
6) MW reductions are not incremental. The peak shifting reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case peak shifting peak demand in 2029 and the peak shifting peak demand if all the measures included in the Economic Potential scenario are implemented.

As with some previous conservation exhibits, Exhibit 73 provides results at a sufficient level of detail that some modeling issues require explanation:

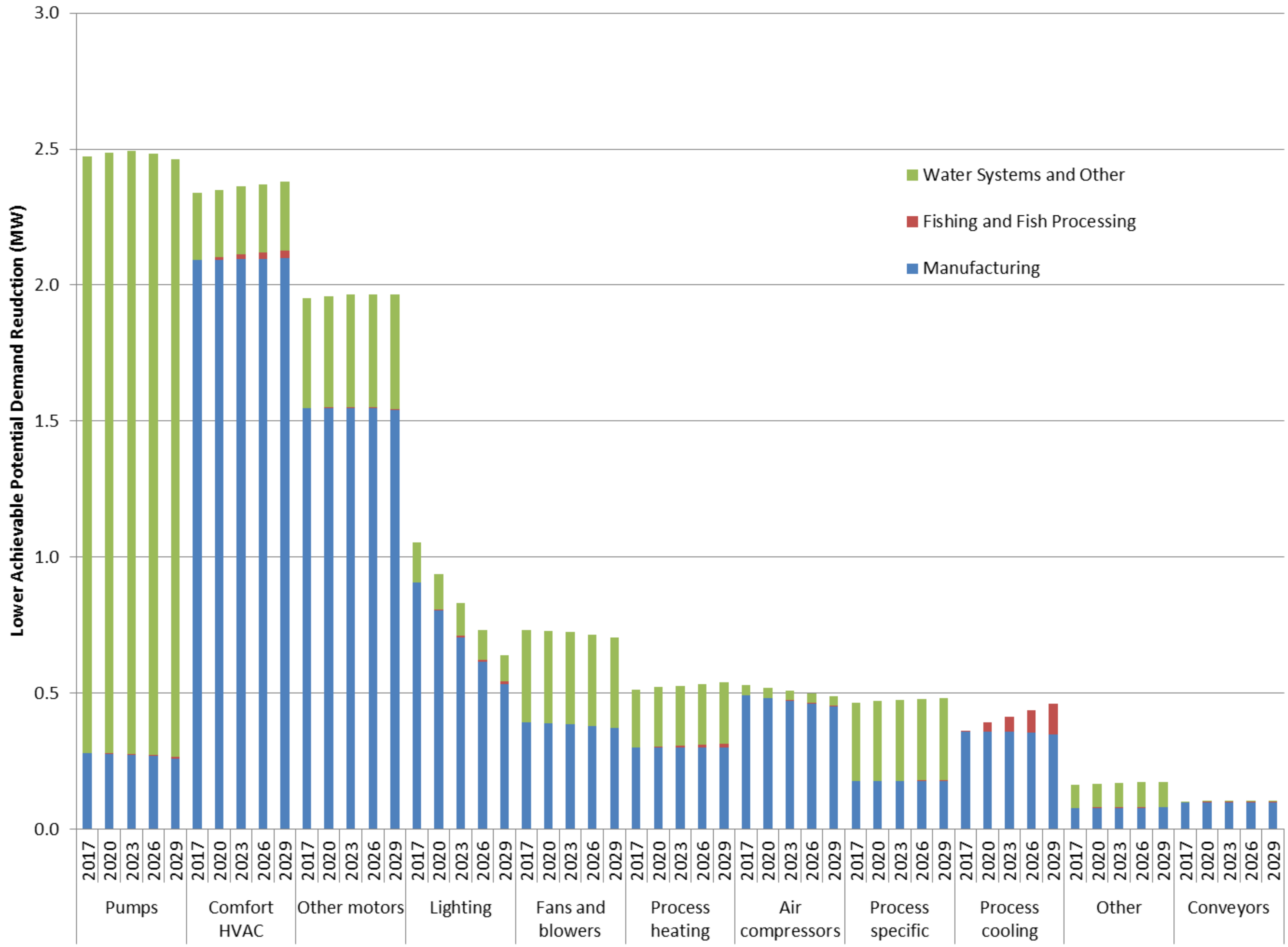
- As explained for previous Achievable Potential exhibits, in some cases, the potential shown for Lower Achievable is higher than for Upper Achievable. This occurs for measures that are late in the "cascade" of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much lower savings in the Lower Achievable than in the Upper Achievable scenarios, leaving more energy to be saved by later measures in the sequence. This is compounded if the later measures have strong adoption potential in the Lower Achievable scenario.
- Additionally, demand-specific measure savings will fluctuate based on the demand savings from conservation measures. The demand reference case to which demand-specific measures are applied already factors in the corresponding Upper or Lower Achievable demand savings from conservation measures. So the more peak demand reductions are generated through conservation measures, the less peak demand remains for demand-specific measures to reduce.
- This is particularly noteworthy for the curtailment demand measure, since cascading impacts could reduce the demand reduction levels shown here below what is expected based on current peak demand reduction arrangements. It is important to note that the model produce total demand reduction potentials in excessive of current curtailment arrangements, but that the model's cascade order will result in more of the total demand reduction potential being credited towards conservation measures and the demand-specific measures that precede curtailment in the cascade order.

Exhibit 74 Lower Achievable Potential Peak Demand Reduction by Major End Use, Year and Sub-sector (MW)



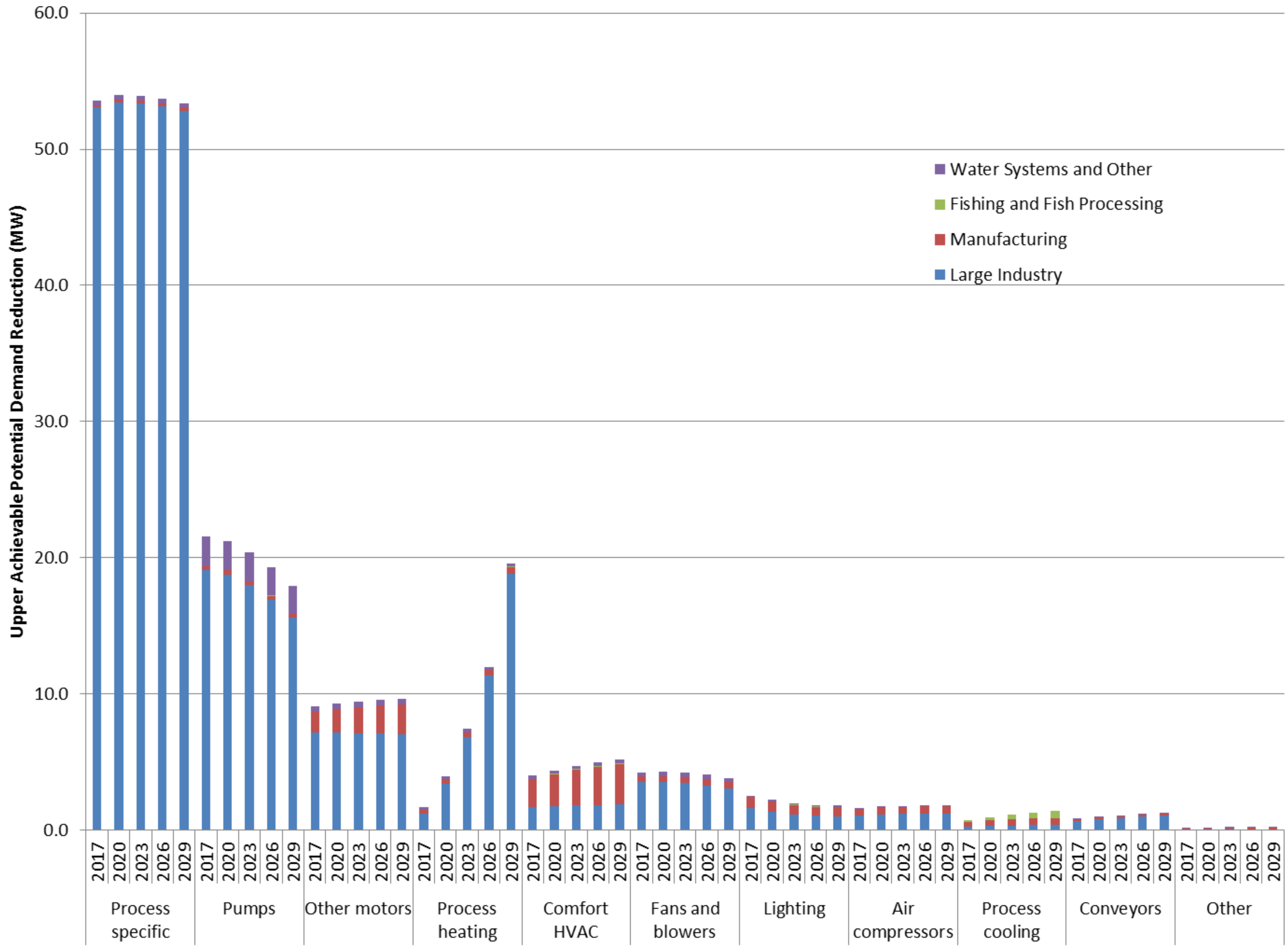
Note: The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered 'commercial' facilities.

Exhibit 75 Lower Achievable Potential Peak Demand Reduction by Major End Use for Small-Medium Industry, Year and Sub-sector (MW)



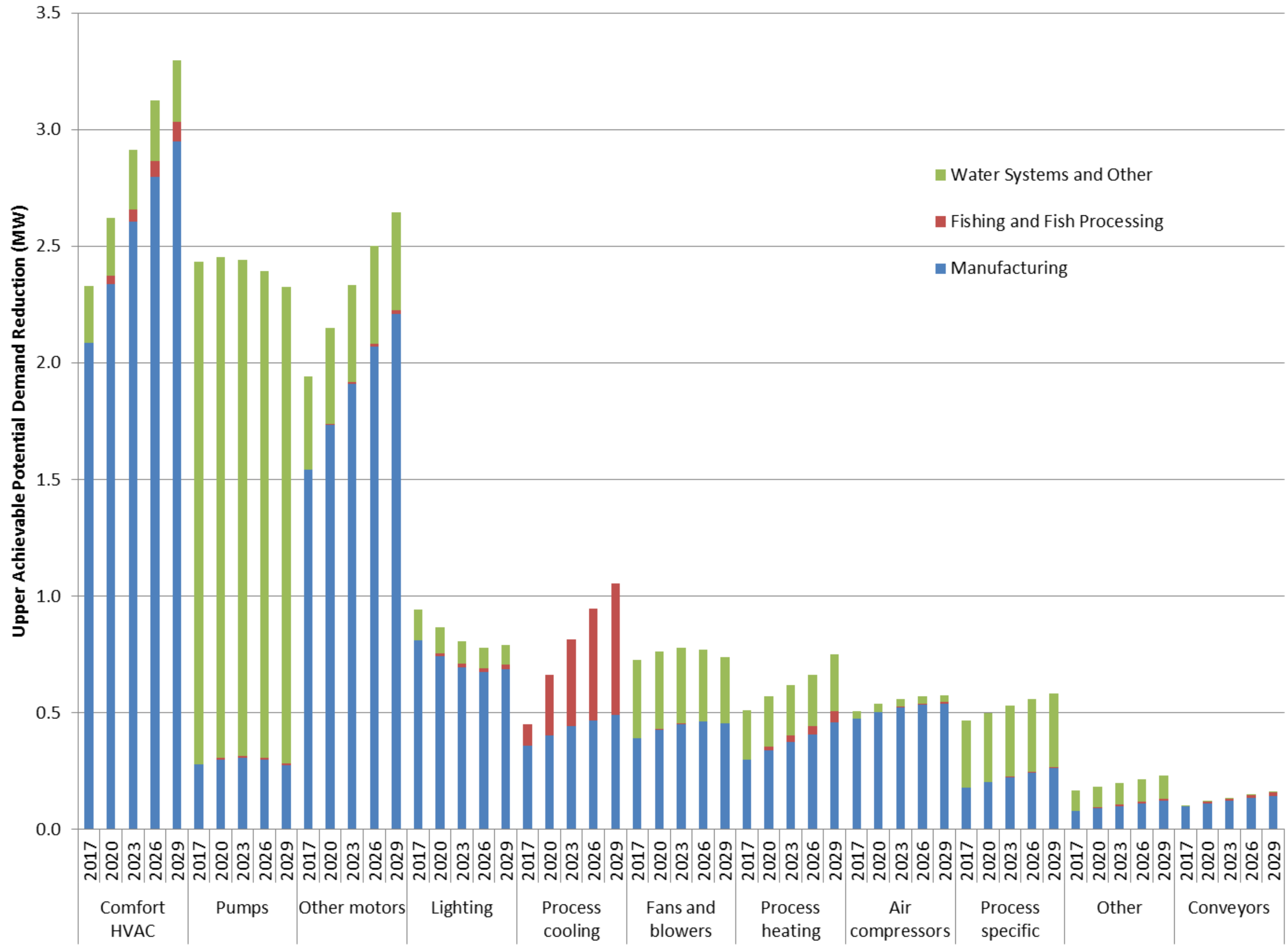
Note: The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered ‘commercial’ facilities.

Exhibit 76 Upper Achievable Potential Peak Demand Reduction by Major End Use, Year and Sub-sector (MW)



Note: As discussed previously, the manufacturing sub-sector also includes curtailment demand reductions from general service customer participants from the commercial sector

Exhibit 77 Upper Achievable Potential Peak Demand Reduction by Major End Use for Small-Medium Industry, Year and Sub-sector (MW)



Note: The manufacturing sub-sector also includes curtailment program reductions from Newfoundland Power general service participants otherwise considered 'commercial' facilities.

9.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Milestone Year

The Lower Achievable Potential peak load reductions decrease from 100 MW in 2017 to 96 MW in 2029. The Upper Achievable Potential peak load reductions increase from 100 MW in 2017 to 116 MW in 2029. All three measures have potential savings beginning with the first milestone year.

Peak Demand Reduction by Sub-Sector

Large industry accounts for approximately 95% of the potential peak load reductions in 2029; this reflects their larger market share and their generally higher level of electrical intensity per facility. Peak load reductions in Water Systems and Other account for 3% of the potential savings; Manufacturing account for 7% of the lower Achievable Potential savings, however a significant portion of these savings can be attributed to general service customers participating in Newfoundland Power's curtailment program, which are captured here but otherwise considered 'commercial' facilities in this study; and Fishing and Fish Processing account for 1% of the lower Achievable Potential savings.

Peak Demand Reduction by End Use

The measure with the most significant impact on peak demand reduction is Operational changes for reduced peak load (DR Curtailments). This measure, as well as Peak shifting through on-site storage and Power factor correction equipment, are applicable to all end uses.

Process specific load reductions initially account for approximately 54% of the total load reductions in the upper Achievable Potential Forecast, not including load reductions from energy efficiency measures, in 2017; this declines to 46% of the total by 2029.

Demand reduction in pump systems account for approximately 22% of the total load reductions in the upper Achievable Potential Forecast in 2017, not including load reductions from energy efficiency measures; this decreases to 15% of the total by 2029.

Demand reduction in process heating account for approximately 2% of the demand reductions in the upper Achievable Potential Forecast in 2017, not including reductions from energy efficiency measures; this increases to 17% of the total by 2029.

9.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Achievable Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

Exhibit 78 shows that the industrial lower Achievable Potential results are not sensitive to this range of avoided costs, as results remain similar in each scenario. By 2029, the exhibit shows almost unchanged energy savings and demand reductions in both upper and lower ranges. The lack of change in energy savings potential with different avoided costs is mainly because the cost of conserved energy for most industrial measures is well below the avoided costs in all three scenarios. This was illustrated by the supply curves in Sections 7.5 and 7.6.

Exhibit 78 Sensitivity of the Lower Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
All Regions	2017	18,856	102	19,188	102	21,537	102
	2020	53,198	105	57,009	105	58,185	106
	2023	106,121	109	108,002	109	108,017	109
	2026	170,137	114	170,436	114	170,431	114
	2029	244,008	119	244,363	119	244,350	119

Exhibit 79 shows that the 2029 industrial upper Achievable Potential results are also not sensitive to this range of avoided costs, as results remain similar in each scenario. In both exhibits, the primary change is in the upper range of reasonableness growing more quickly, as some measures that would not normally pass economic screens until later milestone years are included starting in 2017.[32]

Exhibit 79 Sensitivity of the Upper Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
All Regions	2017	71,663	107	72,541	107	77,160	107
	2020	164,371	118	170,535	119	170,543	119
	2023	279,767	132	284,877	133	284,897	133
	2026	408,343	148	409,407	148	409,442	148
	2029	543,663	166	545,014	166	545,044	166

The Data Manager file contains sensitivity analyses for both upper and lower Achievable Potential by region, which shows similar findings in that results in all regions are almost unchanged between scenarios in 2029.

[32] This change in the rate of measure adoption has a very minor impact on the overall final savings between scenarios. However, this change produces some counter intuitive results, whereby certain base scenario years are higher than the upper range scenario, because the latter scenario adopted certain measures sooner. This is simply a function of the model's architecture and the nature of the cascading measures so that they reduce the savings potential of subsequent measures. The result is a very minor difference, only apparent because of a lack of other differences between scenarios.

9.9 Net-to-Gross

Net-to-gross ratios are used to estimate the free-ridership occurring in CDM programs. Free riders are program participants who would have undertaken an efficiency or demand management measure naturally, even without the influence of the utility's program. A net-to-gross ratio is a factor that represents the net program impact divided by the gross program impact. The net impact can be found by multiplying the gross impact by the net-to-gross ratio.

Net-to-gross ratios have been estimated for many of the utility programs conducted in NL over the past several years. Though net-to-gross ratios are dependent on many factors, the estimates from previous programs were assumed to provide a reasonable approximation for the ratios in the near future. The majority of industrial measures in the present study were not explicitly included in past programs, so net-to-gross ratios were not available. This analysis uses net-to-gross ratios for similar measures from other sectors where possible, as well as an assumed to rate of 93% for many industrial measures. This value is based on programs in other jurisdictions and the assumption that free ridership tends to be low for capital intensive industrial projects reliant on utility support.

Sources:

The following sources were used to estimate the measure net-to-gross ratios shown in Exhibit 80:

- Net-to-gross ratios provided by Newfoundland Power, from evaluations of the CDM programs that have been run in the province.
- Ontario Energy Board TRC Guide recommendations.[33]
- Ontario Power Authority 2013 Conservation Results.[34]

Caviat:

The estimates produced by the models in this study are not purely gross achievable potential estimates, because the reference case includes some naturally occurring savings. In order to calibrate the model's reference case to the Utilities' load forecast, it was essential to make reasonable assumptions about what efficiency improvements customers would make during the study period, in the absence of new utility programs. The economic, upper achievable, and lower achievable potentials were all calculated from this reference baseline that includes some naturally occurring savings. If the results are then adjusted for net-to-gross ratios, the following adjustments are both being made in the model:

- Naturally occurring savings, from customers who would adopt the efficiency measures in the absence of new utility programs, are being accounted for in the reference case.
- Free-ridership, from customers who participate in a program but would have adopted the efficiency measures without its influence, are being accounted for in the net-to-gross ratio.

It appears likely that there is some double-counting between naturally occurring savings and free-ridership: some of the customers who would have adopted the measures naturally and some of the customers who would be free-riders in a program are actually the same people. Therefore, the exhibits shown below with net upper and lower achievable potential, are likely underestimates of the true net potential.

Results:

The net and gross achievable potential results are presented in the following four exhibits:

[33] Ontario Energy Board, *Total Resource Cost Guide.* October, 2006.
[34] Ontario Power Authority, *2013 Conservation Results*. December, 2014.

- Exhibit 80 shows the gross and net upper and lower achievable potential for energy efficiency, by measure for the year 2029, along with the net-to-gross ratios used
- Exhibit 81 shows the gross and net upper and lower achievable potential for demand reduction, by measure for the year 2029, along with the net-to-gross ratios used

At this time, net-to-gross ratios were not available for demand reduction programs in NL. Because these measures offer no financial advantages to the customer where time of use rates are not in use, free-ridership is assumed to be zero for these measures. The net-to-gross ratios are therefore assumed to be 1.0, and the net potential is equal to the gross potential.

Exhibit 80 Gross Versus Net Upper and Lower Achievable EE Potential by Measure, 2029

		Upper		Lower	
Measure	Assumed Net-to-Gross Ratio	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Premium Efficiency Pump Control with ASDs	0.93	74,234	69,038	28,994	26,964
Premium Efficiency Fan Control with ASDs	0.93	60,528	56,291	22,793	21,197
Energy Management Information System (EMIS)	0.93	53,206	49,482	28,417	26,428
Optimization of Pumping System	0.93	47,588	44,257	16,959	15,772
High Efficiency Lights (LEDs)	0.70	44,304	31,013	29,597	20,718
Organizational Energy Management (EM Team)	0.93	41,470	38,567	11,200	10,416
Correctly Sized Pumps: Impeller Trimming or Pump Selection	0.93	23,857	22,187	4,431	4,121
Sub-Metering	0.93	20,060	18,656	7,595	7,063
Operation and Maintenance (O&M) Program Supporting Efficiency	0.93	19,809	18,423	13,645	12,690
Process Optimization Efforts - Pulp and Paper	0.00	16,123	0	13,443	0
Integrated Plant Control System	0.93	14,750	13,718	6,408	5,959
Process Heat Recovery to Preheat Makeup Water	0.93	14,047	13,063	4,891	4,548
Air Leak Survey and Repair	0.90	11,475	10,328	8,267	7,440
Premium Efficiency ASD Compressor	0.90	10,925	9,832	4,945	4,451
Correctly Sized Fans: Impeller Trimming or Fan Selection	0.93	10,009	9,308	3,147	2,926
Advanced ‘Predictive’ Process Control Systems	0.00	9,326	0	2,736	0
Optimized Motor Control	0.93	7,235	6,729	3,168	2,946
Optimized Distribution System (Incl. Pressure and Air End-Uses)	0.93	6,804	6,328	3,785	3,520
Optimized Distribution System (Incl. Pressure Losses)	0.93	6,803	6,327	3,047	2,834

Exhibit 80 Continued: Gross Versus Net Upper and Lower Achievable EE Potential by Measure, 2029

		Upper		Lower	
Measure	Assumed Net-to-Gross Ratio	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Automated Lighting Controls	0.80	4,887	3,909	4,013	3,211
Insulation	0.75	4,439	3,329	2,245	1,684
Process Optimization Efforts - Mining and Processing	0.93	4,090	3,804	2,779	2,584
High-Efficiency Lighting Design	0.80	3,818	3,054	2,462	1,969
Correctly Sized Motors	0.93	3,377	3,141	1,024	952
Premium Efficiency Pump Motor	0.75	3,099	2,324	1,175	881
Premium Efficiency Motors	0.75	3,087	2,315	1,363	1,022
Optimized Conveyor Motor Control	0.93	2,988	2,779	1,358	1,263
Premium Efficiency Refrigeration Control System and Compressor Sequencing	0.93	2,586	2,405	707	658
Premium Efficiency Motors for Fans and Blowers	0.75	2,262	1,697	874	655
Use Cooler Air from Outside for Make Up Air	0.93	2,226	2,070	1,367	1,271
Automated Temperature Control	0.93	2,070	1,925	1,461	1,359
Reduced Temperature Settings	0.93	2,045	1,901	1,476	1,373
High Efficiency Chiller	0.90	1,470	1,323	794	714
Free Cooling	0.93	1,287	1,197	661	615
High-Efficiency Packaged HVAC	0.93	1,285	1,195	317	295
Premium Efficiency Conveyor Motors	0.75	1,010	758	458	343
Synchronous Belts	0.93	990	920	448	417
Smart Defrost Controls	0.93	923	858	240	223
Optimized Sizes of Air Receiver Tanks	0.93	865	805	664	617
Improve Insulation of Refrigeration System	0.93	801	745	170	158
Improved Ice Production System	0.93	486	452	122	113
Air Compressor Heat Recovery	0.93	411	382	96	90
Optimized Distribution System	0.93	410	381	139	129
Chiller Economizer	0.93	379	353	129	120
Heat Pumps	0.93	330	307	61	56
Sequencing Control	0.93	319	297	207	193
Floating Head Pressure Controls	0.93	207	193	56	52
Ventilation Optimization	0.93	195	181	0	0
Air Curtains	0.93	75	70	20	19
High Efficiency Oven/Dryer/Furnace/Kiln	0.93	38	35	7	6
Process Optimization Efforts - Fishing and Fish Processing	0.93	6	6	4	4
Ventilation Heat Recovery	0.85	1	1	0	0
Warehouse Loading Dock Seals	0.75	0	0	0	0

Exhibit 80 Continued: Gross Versus Net Upper and Lower Achievable EE Potential by Measure, 2029

		Upper		Lower	
Measure	**Assumed Net-to-Gross Ratio**	**Gross Upper Achievable Potential (MWh/yr.)**	**Net Upper Achievable Potential (MWh/yr.)**	**Gross Lower Achievable Potential (MWh/yr.)**	**Net Lower Achievable Potential (MWh/yr.)**
Improved Building Insulation	0.00	0	0	0	0
HVAC Air Curtains	0.00	0	0	0	0
Process Optimization Efforts - Oil Refining	0.00	0	0	0	0
Grand Total	0.86	545,014	468,657	244,363	203,042

Exhibit 81 Gross Versus Net Upper and Lower Achievable Demand Reduction Potential by Measure, 2029

		Upper		Lower	
Measure	**Assumed Net-to-Gross Ratio**	**Gross Upper Achievable Potential (MWh/yr.)**	**Net Upper Achievable Potential (MWh/yr.)**	**Gross Lower Achievable Potential (MWh/yr.)**	**Net Lower Achievable Potential (MWh/yr.)**
Operational changes for reduced peak load (DR Curtailments)	1.00	108	108	92	92
Peak Shifting through on-site storage	1.00	1	1	0	0
Power factor correction equipment	1.00	7	7	4	4
Grand Total	1.00	116	116	96	96

10 References

The sources listed below include references used in preparation of this report and additional resources likely to be helpful for research on energy consumption patterns and efficient technologies. Additional references on specific technologies can be found in the TRM Analysis workbooks, supplied as accompanying deliverables with this report.

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11 Glossary

Achievable Potential:
The portion of the economic conservation potential that is achievable through utility interventions and programs given institutional, economic and market barriers.

Avoided Cost:
By reducing electricity consumption and capacity requirements through the implementation of conservation and demand management programs, the NL utilities avoid the cost of having to buy electricity on the open market, contract for long term supply, and/or build and run new generation facilities. This avoided cost is used to develop a benchmark against which the cost of energy efficiency measures can be compared.

Base Year:
The base year for the 2015 CDM potential assessment is the 2014 sales for the two utilities. This number is derived from 2014 sales and forecast 2014 electric energy and capacity requirements as is explained in each report.

Benchmark for Economic Analysis:
The study established benchmarks for the economic cut-off for new avoided electrical supply on each of the different supply systems in NL. These values were selected to provide the CDM potential assessment with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost-effective over time. The following values were used:

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.11	$0.04	$0.21
2017	$0.13	$0.04	$0.23
2020	$0.05	$0.05	$0.26
2023	$0.06	$0.05	$0.29
2026	$0.07	$0.06	$0.34
2029	$0.08	$0.07	$0.37

Cost of Conserved Energy (CCE):
The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Cost of Electric Peak Reduction (CEPR):
The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.

Conservation and Demand Management (CDM):
CDM is the influencing of customers' electricity use to obtain desirable and quantifiable changes in that use. For example, CDM comprises such cooperative joint customer and utility initiatives as peak

clipping, valley filling, load shifting, strategic conservation, strategic load growth, flexible load shape, customer on-site generation and other similar activities.

Economic Potential:
The Economic Potential is the savings in electricity consumption due to energy efficient measures whose Cost of Conserved Energy (CCE) is less than or equal to the Benchmark for Economic Analysis.

Effective Measure Life (EML):
The estimated median number of years that the measures installed under a program are still in place and operable. EML incorporates: field conditions, obsolescence, building remodelling, renovation, demolition, and occupancy changes.

Electricity Audit:
An on-site inspection and cataloguing of electricity-using equipment/buildings, electricity consumption and the related end uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, for CDM program design, and identifying specific energy savings projects.

Electric Capacity:
The maximum electric power that a device or network is capable of producing or transferring.

Electricity Conservation:
Activities by utilities or electricity users that result in a reduction of electric energy use without adversely affecting the level or quality of energy service provided. Electricity conservation measures include substitution of high-efficiency motors for standard efficiency ones, occupancy sensors in office buildings, insulation in residences, etc.

Electricity Efficiency:
The ratio of the useful energy delivered by a dynamic system to the amount of electric energy supplied to it.

Electric Energy:
Energy in the form of electricity. Energy is the ability to perform work. Electric energy is different from electric power. Electric energy is measured in kilowatt-hours, megawatt-hours or gigawatt-hours.

Electricity Intensity:
Electric energy use measured per application or end use. Examples would include kilowatt-hours per square meter of lit office space per day, kilowatt-hours per tonne of pulp produced, and kilowatt-hours per year per residential refrigerator. Electricity intensity increases as electricity efficiency decreases.

Electric Power:
The rate at which electric energy is produced or transferred, usually measured in watts, kilowatts and megawatts.

End use:
The services of economic value to the users of energy. For example, office lighting is an end use, whereas electricity sold to the office tenant is of no value without the equipment (light fixtures, wiring, etc.) necessary to convert the electricity into visible light. End use is often used interchangeably with energy service.

Energy Service:
An amenity or service supplied jointly by energy and other components such as buildings, motors and lights. Examples of energy services include residential space heating, commercial refrigeration, paper production, and lighting. The same energy service can frequently be supplied with different mixes of equipment and energy.

Financial Incentive:
Certain financial features in the utility's conservation and demand management programs designed to motivate customer participation. These may include features designed to reduce a customer's net cash outlay, pay-back period or cost of finance to participate in a specific conservation and demand management measure or technology.

Flexible Load Shape:
This is utility action to present customers with variations in service quality in exchange for incentives. Programs involved may be variations of interruptible or curtailable load, concepts of pooled, integrated energy management systems, or individual customer load control devices offering service constraints.

Gigawatt-hour (GWh):
One gigawatt-hour is one million kilowatt-hours.

Integrated Planning or Integrated Resource Planning (IRP):
See Supply Planning.

Integrated Electricity Planning (IEP):
See Supply Planning.

Kilowatt (kW):
One thousand watts; the basic unit of measurement of electric energy. One kilowatt-hour represents the power of one thousand watts (one kilowatt) for a period of one hour. A typical non-electrically heated detached home in NL uses about 10,700 kWh per year. A four foot fluorescent lamp in an office might use about 100-200 kWh per year and a large coal-fired plant might produce about three billion kWh per year.

Levelized Cost of Conservation (LCC):
The LCC is calculated for each energy efficiency measure. The LCC is the annualized incremental capital and O&M cost of the measure divided by the annual energy conserved, excluding any administrative or program costs. The LCC represents the cost of generating or conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity. In the context of industrial energy efficiency measures, it is essentially the same as the cost of conserved energy (CCE), which is the term used in this report.

Load Forecast:
This is a forecast of electricity demand over a specified time period. Long-term load forecasts usually pertain to a 10 to 20-year period. In the case of NL, the load forecast assumes a specific set of rates or prices for electricity and competing energy forms, as well as many other economic variables. In addition, forecasts of electricity conserved through CDM programs are incorporated into the Supply Planning process.

Load Research:
Research to disaggregate and analyze patterns of electricity consumption by various sub-sectors and end uses is defined as load research. Load research supports the development of the load forecast and the design of conservation and demand management programs.

Load Shape:
The time pattern and magnitude of a utility's electrical demand.

Load Shifting:
Utility program activity to shift demand from peak to off-peak periods is defined as load shifting.

Measure Total Resource Cost (TRC):
The measure TRC calculates the net present value of energy savings that result from an investment in an energy-efficiency measure. The measure TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual energy and O&M costs. This calculation includes, among others, the following inputs: the avoided electricity supply costs, the life of the technology, and the selected discount rate, which in this analysis has been set at 7%.

A measure with a positive measure TRC value is included in subsequent stages of the analysis, which consists of the Economic and Achievable Potential scenarios. A measure with a negative TRC value is not economically attractive and is therefore not included in subsequent stages of the analysis.

Megawatt (MW):
One thousand kilowatts.

Natural Change in Electricity Intensity:
The future change in electricity intensity in a given end use that is expected to occur in the absence of conservation and demand management programs. In developing an estimate of natural change in electricity intensity it is necessary to make an explicit assumption about the future prices of electricity and competing fuels.

Peak Clipping:
Utility program activity to reduce peak demand without reducing demand at other times of the day or year.

Peak Demand:
Peak demand is the maximum electric power required by a customer or electric system during a short time period, typically one hour. The peak is the time (usually of day or year) at which peak demand occurs. The peak period of interest in NL is from 7 a.m. to noon and 4 p.m. to 8 p.m. on the four coldest days of the winter, for a total of 36 hours.

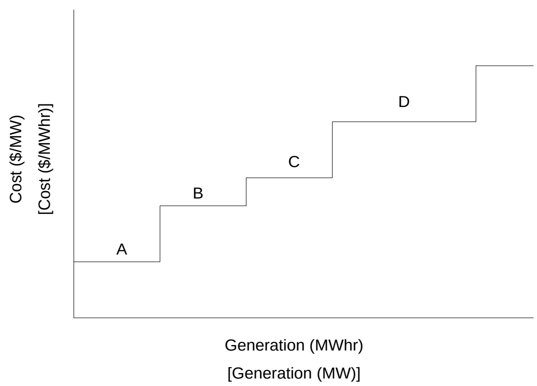
Rate Structure:
The formulas used to calculate charges for the use of electricity. For example, the present rate structures for both NL utilities for most industrial customers consists of a fixed monthly charge and charges for both electric energy usage and monthly peak demand usage.

Reference Case:
Provides a forecast of electricity sales that includes natural conservation (that which would occur in the absence of CDM programs) but no impacts of utility CDM programs. The reference case for the study is based on the 2014 base year and the Utilities' Load Forecast.

Sector:
A group of customers having a common type of economic activity. This CDM potential assessment includes the Residential, Commercial, and Industrial sectors.

Sub-sectors:
A classification of customers within a sector by common features. Industrial sub-sectors are generally grouped by size (electrical intensity) and type of processes. Commercial sub-sectors are generally by type of commercial service (retail and wholesale trade). Residential sub-sectors are by type of home (single-family dwelling or apartment). Commercial sub-sectors are generally by type of commercial service (retail and wholesale trade).

Supply Curves:
A graph that depicts the volume of energy at the appropriate screened price in ascending order of cost. Steps A through D below represent programs options, or technologies arranged as a supply curve.



Supply Planning:
The process of long-term planning of electricity generation and associated transmission facilities, in combination with supply reductions made possible through conservation and demand management, in order to meet forecast demands. Supply Planning in NL is done in a framework that recognizes economic, financial, environmental and social costs, risks, and impacts.

Technical Efficiency:
Efficiency of a system, process, or device in achieving a certain purpose, measured in terms of the physical inputs required to produce a given output. In the context of electricity conservation the relevant input is electric energy.

Technology-Based Potential:
Energy and or capacity/demand savings realized through the implementation of energy-efficiency technologies.

Watt:
The basic unit of measurement of electric power.

Appendix A Background-Section 3: Base Year Electricity Use

Introduction

Appendix A provides additional detailed information related to each of the major steps employed to generate the profile of Industrial sector Base Year electricity use. The major steps involved are:

- **Step 1:** Determine total base year consumption
- **Step 2:** Develop electricity end-use profiles by sub-sector and region
- **Step 3:** Estimate breakdown of electricity consumption for the study Base Year of 2014

A.1 Step 1: Determine Total Base Year Consumption

Utility sales data for 2014 was used to establish the base year consumption by sub-sector and region. The segmentation of data received from the Utilities is discussed below.

The Large industrial category is modeled as three separate sub-sectors, but the results are presented together to maintain customer confidentiality. The sales data used to build up the base case for each sub-sector was received from the Utilities as follows:

- **Pulp and Paper** - This sub-sector includes consumption for the following facility:
  - Corner Brook Pulp & Paper

- **Oil Refining** - This sub-sector includes consumption for the following facility:
  - North Atlantic Refining

- **Mining and Processing** - This sub-sector includes consumption for the following facilities:
  - Iron Ore Company of Canada
  - Vale - Long Harbour
  - Praxair - Long Harbour
  - All small-medium Mining metered accounts (by rate class for each region)

The small-medium sub-sectors used in the modeling are indicated below. Along with each of these sub-sectors are the categories for which the Utilities provided sales data (which also guided the sub-sector selection):

- **Fishing and Fish Processing** - This sub-sector includes consumption for the following facilities:
  - All small-medium Fishing and Fish Processing accounts (by rate class for each region)

- **Manufacturing** - This sub-sector includes consumption for the following facilities:
  - All small-medium Manufacturing accounts (by rate class for each region)

- **Water Systems and Others** - This sub-sector includes consumption for the following facilities:
  - All small-medium 'Comm & Util - Water Systems' accounts (by rate class for each region)
  - All small-medium Sawmill accounts (by rate class for each region)

The 2014 consumption data provided for each of these categories was summed to get sub-sector totals in each region. Rate class divisions were also captured with the Data Manager tool, to enable additional analysis of this data.

Once again, each of these sub-sectors is modeled separately for each region. However, the base year consumption presented below in Exhibit A 1 combines all regions and all Large Industrial sub-sectors.

Exhibit A 1 Base Year Industrial Utility Data from 2014, by Sub-Sector

Sub-Sectors	2014 Consumption (MWh)	Number of Metered Accounts	Portion of Consumption
Large Industry	2,828,377	132	89%
Fishing and Fish Processing	128,368	599	4%
Manufacturing	136,074	1,027	4%
Water Systems and Other	76,585	1,425	2%
Grand Total	**3,169,404**	**3,183**	100%

Note that the number of metered accounts included in the diagram above is not reflective of the number of facilities. These account numbers include separate accounts for different meters, and a lot of these industrial facilities have multiple meters. Also note that the metered account numbers presented for Large Industry also contain the small-medium component of the Mining sub-sector, which accounts for all but five of these accounts.

A.2 Step 2: Develop Electricity End Use Profiles

The next major task involved the development of electricity end use profiles for each of the six sub-sectors covered in this study. These profiles indicate what portion of a facility's total electricity consumption is consumed by each of the different types of equipment (end uses) at the facility.

Separate end use breakdowns were developed for each Large Industrial facility and for each of the small-medium sub-sectors. These breakdowns were then combined through weighted averages to produce a single representative breakdown for each sub-sector in each region, based on the relative consumption associated with each breakdown in the base year.

Exhibit A 3 summarizes the sources used to develop the end use profiles for each of the sub-sectors.

Exhibit A 2 Data Sources for End Use Breakdown Development

Sub-Sector	Sources for End Use Breakdowns
Pulp and Paper	Based on a survey completed by Corner Brook Pulp & Paper in January 2015. Note that refiners and agitators are included in the 'other motors' category.
Oil Refining	Based on a survey completed by North Atlantic Refining in January 2015.
Mining and Processing	Based on a consumption-weighted average of breakdowns from the following sources: ▪ A survey completed by the Iron Ore Company of Canada in January 2015. ▪ A survey completed by Vale - Long Harbour in January 2015. ▪ An estimate of cryogenic air separation unit electricity consumption. ▪ A breakdown developed with local industry experts as part of the 2008 NL study, and mining breakdowns from past ICF studies.
Fishing and Fish Processing	Based on four Commercial End Use Survey audits of relevant NL facilities, the Fish and Fish Processing breakdown developed with local industry experts as part of the 2008 NL study, and on relevant breakdowns from past ICF studies in similar regions.
Manufacturing	Based on three Commercial End Use Survey audits of relevant NL facilities, the manufacturing breakdown developed with local industry experts as part of the 2008 NL study, and on relevant breakdowns from past ICF studies in similar regions.
Water Systems and Other	Based on a Commercial End Use Survey audit of one relevant NL facility, a breakdown developed by ICF based on past energy audits and regional water system studies, as well as ICF's understanding of energy consumption in sawmills. Note that more than 95% of consumption in this sub-sector is made up by Water Systems.

Once again, these profiles map proportionally how much electricity is used by each of the end uses for each sub-sector. Exhibit A 3 summarizes the end use profiles for each of the sub-sectors. While this exhibit presents an average breakdown representing all regions of this study, the modeling does use separate breakdowns for different regions, where the differences between each region are clearly understood (Large industry).

Exhibit A 3 Sub-Sector Electricity End Use Profiles

Level 1	Level 2	Level 3	Large Industry	Fishing and Fish Processing	Manufacturing	Water Systems and Other
Process	Process heating		10%	8%	3%	3%
	Process cooling		0%	53%	6%	0%
	Motors and motor driven equipment	Air compressors	4%	3%	10%	1%
		Pumps	18%	5%	6%	62%
		Fans and blowers	16%	1%	8%	9%
		Conveyors	5%	4%	2%	0%
		Other motors	18%	4%	29%	10%
	Process Specific		24%	2%	3%	8%
Comfort	Lighting		2%	7%	15%	3%
	HVAC		2%	12%	17%	3%
Other			0%	1%	1%	1%

A.3 Step 3: Estimation of Base Year Electricity Consumption

The next step was to calculate how the base year electricity is consumed, based on the previously established total base year consumption and the base year electricity end use profiles. Electricity consumption in each sub-sector in each region is multiplied by the appropriate end use breakdown.

For example, the end use electricity consumption for each sub-sector is calculated by the following equation:

$$EndUse_{1\text{-}2} = Sub\text{-}Sector_{2} * Breakdown_{1\text{-}2}$$

Where: *$EndUse_{1\text{-}2}$ = Electricity consumption for end use type #1 in sub-sector #2*
$Sub\text{-}Sector_{2}$ = Total annual consumption (kWh) for sub-sector #2
$Breakdown_{1\text{-}2}$= End use profile breakdown (%) for end use type #1 in sub-sector #2

The Industrial sector consumption is assessed based on total electricity consumption by sub-sector, not by unit-energy consumption per plant or piece of equipment. For this reason, the Industrial sector only considers electricity consumption, unlike the Residential and Commercial sectors, and does not track natural gas or other fuel used in these facilities. The profiles or sub-sector archetypes that were used in the model to calculate the consumption by end use, sub-sector, and region, were based on plant electricity consumption, not plant energy consumption. As such, some modeling parameters, such as saturations of electrical equipment and fuel share, are kept at 100% for the Industrial sector.

This approach is preferred in the Industrial sector where there is larger variability between facilities and production metrics, even within a given sub-sector. Basing the analysis off actual base year data also eliminates the need for iterative calibration of base year model inputs, required in the other sectors to have them match sales data.

Exhibit A 4 summarizes the base year electricity consumption by end use and sub-sector. Once again, this is a summary of the results for all regions, where the model uses separate end use profiles to calculate these breakdowns independently for each region. So while this table matches Exhibit 7 (which appears in Section 3 of the main body of the report), equivalent base year electricity consumption exhibits are available in Data Manager for the Island Interconnected, Labrador Interconnected, and Isolated regions. This section also does not replicate the pie charts presented in Section 3. Those graphs, along with other regional data are available in, or can be created using, the Data Manager.

Exhibit A 4 Electricity Consumption by End Use and Sub-Sector in the Base Year (2014), All Regions (MWh/yr.)

	Reference Case Consumption (MWh/yr.)					
Sub-Sector	Air compressors	Comfort HVAC	Conveyors	Fans and blowers	Lighting	Other
Large Industry	114,864	63,253	139,539	451,374	66,231	1,816
Fishing and Fish Processing	3,662	15,927	5,100	1,266	8,878	1,663
Manufacturing	13,359	22,895	2,544	11,100	20,518	1,061
Water Systems and Other	742	2,013	39	7,221	2,437	883
Grand Total	132,627	104,087	147,222	470,962	98,064	5,424

	Reference Case Consumption (MWh/yr.)					
Sub-Sector	Other motors	Process cooling	Process heating	Process specific	Pumps	Grand Total
Large Industry	516,357	3,880	271,244	681,186	518,634	2,828,377
Fishing and Fish Processing	5,339	68,032	9,830	2,014	6,656	128,368
Manufacturing	39,644	7,951	4,121	4,759	8,121	136,074
Water Systems and Other	7,692	-	2,228	5,814	47,516	76,585
Grand Total	569,033	79,863	287,423	693,774	580,927	3,169,404

Appendix B Background-Section 4: Base Year Peak Load

Introduction

Appendix B provides additional detailed information related to each of the major steps employed in the generation of the Industrial sector Base Year peak loads. The discussion is organized as follows:

- Overview of peak load methodology
- Segmentation of industrial sub-sectors
- Hours-Use factors
- Detailed results.

B.1 Overview of Peak Load Profile Methodology

As noted in the main text, development of the electric peak load estimates employs four specific factors as outlined below:

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. This allocation factor can be obtained from either (in decreasing order of priority): (a) monthly consumption statistics from end-use load studies; (b) monthly seasonal sales (preferably weather normalized) obtained by subtracting a “base” month from winter and summer heating and cooling months; or (c) heating or cooling degree days on an appropriate base.

- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.

- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.

- **Per Unit Hourly Factor:** The relationship of load among different hours of the day for each day type (weekday, weekend day, peak day) and for each month reflects the operating hours of the electric equipment or end use within residences by sub-sector. For example, for lighting, this would be affected by time of day, season (affected by daylight), and room type, where applicable. For the Base Year, lighting is treated on an aggregate basis by total facility.

The four factors (sets of ratios) defined above provide the basis for converting annual energy to any hourly demand specified including the grouping of hours used in the four peak periods defined in this study. Exhibit B 1, below, illustrates how each of the above four factors is applied sequentially to a known annual energy value to produce a peak load value, defined as a specific peak period. In the example, the Annual Peak Hour is used.

Exhibit B 1 Illustrative Application of Annual Energy to Peak Period Value Factors

The Annual Peak Hour demand is computed based on the December peak day at 6 pm. The NL peak is assumed to occur in December, although the model allows for a January peak, as well. The following steps are required:

- **Step 1:** The monthly usage allocation factor for December is applied to the annual energy use to calculate December energy use.
- **Step 2:** The average weekday in December is calculated based on the formula shown below, which adjusts the average day type use to reflect any difference in typical weekend use versus typical weekday use.

  1 / [Days in Month * (5/7 + 2/7 * Weekend Ratio)]

- **Step 3:** The peak day factor is then applied to the average weekday electric energy use to determine the peak day use (as defined by the NL utilities).
- **Step 4:** The peak hour is then calculated based on allocating the peak day use according to the per unit hourly load factor for a peak winter (December) day, using the percentage of use in that hour versus the daily usage for the December peak day.

It should be noted that the methodology shown in Exhibit B 1 produces aggregate diversified average loads for all customers or end uses in the defined sub-sector.

Exhibit B 2 provides a specific numeric example for the calculation of Annual Peak Hour demand (kW). The example presented in Exhibit B 2 is for electric water heating in a manufacturing plant. The example shows how the annual consumption of 33,000 kWh can be converted to a peak demand value for the Annual Peak Hour by the calculation of a corresponding hours-use value.[35]

Exhibit B 2 Sample Hours-Use Calculation for Electric Water Heating

Annual Peak Hour (7 pm Winter Peak) =

$$\frac{Annual\ kWh\ \times Mo.Allocation}{Days\ in\ Month \times \left[\frac{5}{7} + \left(\frac{2}{7} \times Weekend\ Ratio\right)\right]} \times Peak\ Day\ Factor \times Peak\ Hour\ \%\ Daily\ kWh$$

Annual Peak Hour (7 pm Winter Peak) =

$$\frac{33{,}000\ [\text{Ann. kWh}] \times\ 8.72\%\ [\text{Mo. Alloc.}]}{31 \times \left[\frac{5}{7} + \left(\frac{2}{7} \times 1.0\ [\text{Dec. Wkend Ratio}]\right)\right]} \times 1.0\ [\text{Dec. Peak Day Fact.}] \times 0.035022\ [\text{Peak Hr \% Day kWh}]$$

= 3.25 kW

$$\frac{33{,}000\ [\text{annual kWh}]}{3.25\ [\text{7 pm Winter Peak}]} = 10{,}151\ [\text{Annual Peak Hour Hours Use}]$$

This means that any applicable manufacturing plant annual water heating kWh can be converted to demand at winter peak hour (7 pm) by dividing by 10,151.

[35] This is a sample calculation that does not use numbers or a peak period relevant to this study.

For other peak periods, such as the morning and evening periods of the four coldest winter days used in this study, different sets of hours are used, with calculations corresponding to the above steps. The resulting relationship between annual use and peak can be defined in terms of an hours-use factor, the ratio of the annual energy to the peak, for the defined peak period.

B.2 Segmentation of Industrial Sub-Sectors

The Industrial sector segmentation used to generate the electric peak load profiles is the same as that used for electric energy use. That is, there is a load profile that corresponds to each combination of sub-sector and end use.

Exhibit B 3 shows the industrial sub-sectors and end uses that were addressed.

Exhibit B 3 Industrial Sub-Sectors Used for Electric Peak Load Calculations

Sub-Sector (Mining and Processing, Pulp and Paper, Oil Refining, Fishing and Fish Processing, Manufacturing, and Water Systems and Other)
End Use (Process heating, Process cooling, Air compressors, Pumps, Fans and blowers, Conveyors, Other motors, Process specific, Lighting, Comfort HVAC, and Other)

B.3 Hours-Use Factors

Exhibit B 4 describes the assumptions and data sources for the load profile factors that were used to develop the corresponding hours-use factors. To produce a demand for a combination of sub-sector and end use, the corresponding annual energy is divided by the hours-use factor for the peak period for the applicable load shape. For certain end uses that are assumed to have no usage during the winter months (e.g., space cooling) the hours-use values are considered infinite (noted by 1E+15), resulting in virtually zero demand when divided into annual energy.

Most of the studies referenced in the exhibit are the same as those used to develop hours-use factors for the CDM Potential Study completed for NL in 2008 and are also the same as those used for studies in other provinces. For most end uses, hours-use factors remain very stable from year to year and across jurisdictions, as long as the peak period of interest is the same. The amount of energy consumed varies from year to year and from place to place, but the shape of the load – when the energy is used – remains very similar.

In this analysis, therefore, the initial estimate of industrial peak demand used the hours-use factors from a similar study for another Canadian utility that ICF completed, since this approach had not been used in the industrial portion of the 2008 CDM Potential study for NL. The results were within a few percent of utility measured values. The team then calibrated the model by adjusting the hours-use factors for the weather-sensitive end uses (such as space heating) for all three sectors simultaneously, until the model peak demand output agreed closely with the Utilities' measured peak demand.

Exhibit B 4 Industrial End Use Load Shape Parameters

Load Shape #	End Use	Sub-Sector	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
3001	Process heating	All sub-sectors	Calculated in a past CDM study for 'All Industrials'	1.0 (24/7, based on Fleming Hours Use study)	1.0 Assumed	Flat – Past CDM study, Hours of Use Study by A. Fleming[36] 24

[36] Rochester Gas & Electric Company; 1991 DSM Evaluation Report Load Shape workpapers.

Exhibit B 4 Continued: Industrial End Use Load Shape Parameters

Load Shape #	End Use	Sub-Sector	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
						hours/day, 7 days/wk. 51 wks/yr.
3003	Process cooling	All sub-sectors	Calculated in a past CDM study for 'All Industrials'	RG&E retail refrigeration reflects 6-7days/wk operation from Fleming Study	RG&E retail refrigeration (summer >1)	RG&E retail refrigeration[37] modified to reflect 16 hrs/6-7days/50-51 weeks operation from Fleming Study
3005	Pumps	Large Industry	Calculated in a past CDM study for 'Non-agriculture Industrials'	1.0 assumed, reflects 7-day operation from Fleming Study	1.0 Assumed	Nearly flat, reflects 23/7/52 operation from Fleming Study
3006	Pumps	Small-Medium sub-sectors	Calculated in a past CDM study for 'Agriculture and Other industrials'	0.25 assumed, reflects 5-day operation from Fleming Study	1.0 Assumed	Nearly flat weekday, reflects 23/5/50 operation from Fleming Study
3008	Fans and Blowers	Large Industry	Calculated in a past CDM study for 'Non-agriculture Industrials'	0.6 assumed, reflects 5-7-day operation from Fleming Study	1.0 Assumed	Nearly flat, reflects 22/5-7/51 operation from Fleming Study
3009	Fans and Blowers	Small-Medium sub-sectors	Calculated in a past CDM study for 'Agriculture and Other industrials'	0.25 assumed, reflects 5-day operation from Fleming Study	1.0 Assumed	Nearly flat, reflects 22/5/51 operation from Fleming Study
3011	Conveyors and Other motors	Large Industry	Calculated in a past CDM study for 'Non-agriculture Industrials'	0.6 assumed, reflects 5-7-day operation from Fleming Study	1.0 Assumed	Somewhat flat, reflects 17/5-7/50-51 operation from Fleming Study
3012	Conveyors and Other motors	Small-Medium sub-sectors	Calculated in a past CDM study for 'Agriculture and Other industrials'	0.25 assumed, reflects 5-day operation from Fleming Study	1.0 Assumed	Somewhat flat, reflects 17/5/50 operation from Fleming Study
3014	Compressed air	Large Industry	Calculated in a past CDM study for 'Non-agriculture Industrials'	0.6 assumed, reflects 5-7-day operation from Fleming Study	1.0 Assumed	Mostly flat, reflects 19/5-7/50-52 operation from Fleming Study
3015	Compressed air	Small-Medium	Calculated in a past CDM study for 'Agriculture	0.25 assumed, reflects 5-day	1.0 Assumed	Mostly flat, reflects 19/5/50 operation from Fleming Study

[37] Ibid.

Exhibit B 4 Continued: Industrial End Use Load Shape Parameters

Load Shape #	End Use	Sub-Sector	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
		sub-sectors	and Other industrials'	operation from Fleming Study		
3017	Process specific	Small-Medium sub-sectors	Calculated in a past CDM study for 'Agriculture and Other industrials'	0.25 assumed, reflects 5-day operation from Fleming Study	1.0 Assumed	Somewhat flat, reflects 16/5/51 operation from Fleming Study
3018	Process specific	Mining and Processing	Calculated in a past CDM study for 'Metal & Non-Metal Mining'	1.0 assumed, reflects 7-day operation from Fleming Study	1.0 Assumed	Somewhat flat, reflects 16/7/50 operation from Fleming Study
3019	Process specific	Pulp and Paper, Oil Refining	Calculated in a past CDM study for 'Petroleum, Paper, Other Heavy Industry'	0.85 assumed, reflects 6-7-day operation from Fleming Study	1.0 Assumed	Flat, reflects 24/6-7/50-51 operation from Fleming Study
3020	HVAC	Fishing and Fish Processing	RG&E health ventilation	0.76 – 0.86 from RG&E health ventilation	RG&E health ventilation	RG&E health ventilation - reflects 19/6/45 operation from Fleming Study
3021	HVAC	Pulp and Paper	RG&E office ventilation	App. 0.68 - 0.85 from RG&E office ventilation	RG&E office ventilation	RG&E office ventilation - reflects 12/7/52 operation from Fleming Study
3022	HVAC	All other sub-sectors	RG&E comm. Ventilation	1.0 assumed, reflects 7-day operation from Fleming Study	RG&E comm. Ventilation	RG&E comm. Ventilation - reflects 12-16/7/52 operation from Fleming Study
3024	Lighting	Fishing and Fish Processing	RG&E commercial lighting	0.85 assumed, reflects 6-day operation from Fleming Study	RG&E commercial lighting	RG&E commercial lighting, reflects 21/6/50 operation from Fleming Study
3025	Lighting	Oil Refining	RG&E health lighting	RG&E health lighting, reflects 6-7-day operation from Fleming Study	RG&E health lighting	RG&E health segment lighting, reflects 21/6-7/52 operation from Fleming Study
3026	Lighting	All other sub-sectors	RG&E office lighting	RG&E office. lighting, reflects 5-7-day operation from Fleming Study	RG&E office lighting	RG&E office lighting, reflects 16-22/5-7/52 operation from Fleming Study
3027	Other end uses	All sub-sectors	Calculated in a past CDM study for 'All Industrials'	RG&E Commercial Total	Approx. 1.1 - RG&E Comm. Total	RG&E Commercial Total, reflects 14-20/5-7/48-50 operation from Fleming Study

Exhibit B 4 Continued: Industrial End Use Load Shape Parameters

Load Shape #	End Use	Sub-Sector	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
3029	HVAC	Fishing and Fish Processing	RG&E health ventilation	0.76 – 0.86 from RG&E health ventilation	RG&E health ventilation	RG&E health ventilation - reflects 19/6/45 operation from Fleming Study
3030	HVAC	Pulp and Paper	RG&E office ventilation	App. 0.68 - 0.85 from RG&E office ventilation	RG&E office ventilation	RG&E office ventilation - reflects 12/7/52 operation from Fleming Study
3031	HVAC	All other sub-sectors	RG&E comm. Ventilation	1.0 assumed, reflects 7-day operation from Fleming Study	RG&E comm. Ventilation	RG&E comm. Ventilation - reflects 12-16/7/52 operation from Fleming Study
3033	HVAC	Fishing and Fish Processing	RG&E health ventilation	0.76 – 0.86 from RG&E health ventilation	RG&E health ventilation	RG&E health ventilation - reflects 19/6/45 operation from Fleming Study
3034	HVAC	Pulp and Paper	RG&E office ventilation	App. 0.68 - 0.85 from RG&E office ventilation	RG&E office ventilation	RG&E office ventilation - reflects 12/7/52 operation from Fleming Study
3035	HVAC	All other sub-sectors	RG&E comm. Ventilation	1.0 assumed, reflects 7-day operation from Fleming Study	RG&E comm. Ventilation	RG&E comm. Ventilation - reflects 12-16/7/52 operation from Fleming Study

Exhibit B5 shows the distinct hour-use values developed for each combination of peak period, sector, sub-sector, and end use employed in this study, as generated from the applicable load shape.

The hours-use value represents the divisor to convert annual energy (e.g., MWh) to that peak period demand. For example, dividing the annual electricity consumed for pumping in large industry by the hours-use value for the Annual Peak Hour (i.e., 9,210) will convert annual MWh to demand at the annual system peak hour (6 pm).

Exhibit B 5 Industrial Sector Load Shape Hours-Use Values

Code	Sector Type	Sub-Sector	Region	End Use	End Use Sub	Measure	Hours-Use Factor
3001	Ind	All	All	Process heating	All	Base	8,794
3003	Ind	All	All	Process cooling	All	Base	14,040
3005	Ind	Large Industry	All	Pumps	All	Base	9,210
3006	Ind	Small-Medium sub-sectors	All	Pumps	All	Base	18,340
3008	Ind	Large Industry	All	Fans and Blowers	All	Base	13,200
3009	Ind	Small-Medium sub-sectors	All	Fans and Blowers	All	Base	18,004
3011	Ind	Large Industry	All	Conveyors and Other motors	All	Base	11,744
3012	Ind	Small-Medium sub-sectors	All	Conveyors and Other motors	All	Base	16,317
3014	Ind	Large Industry	All	Compressed air	All	Base	12,150
3015	Ind	Small-Medium sub-sectors	All	Compressed air	All	Base	16,882
3017	Ind	Small-Medium sub-sectors	All	Process specific	All	Base	17,158
3018	Ind	Mining and Processing	All	Process specific	All	Base	7,194
3019	Ind	Pulp and Paper, Oil Refining	All	Process specific	All	Base	12,071
3020	Ind	Fishing and Fish Processing	Island	HVAC	All	Base	7,508
3021	Ind	Pulp and Paper	Island	HVAC	All	Base	7,834
3022	Ind	All other sub-sectors	Island	HVAC	All	Base	6,940
3024	Ind	Fishing and Fish Processing	All	Lighting	All	Base	8,173
3025	Ind	Oil Refining	All	Lighting	All	Base	8,894
3026	Ind	All other sub-sectors	All	Lighting	All	Base	12,766
3027	Ind	All sub-sectors	All	Other end uses	All	Base	8,677
3029	Ind	Fishing and Fish Processing	Labrador	HVAC	All	Base	8,943
3030	Ind	Pulp and Paper	Labrador	HVAC	All	Base	9,332
3031	Ind	All other sub-sectors	Labrador	HVAC	All	Base	8,267
3033	Ind	Fishing and Fish Processing	Isolated	HVAC	All	Base	7,508
3034	Ind	Pulp and Paper	Isolated	HVAC	All	Base	7,834
3035	Ind	All other sub-sectors	Isolated	HVAC	All	Base	6,940

Since the Utilities do not conduct regular class or end-use load analysis studies, there is no actual total (or sub-sector) end-use load profile upon which to calibrate the load profile models developed for this study. The best option for calibrating NL-specific load profile parameters is the weather-sensitive loads, since that is the most area specific.

Since separately metered space heating end-use load data was not available from the Utilities, normal weather for the past 10 years was used to determine monthly allocations, and weekend/weekday ratios were developed from similar studies for another Canadian utility.

For peak day factors, analysis of the past 30 years' average vs. peak weather conditions (in heating degree days) for St. John's was analyzed to determine typical peak day factors for normal weather, which ranged from about 1.4 to 1.5 for winter months. For non weather-sensitive end uses, a factor of 1.0 was assumed, absent specific load study data.

Hours-use factors for weather sensitive end uses (codes 3020, 3021, 3022, and 3029 through 3035 above, along with similar end uses in the residential and commercial sectors) were adjusted to calibrate the model's estimate of peak load to the utility's recorded averages during the peak period, for each of the three regions.

B.4 Detailed Results

The following exhibit shows peak demand by sub-sector and end use for the peak period identified for this study.

Each of these sub-sectors is modeled separately for each region. However, the base year consumption presented below in Exhibit B6 combines all regions and all Large Industrial sub-sectors.

Exhibit B 6 Industrial Sector Base Year (2014) Peak Hour Demand, by Sub-Sector and End Use (MW)*

Sub-Sectors	Process specific	Pumps	Other motors	Fans and blowers	Process heating	Comfort HVAC	Conveyors	Air compressors	Lighting	Process cooling	Other
Large Industry	61	56	44	34	31	8	12	9	6	0	0
Fishing and Fish Processing	0	0	0	0	1	2	0	0	1	5	0
Manufacturing	0	0	2	1	0	3	0	1	2	1	0
Water Systems and Other	0	3	1	0	0	0	0	0	0	-	0
Grand Total	**62**	**60**	**47**	**35**	**33**	**14**	**12**	**11**	**8**	**6**	**1**

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Appendix C Background-Section 5: Reference Case Electricity Use

Introduction

Appendix C provides additional detailed information related to each of the major steps employed to generate the profile of Industrial Sector Reference Case electricity use. The major steps involved are:

- **Step 1:** Estimate consumption growth by sub-sector from Utility load forecasts
- **Step 2:** Estimate naturally-occurring changes to efficiency for each end use
- **Step 3:** Adjust end use breakdowns at each milestone to account for changes from relative levels of growth between certain facilities and from naturally-occurring changes.

C.1 Step 1: Estimation of Growth from Utility load forecasts

The Utilities provided the following load forecast data:

- Individual 2017 and 2019 consumption forecasts for each of the 5 large industrial facilities
- Forecasts by milestone year for each region covering combined commercial and small-medium industrial rate classes

For the five large industrial facilities the reference case consumption growth expectations are based on the required increase from base year levels to meet the 2017 load forecast, for 2017 growth, and based on meeting the 2019 load forecast for 2020 growth. After 2020 the reference case consumption is considered to remain unchanged for these facilities. This assumes that none of the large industries will close, and that no new large industrial facilities will be constructed. The Utilities agreed with this approach being the best option to dealing with uncertainty.

Of the small-medium sub-sectors, Water Systems is the only one where growth was definitely expected by the Utilities. Outside of this sub-sector it is more difficult to predict with accuracy whether there will be growth or plant closures. In general, expectations from the Utilities are for more commercial sector growth than small-medium industrial growth. This is important because the load forecast provided by the Utilities did not separate growth expectations for the small-medium industrial sub-sectors from growth in commercial sub-sectors. The approach agreed upon with the Utilities was to consider that Water Systems would grow at the same pace as the Commercial Sector, with minimal growth expectations for Manufacturing and Fish Processing throughout the study.

To achieve this, the load forecast consumption growth was split up by rate class. A portion of the incremental commercial-industrial consumption was assigned to Water Systems in every rate class where it was included in the base year, based on the relative size of base year Water System consumption to the total. In performing this exercise the Commercial Sector noted some rate classes with expectations for growth (or shrinkage) which were entirely industrial consumption in the base year. These findings were backed up by comments in the load forecast document (references to fish plants, mining activities, etc) so a small level of growth was included in certain small-medium mining and fishing rates classes, to ensure that the load forecast level could be properly met. The balance of the load forecast's consumption growth was attributed to the Commercial Sector, such that the total load forecast levels should equal the model reference case.

Exhibit C1 provides the resulting electricity consumption forecast for the milestone years of this study. The most significant changes are seen in the Large Industry sub-sector, which experiences significant growth towards the beginning of the study period.

Exhibit C 1 Combined Industrial Load Growth by Sub-Sector, (MWh/yr.)

Sub-Sectors	2014	2017	2020	2023	2026	2029
Large Industry	2,828,377	3,545,751	3,610,520	3,611,310	3,612,167	3,613,020
Fishing and Fish Processing	128,368	128,129	128,005	127,889	127,777	127,669
Manufacturing	136,074	135,714	135,714	135,024	134,693	134,371
Water Systems and Other	76,585	76,818	76,818	78,920	79,717	80,613
Grand Total	3,169,404	3,886,412	3,886,412	3,953,143	3,954,354	3,955,674

C.2 Step 2: Estimation of Naturally-Occurring Changes

For the purposes of this study, “natural” changes to electricity consumption are defined as those changes to electricity usage patterns that occur without incentive or other intervention.

The main factor being assessed in the Industrial Sector are expectations for natural stock penetration by more efficient equipment, but natural-occurring improvements in equipment efficiency are also indirectly considered.

The industrial analysis differs from the commercial and residential sectors in that a reference case of measure adoption is estimated, after the TRM workbooks are finalized and base year measure penetration is established. This reference case considers what level of adoption, beyond the base year penetration, measures considered in this study might be adopted without intervention. From this reference case penetration an amount of natural savings (%) will be estimated for each end use. While this approach focuses on measure adoption levels, factors such as recent improvements in LED lighting efficacy and their rapidly declining costs will influence these reference case adoption expectations.

Since the total reference case electricity consumption is calibrated to the Utilities’ forecasts, the impacts of natural conservation did not reduce the overall consumption level. Instead, their impact changes the relative importance of different end uses over the course of the study period.

The naturally occurring changes will alter the end use breakdowns used for different milestones of the study, to make some end uses represent a larger or smaller portion of a facility’s electricity consumption over the study’s time frame. For example, if technology that was 5% more efficient than previous equipment was expected to be installed in all end uses, each end use would maintain its same portion of total electricity consumption. However, if lighting consumption is expected to decrease by 2% per year, while the rest of end uses do not see their efficiencies improve, then lighting will over time represent a smaller portion of a facility’s electricity consumption.

Exhibit C 2 illustrates how the natural savings end use factors were developed. The level of natural savings was estimated by multiplying the natural adoption expectations used in the economic potential scenario by the percentage of end use savings in the economic potential scenario. Then, end use factors were calculated such that applying each factor to its respective reference case consumption will leave the reference case total unchanged. The improvements will be assumed to phase in evenly over the study period, so a fraction of this factor is applied to end use breakdowns at each of the study’s five milestone periods.

Exhibit C 2 Development of Natural Conservation End Use Factors

End Use	Reference Case Consumption 2029 (MWh)	Natural Savings, 2029 (%)	Remaining Portion of Reference Case (MWh)	End-Use Factor
Pumps	731,491	2%	717,474	0.994
Process specific	961,594	0%	956,837	1.008
Process heating	345,232	0%	344,065	1.010
Process cooling	106,481	1%	105,254	1.001
Other motors	615,489	0%	612,468	1.008
Other	5,683	0%	5,683	1.013
Lighting	118,789	12%	105,028	0.896
Fans and blowers	540,384	1%	532,718	0.999
Conveyors	217,317	0%	216,438	1.009
Comfort HVAC	137,695	1%	136,258	1.002
Air compressors	175,517	2%	172,618	0.996
Grand Total	3,955,674		3,904,840	

C.3 Step 3: Adjustment of End Use Breakdowns to Changes

The end use breakdowns used in each milestone period of this study need to be adjusted to account for uneven growth levels and for natural conservation.

As growth across different facilities and sub-sectors is uneven, certain sub-sector end use profiles needed to be adjusted to match these differences. More specifically, for the Mining and Processing sub-sector, which contains a blend of distinct large and small-medium facilities, that each has their own end use profile, the relative growth of these different elements needed to be accounted for in the weighted average sub-sector end use profile. This ensures that if a single segment is growing significantly faster than the rest of the facilities in its sub-sector, the end use profile used in the reference case for all of the sub-sector's facilities would reflect the increased portion of consumption at the growing facility.

The natural conservation factors discussed in the previous section will then be applied to the end use breakdowns. After these adjustments are made, the end use breakdowns can be applied to the load forecast consumption levels to develop the reference case.

This section does not replicate the reference case pie charts and other graphs presented in Section 5. If those graphs are needed for each supply system, they can be created using the Data Manager.

Appendix D Background-Section 6: Reference Case Peak Load

Introduction

The methodology for estimating forecast peak loads is identical to the methodology described in Appendix B, employing the same hours-use factors. The following exhibit shows the Reference Case peak load profile for all regions.

Exhibit D 1 Electric Peak Loads, by Milestone Year, Peak Period and Sub-Sector (MW)

		Reference Case Peak Demand (MW)											
Sub-Sectors	Year	Air compressors	Comfort HVAC	Conveyors	Fans and blowers	Lighting	Other	Other motors	Process cooling	Process heating	Process specific	Pumps	Grand Total
Large Industry	2014	9	8	12	37	6	0	47	0	31	53	56	258
	2017	13	12	17	42	8	0	50	2	37	85	71	337
	2020	13	13	18	42	8	0	50	2	37	88	73	344
	2023	13	13	18	42	8	0	50	2	37	88	73	344
	2026	13	13	18	42	8	0	50	2	37	88	73	344
	2029	13	13	18	42	8	0	50	2	37	89	73	344
Fishing and Fish Processing	2014	0	2	0	0	1	0	0	5	1	0	0	11
	2017	0	2	0	0	1	0	0	5	1	0	0	11
	2020	0	2	0	0	1	0	0	5	1	0	0	11
	2023	0	2	0	0	1	0	0	5	1	0	0	11
	2026	0	2	0	0	1	0	0	5	1	0	0	11
	2029	0	2	0	0	1	0	0	5	1	0	0	11
Manufacturing	2014	1	3	0	1	2	0	2	1	0	0	0	11
	2017	1	3	0	1	2	0	2	1	0	0	0	11
	2020	1	3	0	1	2	0	2	1	0	0	0	11
	2023	1	3	0	1	2	0	2	1	0	0	0	11
	2026	1	3	0	1	1	0	2	1	0	0	0	11
	2029	1	3	0	1	1	0	2	1	0	0	0	11
Water Systems and Other	2014	0	0	0	0	0	0	0	-	0	0	3	5
	2017	0	0	0	0	0	0	0	-	0	0	3	5
	2020	0	0	0	0	0	0	0	-	0	0	3	5
	2023	0	0	0	0	0	0	1	-	0	0	3	5
	2026	0	0	0	0	0	0	1	-	0	0	3	5
	2029	0	0	0	0	0	0	1	-	0	0	3	5

Appendix E Background-Section 7: Technology Assessment: Energy-efficiency Measures

Introduction

Exhibit E1 provides an example of part of the worksheet that calculates the CCE for premium efficiency motors, one of the analyzed measures. For more detail on this and all the other measures, refer to the TRM Workbook submitted with this deliverable.

Exhibit E 1 Sample Measure CCE Calculation Worksheet

NP + NLH: Industrial, Island - Electric efficiency

Premium Efficiency Motors

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	Pulp and Paper ☑	Mining and Processing ☑	Refining ☑	Fishing and Fish Processing ☑	Manufacturing ☑	Water Systems and Other ☑	Weighted Average ☐	Reference + Notes

Measure Description

Description: Electric motors convert approximately 85% of industrial plant electricity use to torque to drive industrial end uses such as fans, pumps, material handling, and a large portion of process loads. These motors range in size from 75 Watts to more than 25,000 kW, with corresponding efficiencies of 40%-98%. While inherently efficient in converting electricity to shaft or motive power, on average 5%-8% of this power is lost in motor inefficiencies that occur before the driven equipment losses.

Baseline: Standard motor
Upgrade: Install premium efficiency motors for other machine drives
Baseline: Annual consumption, equipment
Heating Fuel Type: Electricity
Main End Use: Other Motors
Resource Costs: Baseload

Fuel	Customer Cost		Avoided Costs (NPV)						Reference + Notes
Electricity	$0.082	$/kWh	$0.755	$0.755	$0.755	$0.755	$0.755	$0.755	Please see "Avoided Costs" and "Customer Costs" tabs
Electric Demand	$6.960	$/kW	$0.946	$0.946	$0.946	$0.946	$0.946	$0.946	Please see "Avoided Costs" and "Customer Costs" tabs

Measure Cost Definitions & Calculations		Pulp and Paper	Mining and Processing	Refining	Fishing and Fish Processing	Manufacturing	Water Systems and Other	Weighted Average	Reference + Notes
Baseline Consumption	Electricity kWh/yr	2,192,285	2,280,221	1,755,858	503,313	1,034,587	2,280,221	2,107,973	
Upgrade Consumption	Electricity kWh/yr	2,148,440	2,234,617	1,720,740	493,246	1,013,895	2,234,617	2,065,814	
	Winter Peak Hours-Use☐actor	11,744	11,744	11,744	16,317	16,317	16,317	15,603	
Resource Savings	Electricity (kWh/yr.)	43,846	45,604	35,117	10,066	20,692	45,604	42,159	
	Electricity (kW peak)	3.734	3.883	2.990	0.617	1.268	2.795	2.73	
Cost Parameters	Upgrade, Material ($)	$55,858.00	$55,858.00	$55,858.00	$38,930.00	$32,680.00	$55,858.00	$53,596	
	Upgrade, Installation ($)	$6,671.00	$6,671.00	$6,671.00	$4,785.00	$4,285.00	$6,671.00	$6,438	
	Baseline, Material ($)	$45,177.00	$45,177.00	$45,177.00	$31,430.00	$26,502.50	$45,177.00	$43,354	
	Baseline, Installation ($)	$9,035.40	$9,035.40	$9,035.40	$6,286.00	$5,300.50	$9,035.40	$8,671	
	Total Measure Cost [A]	$8,317	$8,317	$8,317	$5,999	$5,162	$8,317	$8,009	
	Basis (Full/Incremental)	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	
	Incremental O&M ($/yr.)							-	
Lifetimes	Upgrade (yrs.)	15	15	15	15	15	15	15	
	Baseline (yrs.)	15	15	15	15	15	15	15	
	Cost Savings ($/yr.)	$3,617	$3,762	$2,897	$829	$1,703	$3,754	$3,472	
	Simple Payback (yrs.)	2.3	2.2	2.9	7.2	3.0	2.2	2.4	
	NPV of O&M Costs ($) [B]	-	-	-	-	-	-	-	
Total Avoided Supply Costs (NPV, $) [C]	Electric Energy	$33,097	$34,424	$26,508	$7,598	$15,619	$34,424	$31,824	
	Electric Demand	$4	$4	$3	$1	$1	$3	$3	
Total Customer Bill Reduction (NPV, $) [D]	Electric Energy	$34,075	$35,442	$27,292	$7,823	$16,081	$35,442	$32,765	
	Electric Demand	$247	$256	$197	$41	$84	$185	$180	

Economic Tests		Pulp and Paper	Mining and Processing	Refining	Fishing and Fish Processing	Manufacturing	Water Systems and Other	Weighted Average	Reference + Notes
Incentive	Target Payback (yrs.)	10	10	10	30	10	10	10	
	Percent of Measure Costs	-	-	-	-	-	-	-	
	Incentive ($) [E]	-	-	-	-	-	-	-	
Administration Costs	% of Incentive [F]	30%	30%	30%	30%	30%	30%	30%	
	% of Savings Value to Utility [G]	50%	50%	50%	50%	50%	50%	50%	
	Admin. Costs per Unit ($) [H]	$16,550	$17,214	$13,255	$3,800	$7,810	$17,213	$15,913	
	Net-to-Gross Ratio [I]	90%	90%	90%	90%	90%	90%	90%	
Total Resource Cost Test	TRC Benefits ($)	$29,790	$30,985	$23,860	$6,839	$14,058	$30,984	$28,644	
	TRC Costs ($)	$24,035	$24,699	$20,740	$9,199	$12,456	$24,698	$23,121	
	Measure TRC ($)	$5,755	$6,286	$3,119	-$2,359	$1,602	$6,286	$5,523	
	TRC Benefit/Cost Ratio	1.24	1.25	1.15	0.74	1.13	1.25	1.23	
	Cost of Conserved Electricity (CCE) (¢/kWh)	2.15	2.07	2.68	6.75	2.83	2.07	2.20	
Participant Cost Test	PCT Benefits ($)	$34,322	$35,698	$27,489	$7,864	$16,165	$35,627	$32,945	
	PCT Costs ($)	$8,317	$8,317	$8,317	$5,999	$5,162	$8,317	$8,009	
	Measure PCT ($)	$26,005	$27,382	$19,173	$1,865	$11,003	$27,310	$24,936	
	PCT Benefit/Cost Ratio	4.13	4.29	3.31	1.31	3.13	4.28	4.08	
Ratepayer Impact Measure Test	RIM Benefits ($)	$29,790	$30,985	$23,860	$6,839	$14,058	$30,984	$28,644	
	RIM Costs ($)	$47,440	$49,343	$37,996	$10,877	$22,358	$49,277	$45,564	
	Measure RIM ($)	$33,100	$34,428	$26,511	$7,599	$15,620	$34,427	$31,826	
	RIM Benefit/Cost Ratio	1.64	1.64	1.64	1.64	1.64	1.64	1.64	
Program Administrator Costs Test	PAC Benefits ($)	$29,790	$31,216	$24,037	$6,876	$14,134	$31,150	$28,790	
	PAC Costs ($)	$16,550	$17,214	$13,255	$3,800	$7,810	$17,213	$15,913	
	Measure PAC ($)	$13,240	$14,002	$10,782	$3,076	$6,323	$13,937	$12,877	
	PAC Benefit/Cost Ratio	1.80	1.81	1.81	1.81	1.81	1.81	1.81	

Resource Savings Assumptions (Percent relative to baseline, not including heating penalties/cooling benefits) — Applies? (Yes = 1, 0 = No)

Fuel	End Use	Sub End Use	Baseline	Upgrade	Measure Resource Savings (%)						Weighted Average	Reference + Notes
Electricity	Other Motors	General	1	1	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	

Resource Savings Wrap-Up (Percent relative to baseline, main end uses, including heating penalties/cooling benefits) — Applies? (Yes = 1, 0 = No)

Fuel	End Use	Baseline	Upgrade	Measure Resource Savings (%)						Weighted Average	Reference + Notes
Electricity	Other Motors	1	1	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	

Exhibit E2 provides a list of all the industrial measures initially considered for this study. It indicates which measures were included for further study. For those measures excluded from the study, the exhibit provides the reason for that decision.

Exhibit E 2 Industrial Measures Considered

End Use	Measure		Reasons for Exclusion
Air Compressors	Premium Efficiency ASD Compressor	Included	
	Use Cooler Air from Outside for Make Up Air	Included	
	Optimized Distribution System (Incl. Pressure and Air End Uses)	Included	
	Optimized Sizes of Air Receiver Tanks	Included	
	Sequencing Control	Included	
	Air Leak Survey and Repair	Included	
	Replace Compressed Air Use	Excluded	This opportunity has been captured within the above optimized compressed air distribution system measure, since these are inter-related improvements and would both flow from a compressed air audit.
Conveyors	Optimized Conveyor Motor Control	Included	
	Premium Efficiency Conveyor Motors	Included	
Fans and Blowers	Premium Efficiency Fan Control with ASDs	Included	
	Synchronous Belts	Included	
	Premium Efficiency Motors for Fans and Blowers	Included	
	Correctly Sized Fans: Impeller Trimming or Fan Selection	Included	
	Optimized Distribution System (Inc. Pressure Losses)	Included	
	Magnetic Clutch Fan Control	Excluded	Targets the same potential savings as the above ASD measure, with lower cost equipment. The above ASD measure has been expanded to also cover this form of speed control.
HVAC	Automated Temperature Control	Included	
	Air Compressor Heat Recovery	Included	
	Ventilation Heat Recovery	Included	
	Ventilation Optimization	Included	
	Reduced Temperature Settings	Included	
	High-efficiency Packaged HVAC	Included	
	Warehouse Loading Dock Seals	Included	
	Improved Building Insulation	Included	
	HVAC Air Curtains	Included	

Exhibit E 2 Continued: Industrial Measures Considered

End Use	Measure		Reasons for Exclusion
Lighting	High Efficiency Lights (LEDs)	Included	
	Automated Lighting Controls	Included	
	High Efficiency Lighting Design	Included	
Other Motors	Correctly Sized Motors	Included	
	Optimized Motor Control	Included	
	Premium Efficiency Motors	Included	
Process Cooling/ Refrigeration/ Freezing	Chiller Economizer	Included	
	Free Cooling	Included	
	Floating Head Pressure Controls	Included	
	High Efficiency Chiller	Included	
	Optimized Distribution System	Included	
	Premium Efficiency Refrigeration Control System and Compressor Sequencing	Included	
	Improve Insulation of Refrigeration System	Included	
	Smart Defrost Controls	Included	
	Improved Ice Production System	Included	
	Air Curtains	Included	
Process Heating	Heat Pumps	Included	
	Insulation	Included	
	Process Heat Recovery to Preheat Makeup Water	Included	
	High Efficiency Oven/Dryer/Furnace/Kiln	Included	
	High Efficiency Water Heater	Included	
Process Specific	Process Optimization Efforts – Fishing and Fish Processing	Included	
	Process Optimization Efforts – Pulp and Paper	Included	
	Process Optimization Efforts – Mining and Processing	Included	
	Process Optimization Efforts – Oil Refining	Included	
	Advanced ‘Predictive’ Process Control Systems	Included	
Pumps	Optimization of Pumping System	Included	
	Premium Efficiency Pump Motor	Included	
	Premium Efficiency Pump Control with ASDs	Included	
	Correctly Sized Pumps: Impeller Trimming or Pump Selection	Included	
System (Energy)	Sub-Metering	Included	
	Energy Management Information System (EMIS)	Included	
	Organizational Energy Management (EM Team)	Included	

Exhibit E 2 Continued: Industrial Measures Considered

End Use	Measure		Reasons for Exclusion
	Operation and Maintenance (O&M) Program Supporting Efficiency	Included	
	Integrated Plant Control System	Included	
System (Demand)	Power Factor Correction Equipment	Included	
	Operating Changes for Reduced Peak Load	Included	
	Peak Shifting Through On-Site Storage	Included	
	More Specific Demand Reduction Technologies	Excluded	The Peak Shifting measure above considers technologies that can be used in each sub-sector to reduce demand.[38] The electric energy technologies include numerous measures that will also reduce demand.

[38] The demand reduction benefits quantified in this model only capture the benefits from reductions coincident with the annual provincial peak periods.

Appendix F Background-Section 8: Economic Potential: Electric Energy Forecast

Introduction

Exhibit F 1 provides the industrial economic potential consumption by measure and milestone. For further details on the economic potential scenario, including regional breakdowns, please refer to the Data Manager file submitted with this report.

Exhibit F 1 Economic Potential Electricity Savings by Measure and Milestone Year (GWh/yr.)

End Use	Measure	Cost Basis	Annual Savings (GWh/yr.)				
			2017	2020	2023	2026	2029
System	Sub-Metering	Full	57.7	56.2	54.6	53.1	51.5
	Energy Management Information System (EMIS)	Full	56.5	55.8	55.1	54.4	53.7
	Organizational Energy Management (EM Team)	Full	49.5	48.8	48.1	47.4	46.7
	Operation and Maintenance (O&M) Program Supporting Efficiency	Full	29.6	28.9	28.2	27.5	26.8
	Integrated Plant Control System	Full	18.8	18.4	18.0	17.5	17.1
Pumps	Optimization of Pumping System	Full	58.7	57.7	56.8	59.6	59.9
	Premium Efficiency Pump Motor	Incr	3.9	5.2	6.5	2.6	1.3
	Premium Efficiency Pump Control with ASDs	Full	88.8	87.6	86.3	90.1	90.0
	Correctly Sized Pumps: Impeller Trimming or Pump Selection	Full	42.9	42.0	41.0	43.9	44.5
Fans and Blowers	Premium Efficiency Fan Control with ASDs	Full	65.7	65.1	64.4	66.4	66.7
	Synchronous Belts	Full	1.5	1.4	1.4	1.5	1.5
	Premium Efficiency Motors for Fans and Blowers	Incr	2.8	3.7	4.7	1.9	0.9
	Correctly Sized Fans: Impeller Trimming or Fan Selection	Full	27.3	26.7	26.0	27.9	28.5
	Optimized Distribution System (Incl. Pressure Losses)	Full	16.1	15.4	14.7	10.0	9.9
Lighting	High Efficiency Lights (LEDs)	Full	53.9	51.3	48.7	56.3	45.3
	Automated Lighting Controls	Full	5.3	5.3	5.2	5.3	3.2
	High-Efficiency Lighting Design	Full	5.3	5.3	5.2	5.4	5.2
Process Specific	Process Optimization Efforts - Fishing and Fish Processing	Full	0.0	0.0	0.0	0.0	0.0
	Process Optimization Efforts - Pulp and Paper	Full	16.5	16.4	16.3	16.6	16.7
	Process Optimization Efforts - Mining and Processing	Full	4.7	4.6	4.5	4.9	4.8
	Advanced 'Predictive' Process Control Systems	Full	13.3	13.3	13.2	13.4	13.5
	Process Optimization Efforts - Oil Refining	Full	-	-	-	-	-
Air Compressors	Premium Efficiency ASD Compressor	Incr	15.9	15.9	15.8	16.0	15.6
	Use Cooler Air from Outside for Make Up Air	Full	2.9	2.9	2.8	3.0	2.9

Exhibit F 1 Continued: Economic Potential Electricity Savings by Measure and Milestone Year (GWh/yr.)

End Use	Measure	Cost Basis	Annual Savings (GWh/yr.)				
			2017	2020	2023	2026	2029
	Optimized Distribution System (Incl. Pressure and Air End-Uses)	Full	9.1	9.0	8.9	9.2	8.9
	Optimized Sizes of Air Receiver Tanks	Full	1.4	1.4	1.3	1.5	1.5
	Sequencing Control	Full	0.5	0.5	0.5	0.5	0.5
	Air Leak Survey and Repair	Full	13.7	13.6	13.4	13.9	13.6
Process Cooling / Refrigeration / Freezing	Chiller Economizer	Full	1.3	1.3	1.2	1.3	1.3
	Free Cooling	Full	3.4	3.4	3.4	3.5	3.5
	Floating Head Pressure Controls	Full	0.3	0.3	0.3	0.3	0.3
	High Efficiency Chiller	Incr	1.8	2.0	2.0	1.8	1.8
	Optimized Distribution System	Full	1.4	1.4	1.3	1.4	1.4
	Premium Efficiency Refrigeration Control System and Compressor Sequencing	Full	3.9	3.8	3.8	3.9	3.9
	Improve Insulation of Refrigeration System	Full	1.7	1.7	1.7	1.7	1.7
	Smart Defrost Controls	Full	1.4	1.4	1.4	1.4	1.4
	Improved Ice Production System	Full	1.2	1.2	1.2	1.2	1.2
	Air Curtains	Full	0.3	0.3	0.3	0.3	0.3
Other Motors	Correctly Sized Motors	Full	3.8	5.1	6.4	2.6	1.3
	Optimized Motor Control	Full	9.8	9.5	9.3	10.0	10.2
	Premium Efficiency Motors	Incr	3.5	4.6	5.8	2.3	1.1
HVAC	Automated Temperature Control	Full	3.4	3.3	3.2	3.5	3.4
	Air Compressor Heat Recovery	Full	0.8	0.8	0.7	0.8	0.8
	Ventilation Heat Recovery	Full	0.0	0.0	0.0	0.0	0.0
	Ventilation Optimization	Full	0.6	0.6	0.6	0.6	0.7
	Reduced Temperature Settings	Full	3.8	3.7	3.6	3.9	3.9
	High-Efficiency Packaged HVAC	Incr	3.2	4.2	5.3	2.1	1.0
	Warehouse Loading Dock Seals	Full	0.0	0.0	0.0	0.0	0.0
	Improved Building Insulation	Full	-	-	-	-	-
	HVAC Air Curtains	Full	-	-	-	-	-
Conveyors	Optimized Conveyor Motor Control	Full	4.0	3.9	3.8	4.0	1.4
	Premium Efficiency Conveyor Motors	Incr	1.1	1.5	1.9	0.8	0.4
Process Heating	Heat Pumps	Full	1.1	1.1	1.1	1.1	1.0
	Insulation	Full	4.9	4.9	4.9	5.0	5.0
	Process Heat Recovery to Preheat Makeup Water	Full	17.9	17.7	17.6	3.8	3.6
	High Efficiency Oven/Dryer/Furnace/Kiln	Incr	0.0	0.1	0.1	0.0	0.0
	High Efficiency Water Heater	Incr	-	-	-	-	-

Appendix G Background-Section 9: Achievable Workshop Action Profile Slides

22/05/2015

Agenda

1. Overview of the CPR Approach, Tools, Outputs
2. Overview of the Industrial technology results to date
3. Discussion of Industrial Opportunities
4. Wrap Up & Next Steps

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9:00 am – 9:15 am	Welcome & Introductions
9:15 am – 9:45 am	Overview Of CDM Potential Study Approach, Outputs & Tools
9:45 am – 10:15 am	Overview of Industrial Sector Technology Results to Date and Workshop Discussion Format
10:15 am– 10:30 am	Break
10:30 am – 11:30 am	Discussion of Industrial Opportunity #1 LED Lighting
11:30 am – 12:00 pm	Discussion of Industrial Opportunity #2 Optimization of Pumping Systems
12:00 pm – 12:30 pm	Lunch
12:30 pm – 1:00 pm	Discussion of Industrial Opportunity #3 Roving Energy Managers
1:00 pm – 1:30 pm	Discussion of Industrial Opportunity #4 Premium Efficiency Refrigeration Control Systems
1:30 pm – 2:00 pm	Discussion of Industrial Opportunity #5 Demand Response Curtailments
2:00 pm – 2:30 pm	Discussion of Industrial Opportunity #6 Optimization of Compressed Air Distribution Systems and End-uses
2:30 pm – 2:45 pm	Break
2:45 pm – 3:15 pm	Discussion of Industrial Opportunity #7 Optimized Motor Control
3:15 pm – 3:45 pm	Discussion of Industrial Opportunity #8 Process Heat Recovery for HVAC
3:45 pm – 4:30 pm	Wrap up and Next Steps

1

Overview of the CPR Approach, Tools, Outputs

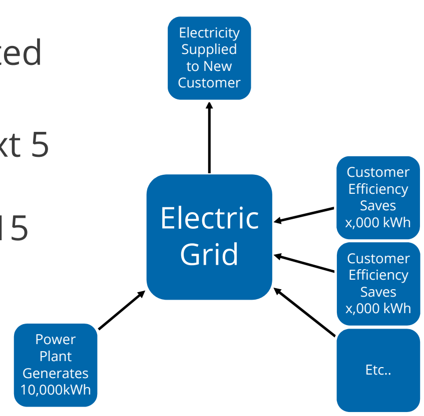
Study Background & Objectives

"The purpose of this Project is to develop a Conservation and Demand Management ("CDM") Potential Study to identify the remaining achievable, cost-effective **electric energy efficiency and demand management potential** in Newfoundland and Labrador."

- Characterize available equipment and behaviours: EE and DR
- Estimate achievable potential EE (GWh) and DR (MW) load reduction

Study Objectives

- Last Study: 2008
- Factors in expected system changes
- Will feed into next 5 year plan – to be completed in 2015



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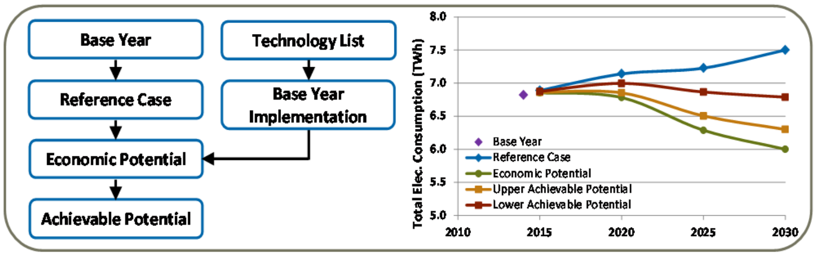
Study Methodology and Outputs



Level of Study Detail

- Sectors: **Residential, Commercial,** and **Industrial**
- Regions: **Newfoundland, Labrador,** and **Isolated Diesel**
- Base Year: calendar year **2014**
- Milestone Years: **2017, 2020, 2023, 2026** and **2029.**
- Subsectors
- End Uses
- Technologies

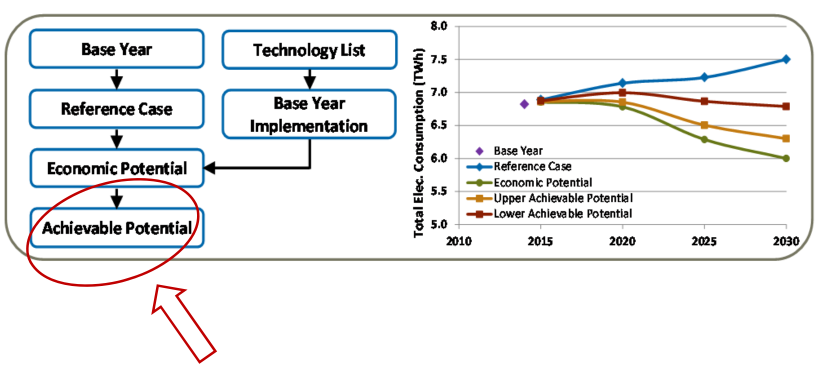
More on these later

What this Study is NOT

- It is not program design
- It is not setting DSM targets
- It is not an IRP

- It is designed to provide input to all those processes.

Today



Achievable Potential

Achievable Potential: *The achievable potential is the portion of the economic conservation potential that is achievable through utility interventions and programs given institutional, economic, and market barriers.*

- "Upper" = Very Best Possible Case
- "Lower" = Business as Usual

2

Overview of the Industrial technology results to date

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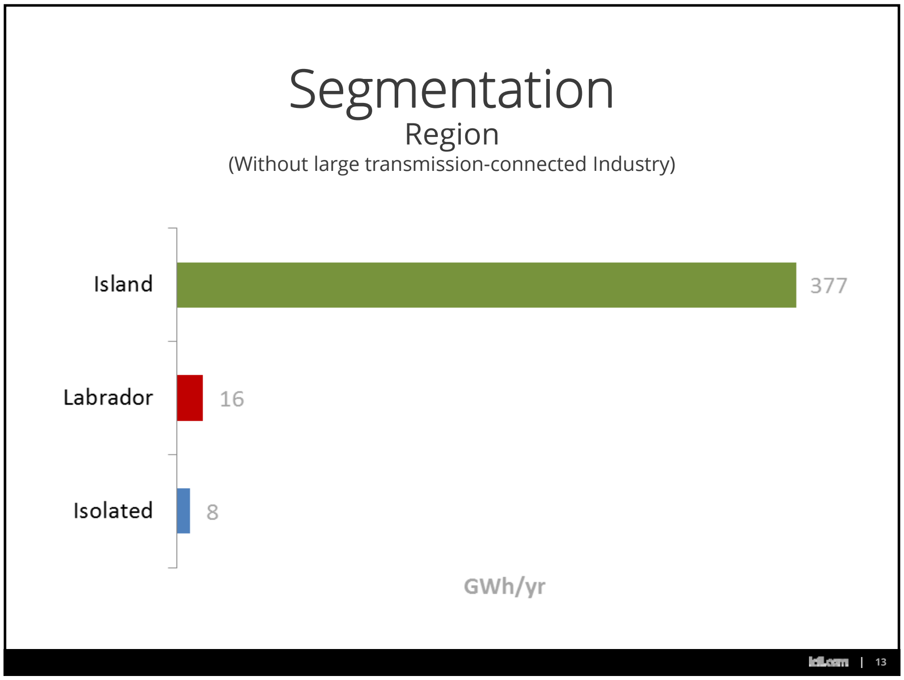
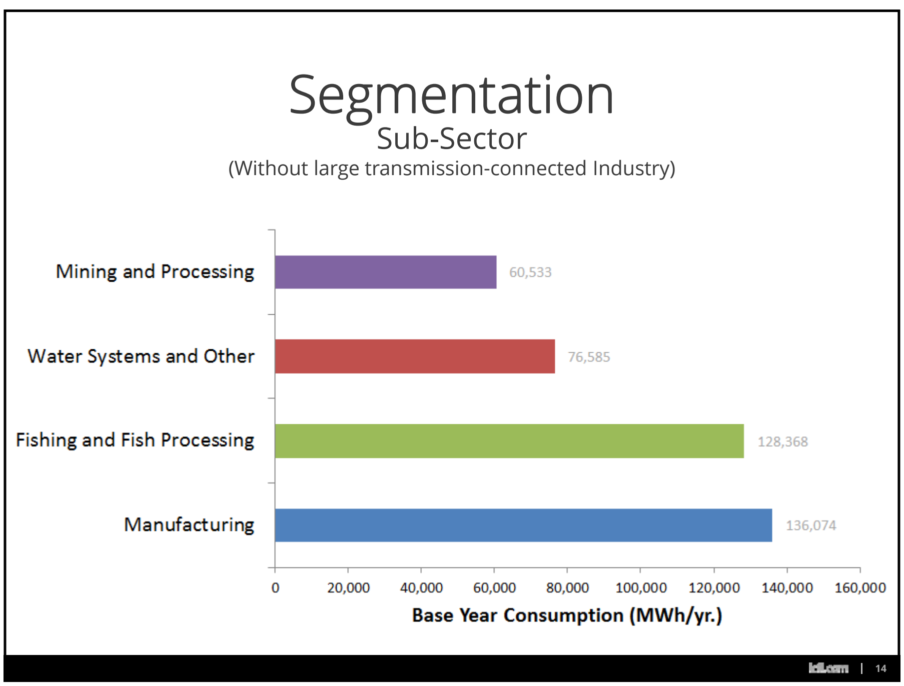

Segmentation
Region
(Without large transmission-connected Industry)
Island
377
Labrador
16
Isolated
8
GWh/yr
13


Segmentation
Sub-Sector
(Without large transmission-connected Industry)
Mining and Processing
60,533
Water Systems and Other
76,585
Fishing and Fish Processing
128,368
Manufacturing
136,074
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
Base Year Consumption (MWh/yr.)
14

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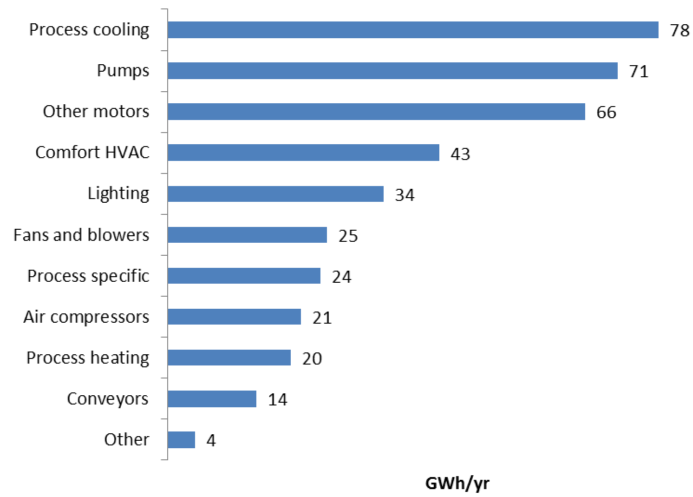
End Uses



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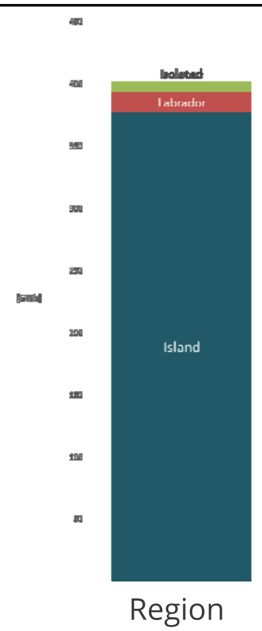
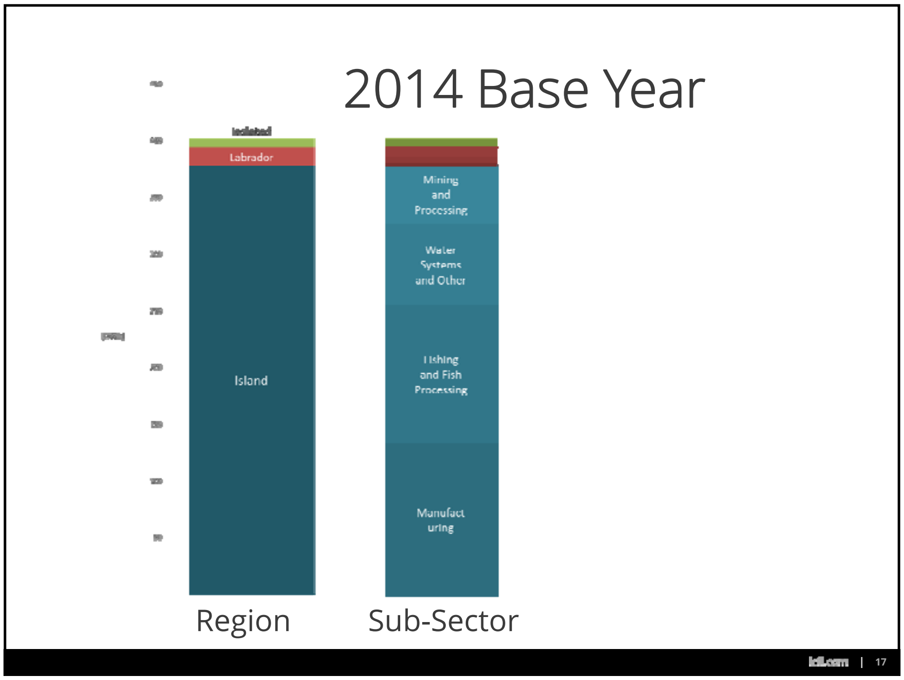
2014 Base Year



Total electricity
sold to small-medium
industrial customers,
by region
for 2014

16


2014 Base Year
Isolated
Labrador
Island
Mining and Processing
Water Systems and Other
Fishing and Fish Processing
Manufacturing
Region
Sub-Sector
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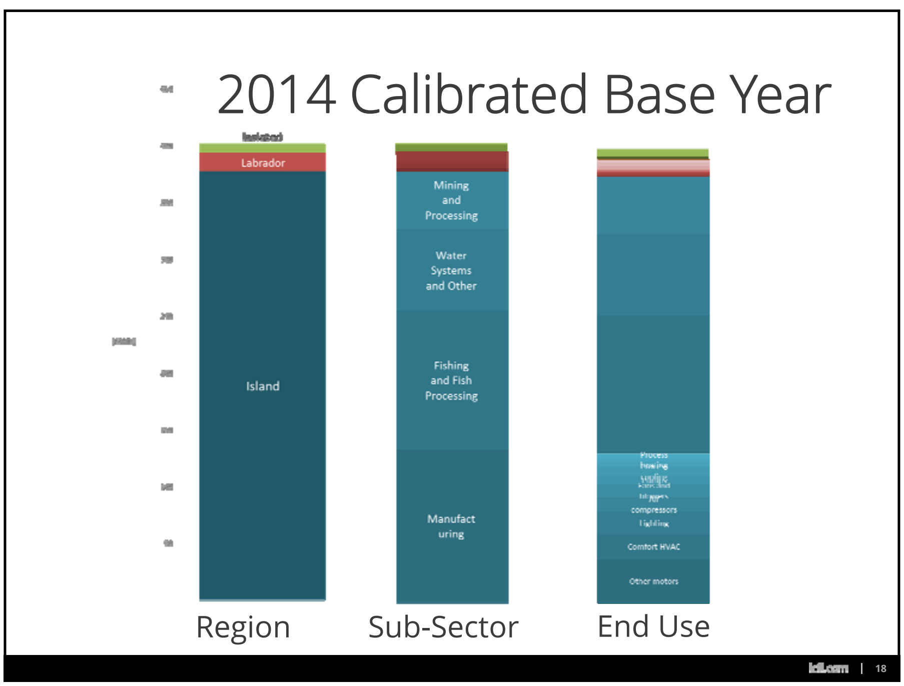
2014 Calibrated Base Year
Isolated
Labrador
Island
Mining and Processing
Water Systems and Other
Fishing and Fish Processing
Manufacturing
Comfort HVAC
Other motors
Region
Sub-Sector
End Use
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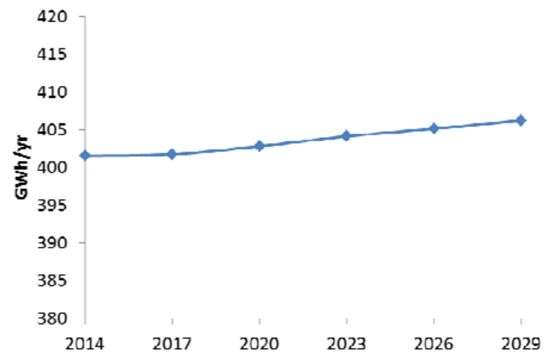
Reference Case – The Foundation



- Utility load forecast is used to create growth forecasts applied out to the year 2029. This becomes the reference case.
- Efficiency measures can then be applied.

Screening the Technologies

- Compare cost of conserved electricity for over the energy efficiency technologies to economic thresholds of:

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.108	$0.037	$0.21
2017	$0.125	$0.039	$0.23
2020	$0.050	$0.045	$0.26
2023	$0.059	$0.053	$0.29
2026	$0.068	$0.061	$0.34
2029	$0.076	$0.068	$0.37

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Screening the Technologies

- Compare cost of electric peak reduction for the demand reduction technologies to economic thresholds of:

Year	Avoided Cost per kW		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$50.911	$72.059	
2017	$65.116	$82.527	
2020	$101.821	$91.601	
2023	$115.126	$103.571	
2026	$124.930	$112.390	
2029	$124.907	$112.370	

The Results – the Big Picture

- Overall economic potential is around 28% of projected 2029 consumption
- Around 52 out of 57 measures passed the screen in at least some sub-sectors and regions
  - Most measures pass the economic screens on a full-cost basis, and can therefore are implemented immediately in the economic potential scenario.
  - During the next section of the study, with the help of this workshop, the achievable potential will factor in more realistic adoption timelines, and will result in increasing savings over the milestones.

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The Results – the Big Picture

- Almost all of savings for sub-sectors considered today are in the Island region.
- Pumps, Lighting, Process Cooling, and Fans/Blowers are the four largest end uses for savings, and together account for around 75% of the economic potential.
- HVAC represents a larger portion of potential demand savings (although pumps are still the largest end use).

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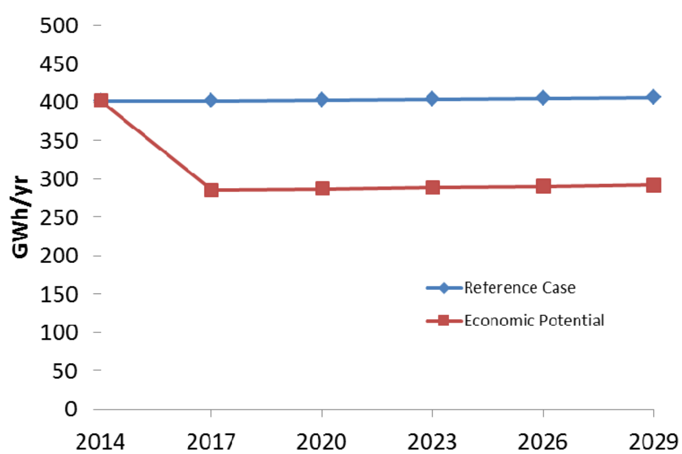
Overall results – 2 scenarios



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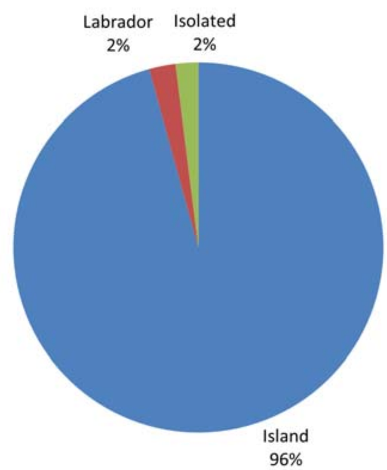
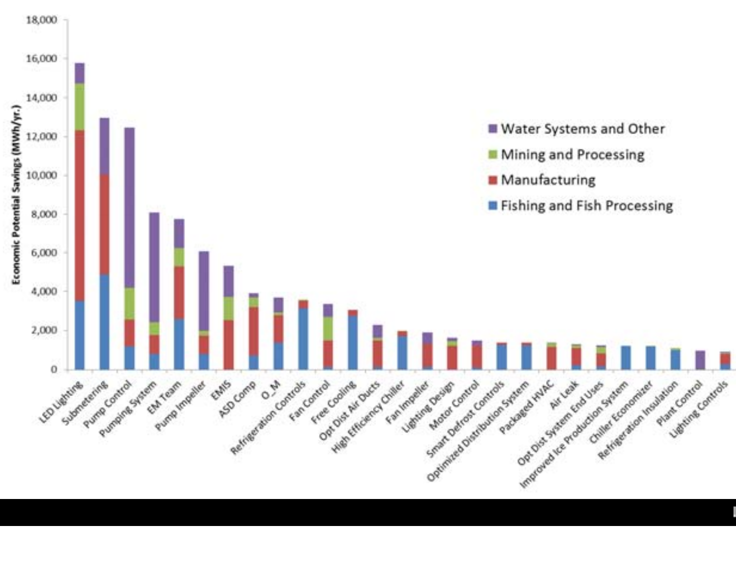
Overall Results-Distribution of Savings



Top Measures in 2029 – Economic Potential



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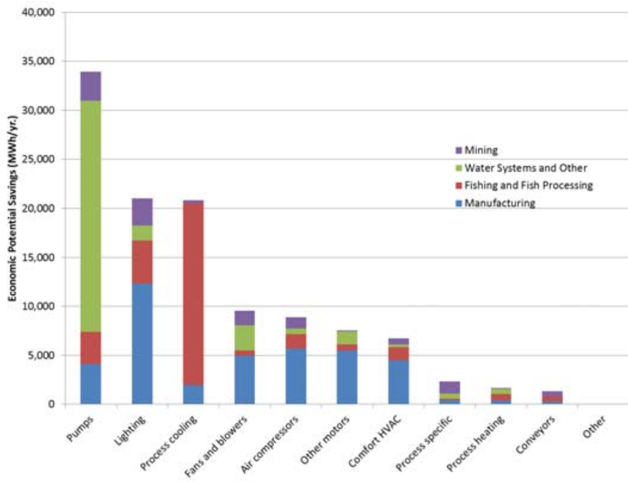
Economic Potential by End Use and Sub-Sector



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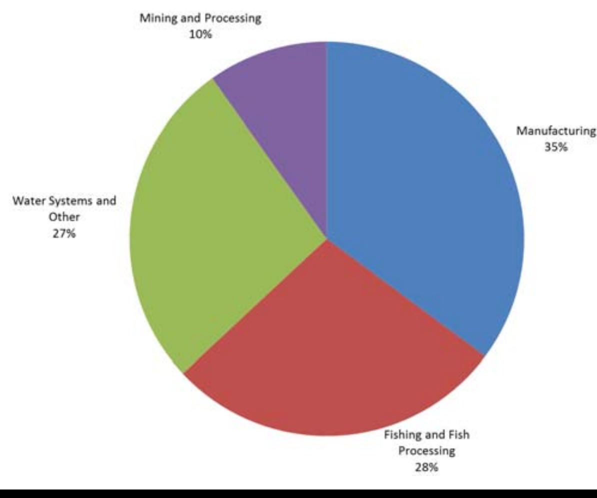
Economic Potential by Sub-Sector - 2029



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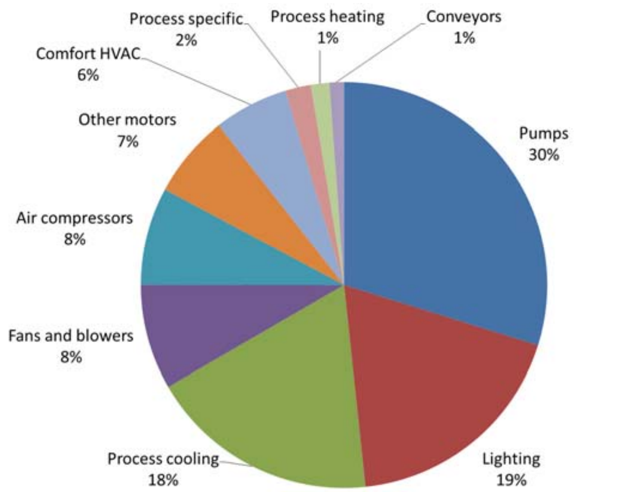
Economic Potential by End Use - 2029



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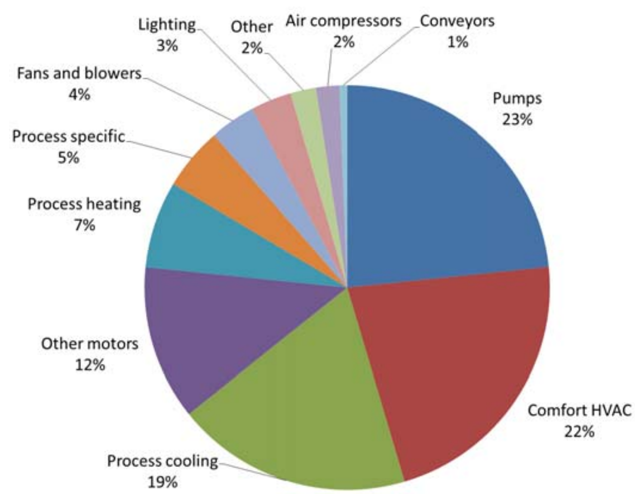
Peak Demand Reduction by End Use – 2029



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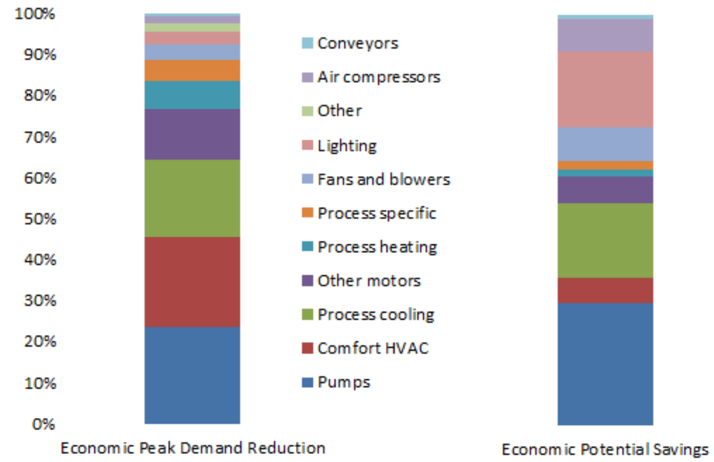
Comparison of Electric Energy & Peak Demand Savings



3

Discussion of Industrial Opportunities

Today's Discussion

High Level Market Characterization

- Barriers – Price, Availability, Awareness, Risk, etc
- Baseline – Affirmation of where we are starting from
- Market Structure – supply channels
- Main Actors – potential partners

High Level Strategy/ Program Design

- How do we make this opportunity happen?
- What would ideal strategy/program look like?
- Participation at the "upper" and "lower" levels?
- Applicability to other markets? Related technologies?

Today's Discussion

- Exchange of ideas and views
  - There are no wrong answers
  - Discussion is key!! Numbers will follow from it
- Today's Focus - selected opportunities
  - Subset of the opportunities identified in the study
  - Selected to cover a variety of different technologies and markets
  - Will extrapolate results to remaining sub-sectors and/or technologies

Choice of Measures to Discuss

- Represent a substantial portion of the economic potential
- Cover many different end uses
- Can be used as a basis to discuss other measures in the same end use
- Some new program options
- **A set of conversations that are as different from each other as possible!**

Discussion Approach

- Proposed approach to each opportunity discussion
  - Introduction by ICF
  - Constraints, barriers & challenges
  - High level strategy
  - "Best Case" participation rates, 2029
  - "Lower Case" participation rates, 2029
  - Shape of adoption curve
  - Guidelines to consultants

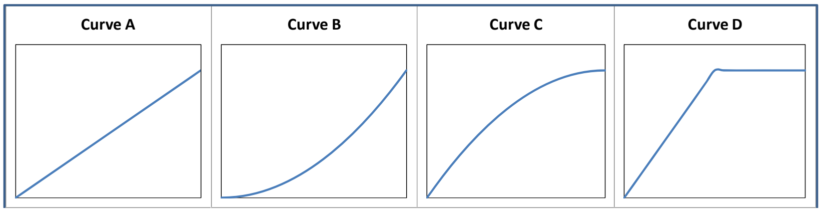
Achievable Potential - Definition

- The proportion of Economic Potential that can be realistically achieved
  - Includes consideration of customer perspective & market barriers
  - Recognizes that CDM programs can address some, but not all, market barriers
- Expressed as a range
  - Reflects the uncertainties of any forecast
  - Acknowledges that there are different levels of potential CDM program intervention
  - Recognizes that there are external factors that influence customer decisions

Achievable Potential – 2 Scenarios

- **"**Upper" = Very Best Possible Case
  - Theoretically = Economic potential minus "can't" or "won't" portion of market
  - Aggressive CDM program approach implied
  - Highly supportive context e.g. healthy economy, high level of public emphasis on climate change mitigation etc.
- "Lower" = Business as Usual
  - CDM program support is similar to, or modest increase over past years
  - Market interest/commitment to energy efficiency and environment remains approximately as current
  - Federal and provincial gov't EE and GHG efforts as current

Adoption Curves



Opportunities for Today's Workshop

Opportunity	Primary End Use	Percent of 2029 Economic Potential Savings
LED Lighting	Lighting	13.9%
Optimization of Pumping Systems	Pumping	7.1%
Roving Energy Managers	System (all)	6.8%
Premium Efficiency Refrigeration Control Systems	Process Cooling / Refrigeration / Freezing	3.1%
Demand Response Curtailments	System - Demand	51%
Optimization of Compressed Air Distribution Systems and End-uses	Compressed Air	1.1%
Optimized Motor Control	Other Motors	1.3%
Process Heat Recovery for HVAC	HVAC	0.5%

Industrial Opportunity 1:

LED Lighting

Installing LED lighting to replace inefficient existing lighting fixtures (MH, HPS, T12).

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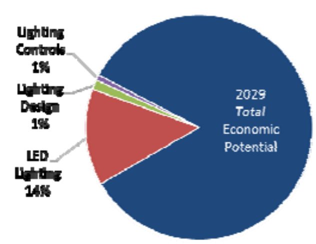
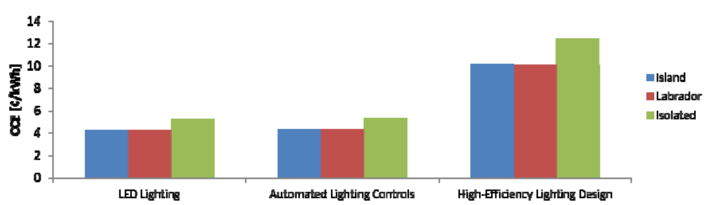
Industrial Opportunity 1:

LED Lighting

Comparison with Other Lighting Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
LED Lighting	15,773	All
Automated Lighting Controls	889	All
High-Efficiency Lighting Design	1,608	Island (in 2017) & Isolated





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Industrial Opportunity 1:

LED Lighting

Assumptions

Focus Building Type	Manufacturing
Focus Region	Island
Typical Application:	
Cost	$230
Useful Life	12 years
Savings:	
Lighting	52%

Industrial Opportunity 1:

LED Lighting

Economic Indicators

Simple Payback (Manufact. - Island)	4.8 years
Average CCE (¢/kWh):	
Island	4.30
Labrador	4.27
Isolated	5.27
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	66,812 MWh
Applicability (Manufacturing)	100%

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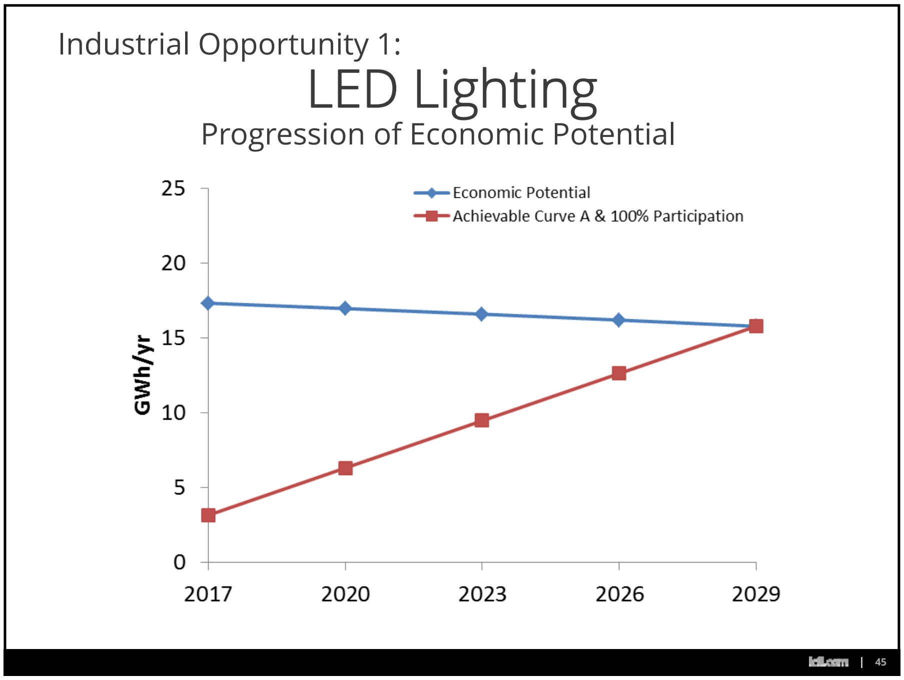
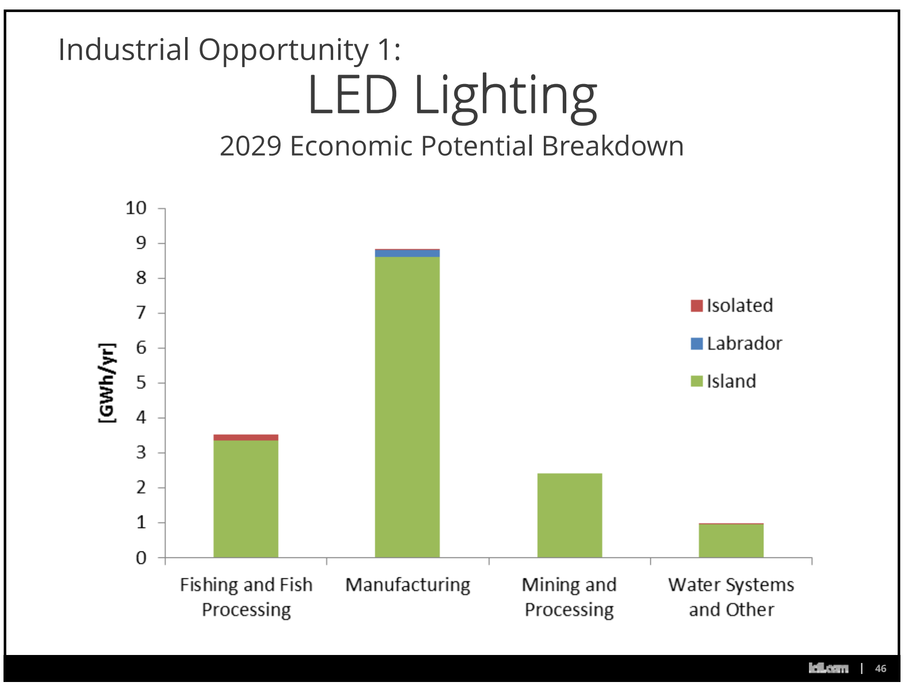
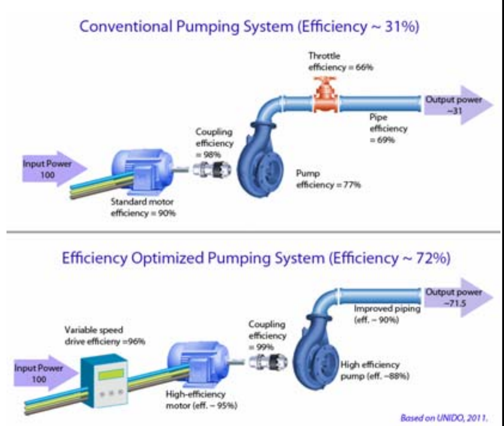

Industrial Opportunity 1:
LED Lighting
Progression of Economic Potential
Economic Potential
Achievable Curve A & 100% Participation
GWh/yr
25
20
15
10
5
0
2017
2020
2023
2026
2029
45


Industrial Opportunity 1:
LED Lighting
2029 Economic Potential Breakdown
[GWh/yr]
10
9
8
7
6
5
4
3
2
1
0
Isolated
Labrador
Island
Fishing and Fish Processing
Manufacturing
Mining and Processing
Water Systems and Other
46

Industrial Opportunity 2:

Optimization of Pumping Systems

- Better **matching pump size** and type with operation and system demands (pump replacement, replacing valves)
- **Operational changes**
- Reduce friction in pumping system by piping redesign and retrofit; **removing dead end pipes** and isolating flow paths to nonessential or non-operating equipment.
- Use pressure switches to **shut down unnecessary pumps**

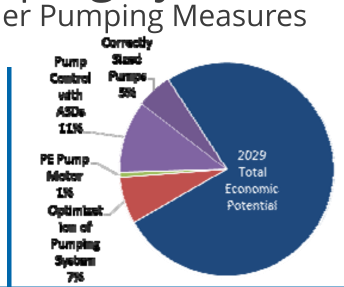


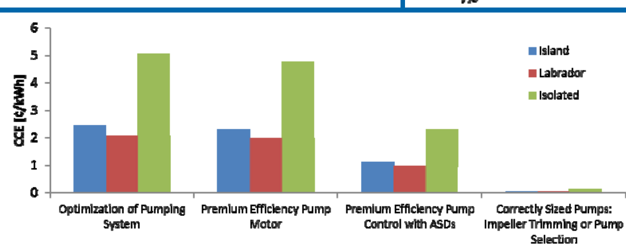
Industrial Opportunity 2:

Optimization of Pumping Systems

Comparison with Other Pumping Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Optimization of Pumping System	8,085	All
Premium Efficiency Pump Motor	856	All
Premium Efficiency Pump Control with ASDs	12,476	All
Correctly Sized Pumps: Impeller Trimming or Pump Selection	6,065	All





Industrial Opportunity 2:

Optimization of Pumping Systems

Assumptions

Focus Sub-Sector Type	Water Systems and Other
Focus Region	Island
Typical Application:	
Cost	$62,150
Useful Life	15 years
Savings:	
Pumping	20%

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Industrial Opportunity 2:

Optimization of Pumping Systems

Economic Indicators

Simple Payback (Water Systems - Island)	2.3 years
Average CCE (¢/kWh):	
Island	2.46
Labrador	2.09
Isolated	5.06
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	198,800 MWh
Applicability (Water Systems)	80%

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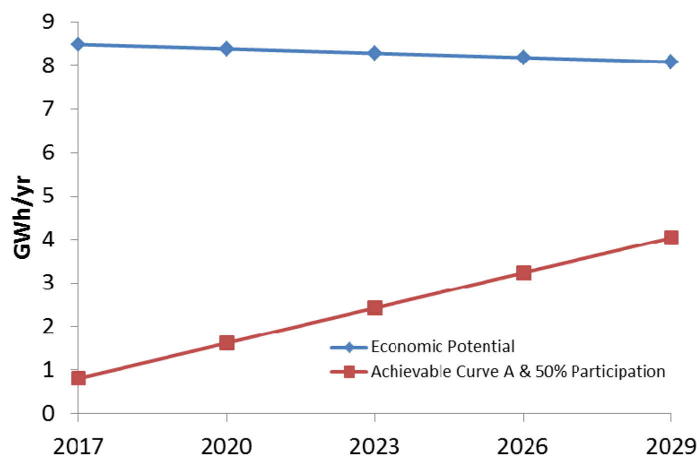
Industrial Opportunity 2:

Optimization of Pumping Systems

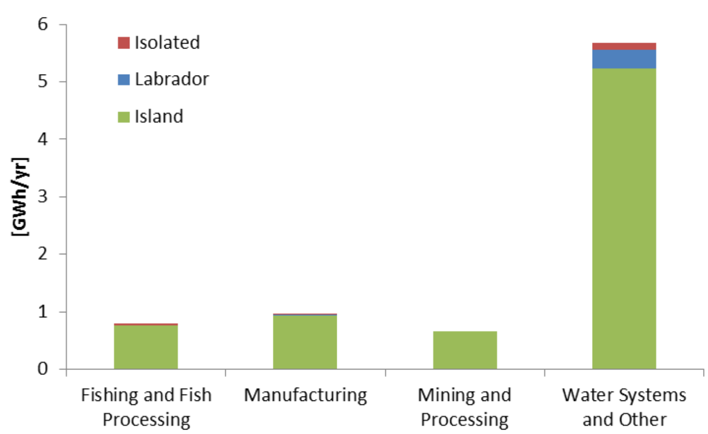
Progression of Economic Potential



Industrial Opportunity 2:

Optimization of Pumping Systems

2029 Economic Potential Breakdown

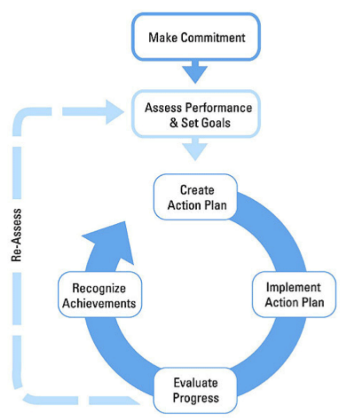


Industrial Opportunity 3:

Roving Energy Managers

- Formal establishment of energy management responsibilities
- Internal plant EM team or a Roving Energy Manager that splits their time between multiple facilities.
- Ensure someone is focused on improving facility energy performance and championing energy efficiency projects.
- ‘Enabling’ measure

Structure of a Strategic Energy Management System



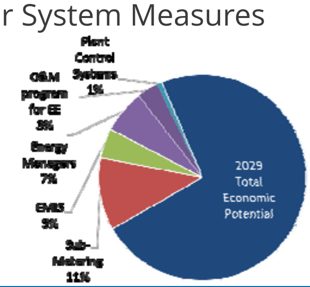
Source: US EPA, 2010.

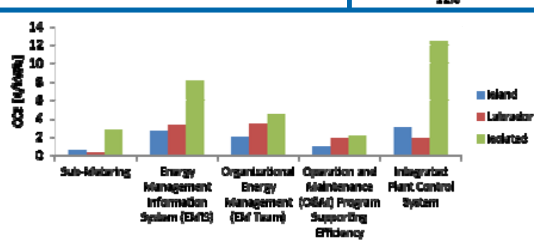
Industrial Opportunity 3:

Roving Energy Managers

Comparison with Other System Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Sub-Metering	12,969	All
Energy Management Information System (EMIS)	5,315	All
Organizational Energy Management (EM Team)	7,742	All
Operation and Maintenance (O&M) Program for Efficiency	3,696	All
Integrated Plant Control System	963	Isolated





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Industrial Opportunity 3:

Roving Energy Managers

Assumptions

Focus Sub-Sector Type	Fishing and Fish Processing
Focus Region	Island
Typical Application:	
Cost	$5,000
Useful Life	1 years
Savings:	
System (all end-uses)	2.5%

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Industrial Opportunity 3:

Roving Energy Managers

Economic Indicators

Simple Payback (Fishing - Island)	1.7 years
Average CCE (¢/kWh):	
Island	1.97
Labrador	3.42
Isolated	4.52
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	1,058,314 MWh
Applicability (Fishing)	100%

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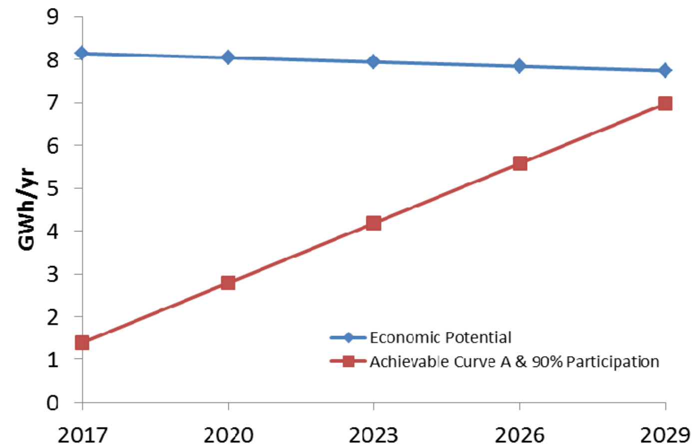
Industrial Opportunity 3:

Roving Energy Managers

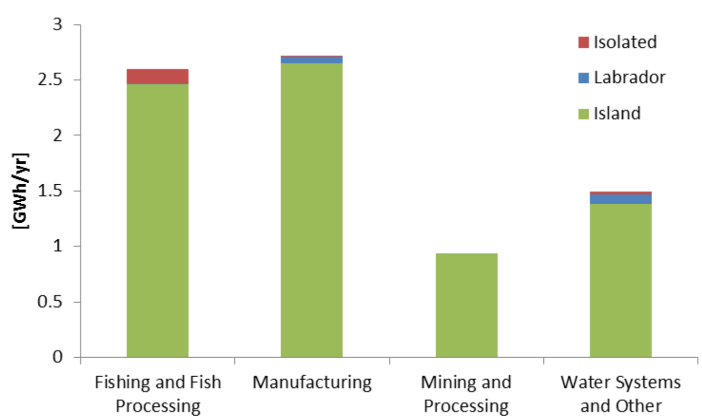
Progression of Economic Potential



Industrial Opportunity 3:

Roving Energy Managers

2029 Technical Potential Breakdown



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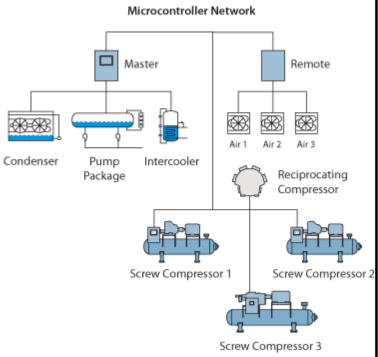
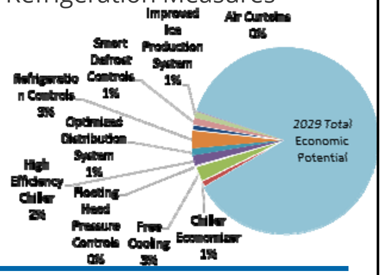
Industrial Opportunity 4:
PE Refrigeration Control Systems

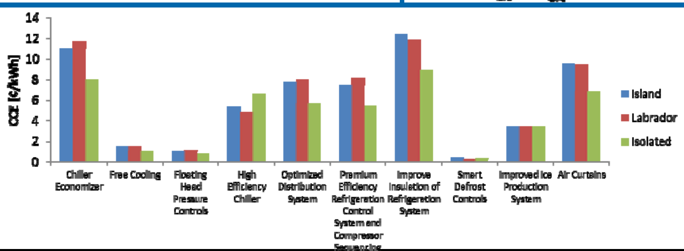
- Centralized control system interfacing to existing controllers for optimally controlling the operation of each of the compressors, condensers, and evaporators
- Ensure smooth control during load fluctuations or setpoint changes
- Optimize the sequencing when multiple compressors are included in a system, to most efficiently match variable load requirements



Industrial Opportunity 4:
PE Refrigeration Control Systems
Comparison with Other Refrigeration Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Chiller Economizer	1,183	Isolated
Free Cooling	3,068	All
Floating Head Pressure Controls	302	All
High Efficiency Chiller	1,959	Island, Isolated
Optimized Distribution System	1,360	Island, Isolated
PE Refrigeration Control and Sequenc	3,567	Island, Isolated
Improve Insulation of Refrigeration Sy	1,078	Isolated
Smart Defrost Controls	1,376	All
Improved Ice Production System	1,203	All
Air Curtains	215	Isolated





Industrial Opportunity 4:

PE Refrigeration Control Systems

Assumptions

Focus Sub-Sector Type	Fishing and Fish Processing
Focus Region	Island
Typical Application:	
Cost	$88,992
Useful Life	15 years
Savings:	
Refrigeration	9%

Industrial Opportunity 4:

PE Refrigeration Control Systems

Economic Indicators

Simple Payback (Fishing - Island)	5.0 years
Average CCE (¢/kWh):	
Island	7.47
Labrador	8.18
Isolated	5.42
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	106,294 MWh
Applicability (Fishing)	80%

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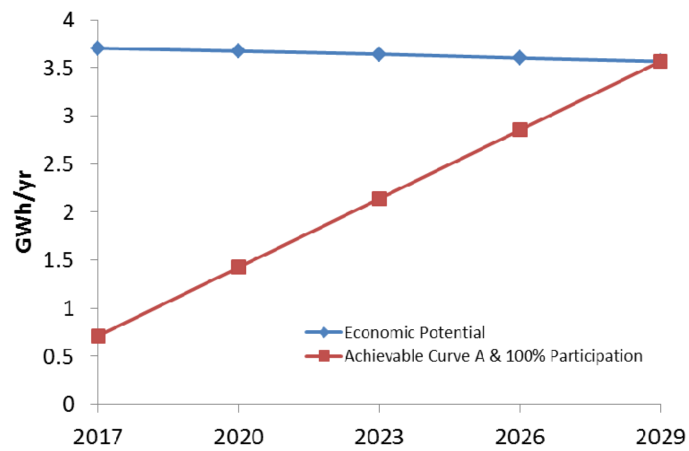
Industrial Opportunity 4:

PE Refrigeration Control Systems

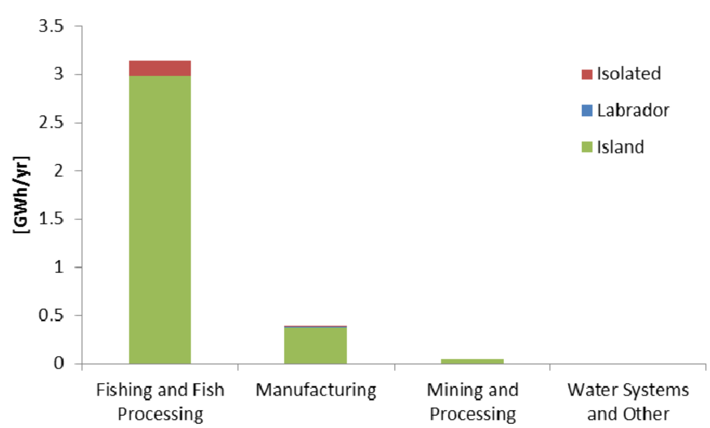
Progression of Economic Potential Savings



Industrial Opportunity 4:

PE Refrigeration Control Systems

2029 Economic Potential Breakdown



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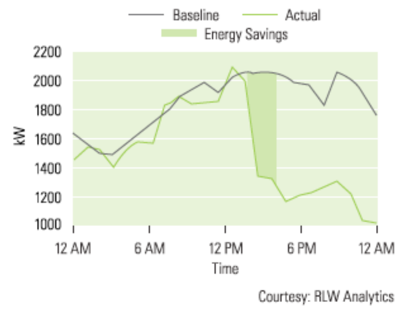
Industrial Opportunity 5:

Demand Response Curtailments

- Participating facilities are incented to reduce their demand during critical provincial peak periods
- Utilities inform program participants when there will be a 'peak period event'
- Operational changes, rescheduling of production, and use of back-up power equipment

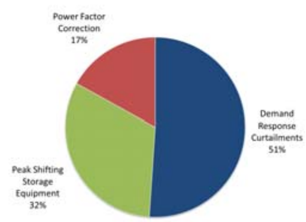


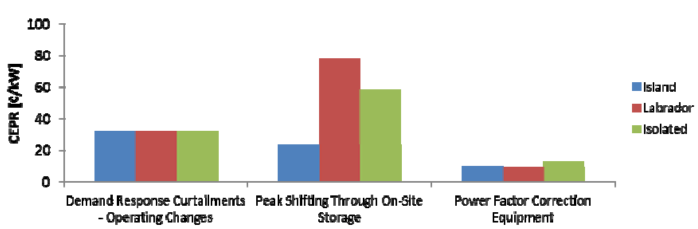
Industrial Opportunity 5:

Demand Response Curtailments

Comparison with Other Demand Measures

	2029 Economic Potential Peak Demand Reduction (MW)	Passes Economic Test in Regions
Demand Response Curtailments - Operating Changes	3 *	All
Peak Shifting Through On-Site Storage	2	Island, Isolated, partial Labrador
Power Factor Correction	1	All





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Industrial Opportunity 5:

Demand Response Curtailments

Assumptions

Focus Sub-Sector Type	Manufacturing
Focus Region	Island
Typical Application:	
Cost	$29 / peak kVA
Useful Life	1 years
Savings:	
System (all end uses)	10%

Industrial Opportunity 5:

Demand Response Curtailments

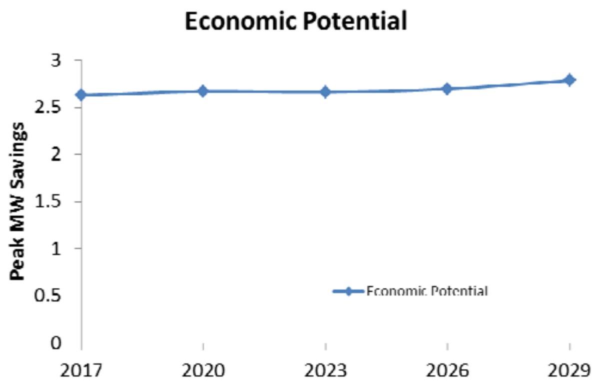
Economic Indicators

Simple Payback (Manufact - Island)	0.5 years *
Average CEPR (¢/kW):	
Island	32.3
Labrador	32.0
Isolated	32.4
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
Demand by 2029 (ref. case)	375 MW
Applicability (Manufacturing)	100%

Industrial Opportunity 5:

Demand Response Curtailments

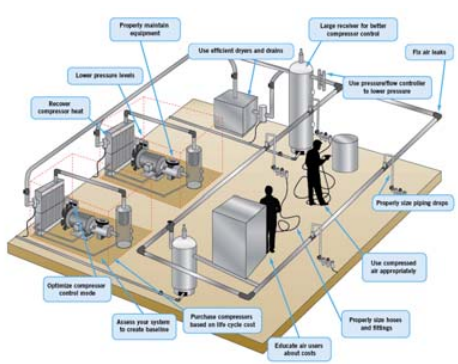
Progression of Economic Potential Savings



Industrial Opportunity 6:

Optimization of Compressed Air Systems

- Minimization of system pressure drops between the compressor and the end uses
- Elimination of inappropriate uses of compressed air



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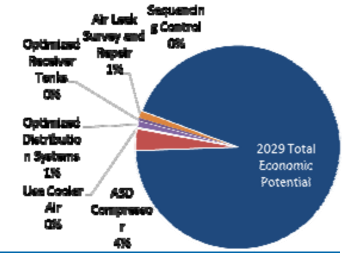
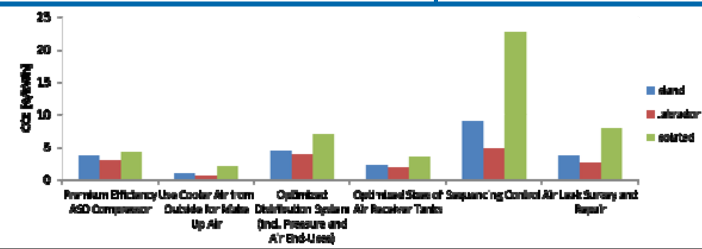
Industrial Opportunity 6:

Optimization of Compressed Air Systems

Comparison Between Compressed Air Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
PE ASD Compressor	3,927	All
Cooler Air from Outside for MUA	243	All
Optimized Distribution System (Incl. F	1,214	All
Optimized Sizes of Air Receiver Tank	502	All
Sequencing Control	22	Island (2017), Labrador
Air Leak Survey and Repair	1,290	All





Industrial Opportunity 6:

Optimization of Compressed Air Systems

Assumptions

Focus Sub-Sector Type	Mining
Focus Region	Island
Typical Application:	
Cost	$50,200
Useful Life	10 years
Savings:	
Air Compressors	10%

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Industrial Opportunity 6:

Optimization of Compressed Air Systems

Economic Indicators

Simple Payback (Mining - Island)	3.5 years
Average CCE (¢/kWh):	
Island	4.35
Labrador	3.75
Isolated	6.97
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	56,396 MWh
Applicability (Mining)	90%
Principal Sub-Sectors	Mining

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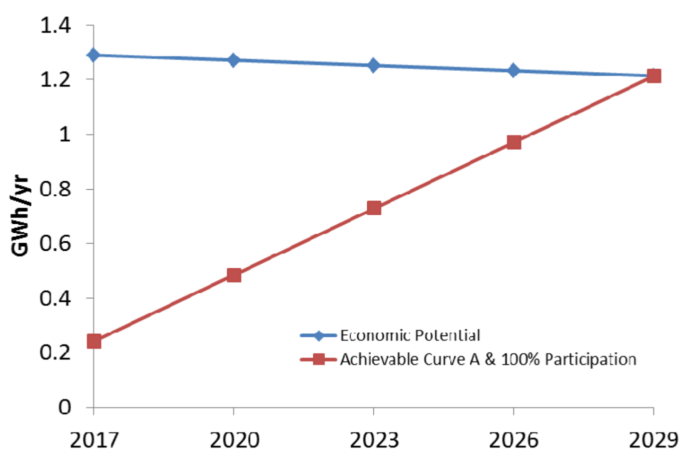
Industrial Opportunity 6:

Optimization of Compressed Air Systems

Progression of Economic Potential Savings



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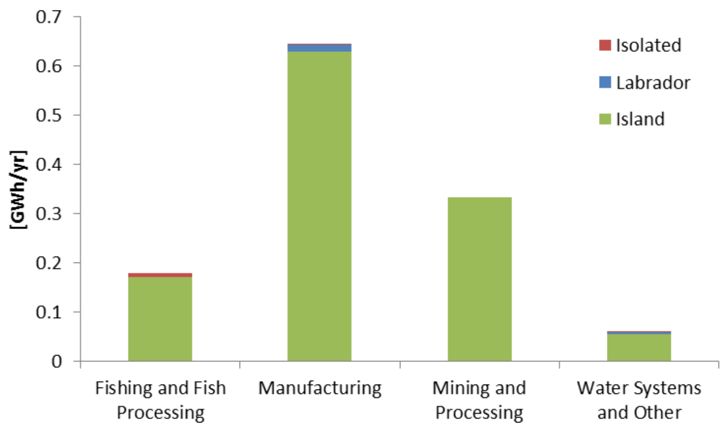
Industrial Opportunity 6:

Optimization of Compressed Air Systems

2029 Economic Potential Savings Breakdown



Industrial Opportunity 7:

Optimized Motor Control

- For many applications, optimized sensor-based controls offering on/off settings for motors will be the ideal control solution, shutting themselves off when the process is not in session.
- For applications with significant variations in load, adjustable speed drives that match the motor speed to load requirements can result in significant energy savings.

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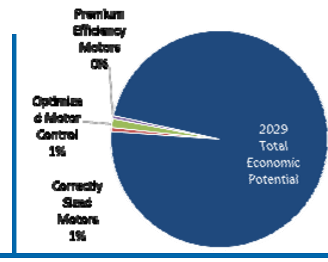
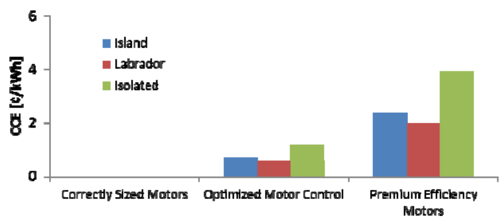
Industrial Opportunity 7:

Optimized Motor Control

Comparison Between Other Motor Measures

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Correctly Sized Motors	677	All
Optimized Motor Control	1,471	All
Premium Efficiency Motors	557	All





Industrial Opportunity 7:

Optimized Motor Control

Assumptions

Focus Sub-Sector Type	Manufacturing
Focus Region	Island
Typical Application:	
Cost	$3,781
Useful Life	15 year
Savings:	
Other Motors	5%

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Industrial Opportunity 7:

Optimized Motor Control

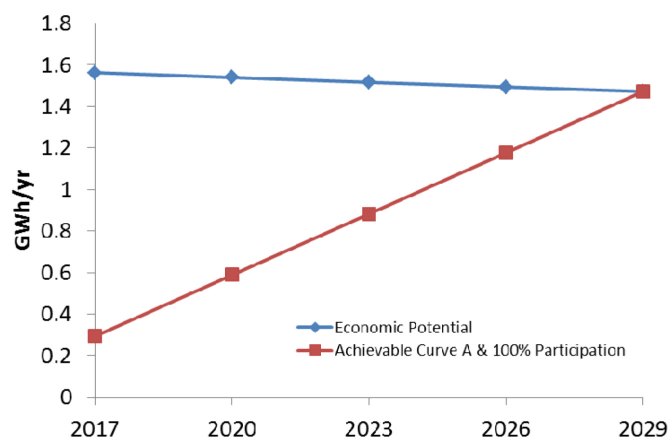
Economic Indicators

Simple Payback (Manufacturing - Is	0.9
Average CCE (¢/kWh):	
Island	0.71
Labrador	0.61
Isolated	1.17
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	77,010 MWh
Applicability (Manufacturing)	70%

Industrial Opportunity 7:

Optimized Motor Control

Progression of Economic Potential Savings



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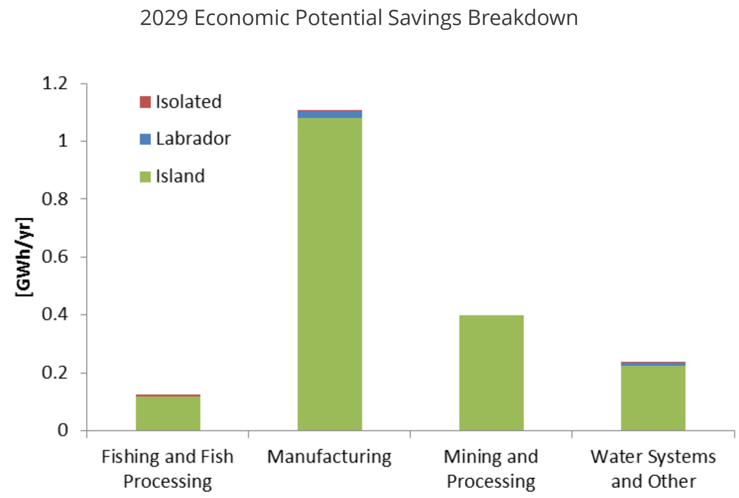
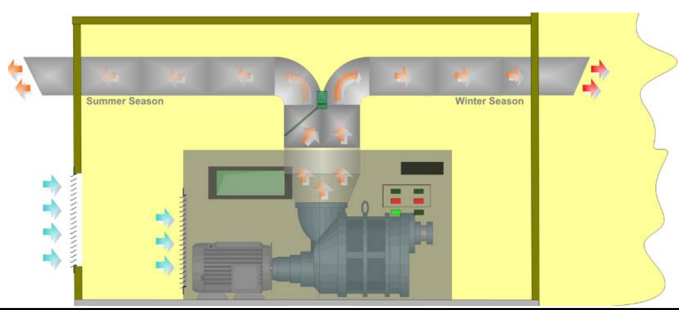
Industrial Opportunity 7:
Optimized Motor Control



Industrial Opportunity 8:
Process Heat Recovery for HVAC

- Air cooled compressors exhaust heated air. In most cases a simple duct system can direct the heated air to inside the building during winter and to outside the building during summer.
- Many other processes also produce waste heat that can be harnessed with varying degrees of difficulty.



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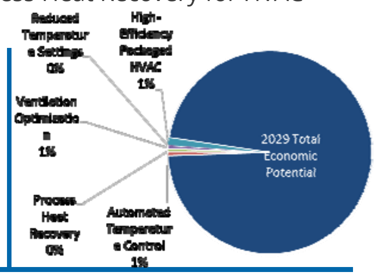
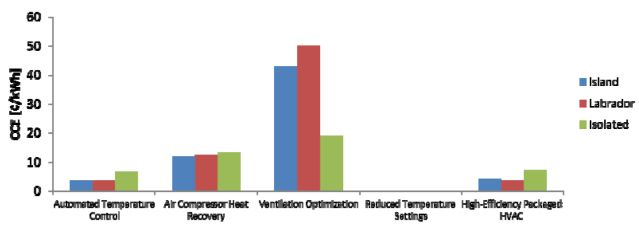
Industrial Opportunity 8:

Process Heat Recovery for HVAC

Comparison Between Process Heat Recovery for HVAC

	2029 Economic Potential Savings (MWh)	Passes Economic Test in Regions
Automated Temperature Control	724	All
Process Heat Recovery	541	Island (2017), Isolated
Ventilation Optimization	586	Isolated
Reduced Temperature Settings	94	All
High-Efficiency Packaged HVAC	1,341	All





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Industrial Opportunity 8:

Process Heat Recovery for HVAC

Assumptions

Focus Sub-Sector Type	Manufacturing
Focus Region	Island
Typical Application:	
Cost	$5,425
Useful Life	20 years
Savings:	
Comfort HVAC	15%

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Industrial Opportunity 8:

Process Heat Recovery for HVAC

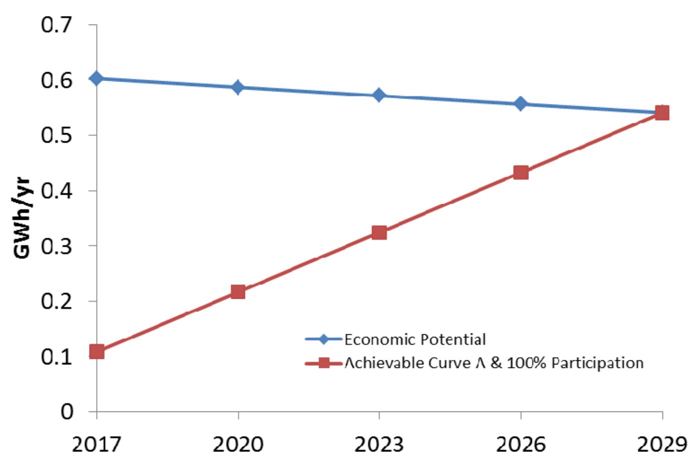
Economic Indicators

Simple Payback (Manufacturing - Is	9.9 years
Average CCE (¢/kWh):	
Island	12.01
Labrador	12.38
Isolated	13.24
Basis	Full
Eligibility Timeline	Immediate
Eligible participants:	
End Use size by 2029 (ref. case)	73,431 MWh
Applicability (Manufacturing)	30%

Industrial Opportunity 8:

Process Heat Recovery for HVAC

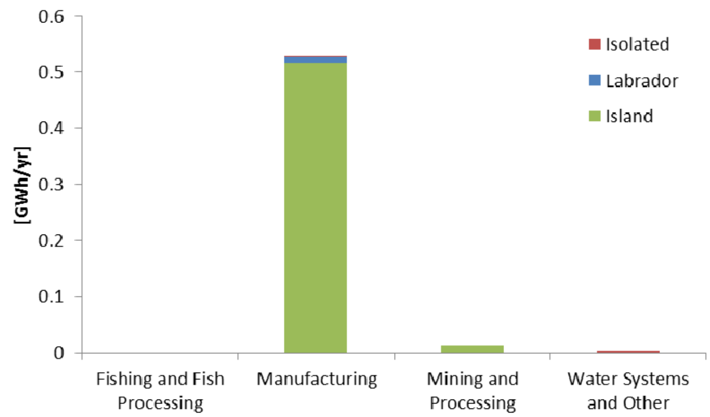
Progression of Economic Potential Savings



Industrial Opportunity 8:

Process Heat Recovery for HVAC

2029 Economic Potential Savings Breakdown



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Wrap Up & Next Steps

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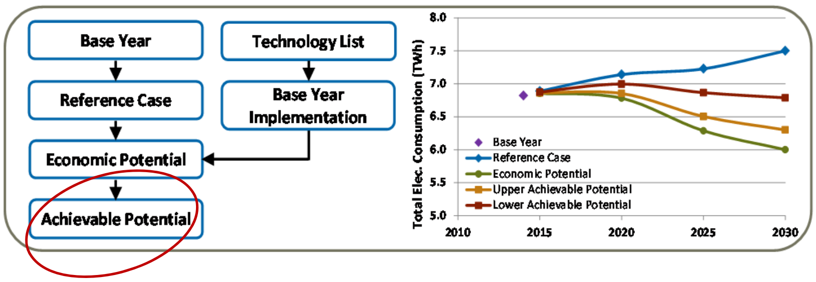
Next Steps



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Appendix H Background-Section 10: Achievable Workshop Measure Worksheets

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

1: LED Lighting

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Manufacturing		
MEASURE INFORMATION			
CCE (¢/kWh)	4.9		
Simple Payback (years)	4.8		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	20,518		
Econ Potential Savings (MWh)	8,808		
Econ Potential Savings (%)	43%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	85%	Curve A	Lot of momentum for the technology, distributor support, and customer demand (maintenance/reliability drivers as
Aggressive Marketing (HIGH)	95%	Curve C	
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	17,440		Lower 2029 Savings
Aggressive Marketing (MWh)	19,492		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Automated Lighting Controls	Slightly lower (since LEDs so high)	Pretty easy sell, particularly if retrofitting lighting already, but is an extra step and not everyone will bother.	
High-Efficiency Lighting Design	A lot lower	Distributors wont mention unless you ask.	Note that lighting design is often free, and done by the lighting distributors/vendors if asked for
Other Sub-Sectors:			
Fishing and Fish Processing	Same.		
Mining and Processing	Same.		
Water Systems and Other	Similar, maybe slightly lower; Municipalities, town councils, could be constrained in		
Other Regions:			
Labrador	Same	Isolated	Lower - Availability of electricians and cost of LEDs higher
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High - and needs simple incentive
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Need more external technical support, plant focused on

GENERAL NOTES:
- Down the road, trend is strongly towards LEDs, and distributors will be pushing these instead of fixtures like MH - which may not even be available.
- Work through lighting distributors or contractors working on standing offers at the facility

BARRIERS/CHALLENGES:
- Upfront costs: Awareness is there
- While people know of technology, not always fully aware of savings, simplicity
- Worries about reliability
- Competing priorities: focused on keeping production going and not worried about energy/lighting
- Savings too low in some cases to justify efforts (if lighting small portion at facility)
- Cost of getting an electrician to come out and put up lights
- Isolated communities (Lab & Island) have even harder time getting contractors to come on site.
-Food & Bev / Fishing: Fixtures need to be aproved

STRATEGIES/SOLUTIONS:
- External technical support
- Low hanging fruit assessments
- Significant and simple incentives
- Direct install program options - again, simpler the better
- Demo projects /case studies / share success stories amongst industry
- CME strategy where they are the application process: Utility direct install where they have a team of people to get it done, incl. electricians on board and everything taken care of

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

2: Optimization of Pumping Systems

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Water Systems and Other		
MEASURE INFORMATION			
CCE (¢/kWh)	2.0		
Simple Payback (years)	2.3		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	50,274		
Econ Potential Savings (MWh)	5,672		
Econ Potential Savings (%)	11%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	10%	B	Opportunity has to present itself.
Aggressive Marketing (HIGH)	80%	B	In St. Johns.... Likely higher outside St. johns. Customer base is quite small, so should be able to build relationships. (However one person thought smaller players outside St. Johns might be harder to reach).
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	5,027		Lower 2029 Savings
Aggressive Marketing (MWh)	40,219		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Premium Efficiency Pump Control with ASDs	Higher	More straightforward opportunity. But need awareness of variability. Similar cost/technical barriers.	
Correctly Sized Pumps: Impeller Trimming or Pump Selection	Lower	Need of team/engineer to actually implement this.	
Premium Efficiency Pump Motor	Same	Need more awareness on HE motors of re-winding, cost of motor 2% of lifetime costs.	
Other Sub-Sectors:			
Mining and Processing	Higher - Controls/VFDs for systems. More in house expertise for larger mines. Mill has some shutdown opportunities for maintenance, not underground in the mine. Similar barriers.		
Fishing and Fish Processing	Same - Limited awareness and technical expertise. Need to help ID opps and with technical aspects. More time in off-season for retrofits, but during season focus is all on production. Lots off opps in general in Fish plants and historically little focus on EE.		
Manufacturing	Same - Similar barriers		
Other Regions:			
Labrador	Same	Isolated	Lower - Logistics are an issue
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Opp ID, technical support, case studies, audit program.

GENERAL NOTES:
- VFD can cover up some aspects of poor design
- Municipality: as building and expanding systems, putting in VFDs (2 of 5)

BARRIERS/CHALLENGES:
- Awareness is a major issue. A lot of people do not understand pumping and the opportunity
- A lot of over design in pumping systems (no one complains about overdesign, but under design risks the process failing). If you tell someone to trim impellers, needs an engineer and team of people to get it done. Not easy.
-Generally poor design of systems. Often too many pumps.
- VFD studies get done, business case presented, often not implemented.
-Disruption to service is barrier for municipality. Dont take a day off, harder to switch out.
- Fish plant seasonality (low hours of use limits savings, bumps up payback)
- cost
-20 year rated pumps going for 40 years+
- Risk of other impacts from changing pumps on system.

STRATEGIES/SOLUTIONS:
- Identifying custom solutions by facility
- Technical challenges / Education / Expertise: awareness of opportunity, spread awareness of incentives
-Engineering consulting, some pump suppliers - suppliers convenient, but want unbiased opinions
-Incorporate with production schedules - production is king, fish plants needs to happen off-season, and cant impact reliability.
- Educational campaigns / awareness / case studies

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

3: Roving Energy Managers

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Fishing and Fish Processing		
MEASURE INFORMATION			
CCE (¢/kWh)	5.2		Lower for other Sub-sectors
Simple Payback (years)	1.7		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	128,250		
Econ Potential Savings (MWh)	2,596		
Econ Potential Savings (%)	2%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	0%		
Aggressive Marketing (HIGH)	70%	Curve B	If all costs are removed, seafood specific this would be fast (95%), but unlikely to be fully paid by the utilities.
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	0		Lower 2029 Savings
Aggressive Marketing (MWh)	89,775		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Sub-Metering	Much lower	Subscriptions services also available. 10-20k offering, meter, technician time, etc… relatively extensive service and little interest in doing on their own. Tough to prove opps without this…. Might follow after awareness.	
Energy Management Information System (EMIS)	Much lower		
Integrated Plant Control System	Much lower	Capital costs high.	
Operation and Maintenance (O&M) Program for Efficiency	Lower	Some maintenance slips from schedule. Ie, look for 3 year but then slips to 5 year cycle. If minor problems only then don't waste money on maintenance, shift budget to production.	
Other Sub-Sectors:			
Mining and Processing	Same		
Water Systems and Other	same		
Manufacturing	same		
Other Regions:			
Labrador	Lower - harder to access	Isolated	Much Lower - services cost less i
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Technical Support

GENERAL NOTES:
- Only a hanful of companies on the island that would hire someone for EM on their own. Lots would participate if had access to shared resource through utilities.
-

BARRIERS/CHALLENGES:
- Awareness. Comes back to simply not recognizing energy waste as an issue.
- Risk on utility side in terms of results from roving energy manager actually being implemented.
- Availability of people for this - there are qualified people, but they are not necessarily available (wont quit job for this).

STRATEGIES/SOLUTIONS:
- Screen ideal candidates
- Have sites have some skin in the game; possibly increasing over time.
- Training opportunities offered to generate EMs
- As plants interact with EM their awareness of EM grows, and it progresses more naturally.

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

4: Premium Efficiency Refrigeration Control Systems and Compressor Sequencing

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Fishing and Fish Processing		
MEASURE INFORMATION			
CCE (¢/kWh)		4.8	
Simple Payback (years)		5.0	
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)		67,969	
Econ Potential Savings (MWh)		3,141	
Econ Potential Savings (%)		5%	
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	15%	Curve B	Some dept. of fisheries money going into this.
Aggressive Marketing (HIGH)	60%	Curve B	Shift to younger generation to encourage and require newer systems
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)		10,195	Lower 2029 Savings
Aggressive Marketing (MWh)		40,782	Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Floating Head Pressure Controls	Same	Improve Insulation of Refrigeration System	
Smart Defrost Controls	Same	Air Curtains	
Free Cooling	Lower	Chiller Economizer	
High Efficiency Chiller	Higher for VFD on screw compressor	Optimized Distribution System	
Improved Ice Production System	Lower	Heat Recovery for Water Heating	Mainly savings from oil, so lower on its own.
Other Sub-Sectors:			
Mining and Processing			
Water Systems and Other			
Manufacturing	Same		
Other Regions:			
Labrador	Lower - Remote	Isolated	Lower - Remote
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Sensitivity to Education and Direct Program Support (High, Med, Low)			Awareness / Education
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			

GENERAL NOTES:
- Awareness/Comfort - Content with old systems that are easy to understand. Harder to troubleshoot PLCs, and focused on reliability.
- CCE for $1/kwh for current refrig costs in isolated, but consultants cost is huge

BARRIERS/CHALLENGES:
- Internet acces in isolated prevents access online for online optimization services.
- Lack of consultants to go to all the remote areas - Need to pay them more to go farther, and need to ensure costs remain at acceptable level for Utility.
- Capital cost
- People resist change, and not going to let go easily of something critical to the facility that they know works/is reliable.
- Intimidated / change of routine required to go from looking at a dial to going on a computer system.
-Need to have operators there by law, so hesitancy to invest in control systems, if still need operator there anyways. Some provinces have legislation that requires less operators with controls.

STRATEGIES/SOLUTIONS:
- Try to convince people it works / fine line vs. not insulting people
- Lot of training / education / good training program for operators
- Not enough to just have case studies - need training /help
-Maybe down the road with younger more tech savvy operators adoption will better accepted.

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

5: Demand Response Curtailments

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Manufacturing		
MEASURE INFORMATION			
CCE (¢/kWh)	32.3		
Simple Payback (years)	0.5*		
ECONOMIC POTENTIAL (2029)			
Peak Demand (MW)	11		
Peak Demand Reduction (MW)	1		
Econ Potential Savings (%)	5%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	5%	D	Few have opted out, fuel costs were too much after events went up in last 2 year period.
Aggressive Marketing (HIGH)	15%	B	More back-up generation being installed in the future.
ACHIEVABLE POTENTIAL			
BAU Marketing (MW)	1		Lower 2029 Savings
Aggressive Marketing (MW)	2		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Peak Shifting Through On-Site Storage	Similar	See commercial discussion. Not all Building automation systems used as prescribed (overuled).	High demand times for water similar to Electricity. So harder.
Power Factor Correction Equipment	Higher	Lack of awareness. Know of one mine that is around 0.8 PF so is an opp, but some facilities do have PF correction.	
Other Sub-Sectors:			
Fishing and Fish Processing	N/A		
Mining and Processing	Would not disrupt process. Full back-up, but the cost to do this would be prohibitive. Also have some smaller generation, but limited.		
Water Systems and Other	Most of big systems in St. Johns already on curtailment program. Smaller systems outside harder. Shutting down system by system difficult, and coming back online in stages poses challenges.		
Other Regions:			
Labrador		Isolated	N/A
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Sensitivity to Education and Direct Program Support (High, Med, Low)			Medium
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Medium

GENERAL NOTES:
- Awareness of program is high
- Around 9-10 larger customers participating

BARRIERS/CHALLENGES:
- Back-up power doesnt usually cover 100%, so can maybe partially cover
-Transfer switches also an issue as dated switches not meant to be used in such frequency.

STRATEGIES/SOLUTIONS:
- Higher incentives could make participation more valuable and grow.
- Some promotion of programs / explanation of options.

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

6: Optimization of Compressed Air Distribution Systems and End-uses

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Mining and Processing		
MEASURE INFORMATION			
CCE (¢/kWh)	3.7		
Simple Payback (years)	3.5		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	18,435		
Econ Potential Savings (MWh)	997		
Econ Potential Savings (%)	5%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	20%	A	
Aggressive Marketing (HIGH)	90%	A	Lots of potential and interest.
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	3,687		Lower 2029 Savings
Aggressive Marketing (MWh)	16,592		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Air Leak Survey and Repair	Same	low-cost opp	
PE ASD Compressor	Lower	Higher capital costs	
Optimized Sizes of Air Receiver Tanks	Lower	low-cost opp	
Cooler Air from Outside for MUA	Same	Higher capital costs	
Sequencing Control	Lower	Higher capital costs	
Other Sub-Sectors:			
Manufacturing	Same		
Fishing and Fish Processing	Same		
Water Systems and Other	Same		
Other Regions:			
Labrador	same	Isolated	lower - travel barrier for auditor
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Med
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Compressed Air Audit

GENERAL NOTES:

-

-

BARRIERS/CHALLENGES:

- Perception that compressed air is free in industry
- Costs
- Awareness/education: know its an opp but dont have solid facts to base decision on.

STRATEGIES/SOLUTIONS:

- Support proving business case / focusing on which compressed air opps to pursue
- Raise awareness - lot of low cost measures but people have other priorities and need utility help to sitdown and create a plan/quantify what they know is there.
-Need boots on the ground to ID opps at plant.
-Compressed air audit program

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

7: Optimized Motor Control

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Manufacturing		
MEASURE INFORMATION			
CCE (¢/kWh)	0.8		
Simple Payback (years)	0.9		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	39,644		
Econ Potential Savings (MWh)	1,106		
Econ Potential Savings (%)	3%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	15%	B	Fairly low uptake as of now.
Aggressive Marketing (HIGH)	80%	A	Capital cost involved, but mature enough technology and there is interest.
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	5,947		Lower 2029 Savings
Aggressive Marketing (MWh)	31,716		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Correctly Sized Motors	Same	Most customers just want it to work again as fast as possible. Don't even consider that it might not be sized correctly.	Through a motor maintenance program include assessment of sizing.
Premium Efficiency Motors	Higher		
Conveyor Motor Control	Same		
Fan ASD	Same		
Other Sub-Sectors:			
Fishing and Fish Processing	Same		
Mining and Processing	Same		
Water Systems and Other	Same		
Other Regions:			
Labrador	Same	Isolated	Lower - accessability
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			Med
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			ID and proper implementation of motor control

GENERAL NOTES:
- On/off controls only for smaller motors
- Supply channels exist

BARRIERS/CHALLENGES:
- Percieved reliability risk
- VFDs installed by personel that are not knowledgeable
- VFDs being installed where not the correct solution to the problem... covering up the issues with a VFD.
- When customer goes to supplier for VFD, not going to be turned down and told to do a study.

STRATEGIES/SOLUTIONS:
- Need education on what VFDs have acceptable harmonics performance. Avoid PF issues as well. Low additional cost for these better performance VFD.
- Developing lists of qualified or reputable suppliers
- Utility support at comissioning stage to support more effective implementation
- Qualified product list

NL ACHIEVABLE POTENTIAL WORKSHOP - INDUSTRIAL SECTOR

Process Heat Recovery for HVAC

			COMMENTS
Focus Region	Island Interconnected		
Focus Sub-Sector	Manufacturing		
MEASURE INFORMATION			
CCE (¢/kWh)	8.1		
Simple Payback (years)	9.9		
ECONOMIC POTENTIAL (2029)			
End Use Consumption (MWh)	22,895		
Econ Potential Savings (MWh)	528		
Econ Potential Savings (%)	2%		
PARTICIPATION RATES	**% by 2029**	**Curve**	
BAU Marketing (LOW)	10%	A	Mature opp already, with low adoption.
Aggressive Marketing (HIGH)	50%	A	Applicability, already removed 70%...
ACHIEVABLE POTENTIAL			
BAU Marketing (MWh)	2,289		Lower 2029 Savings
Aggressive Marketing (MWh)	11,447		Upper 2029 Savings
RELATIVE PARTICIPATION RATES (H=Higher; L=Lower; S=Same; N/A=Not Applicable)			
Related Measures:			
Automated Temperature Control	Higher	Warehouse Loading Dock Seals	lower
High-Efficiency Packaged HVAC	same*	Improved Building Insulation	lower
Reduced Temperature Settings	Higher	HVAC Air Curtains	lower
Ventilation Optimization	lower		
Ventilation Heat Recovery	lower		
Other Sub-Sectors:			
Fishing and Fish Processing	same		
Mining and Processing	same		
Water Systems and Other	same		
Other Regions:			
Labrador	same	Isolated	lower
OTHER PARAMETERS			
Sensitivity to Incentives (High, Med, Low)			High
Sensitivity to Education and Direct Program Support (High, Med, Low)			High
Most Critical Program Support Type(s) (e.g. Opportunity Identification, Trade Ally Training, Technical Workshops, etc.)			Opp identification

GENERAL NOTES:
- Really depends on existing setup of compressors. More common in new builds.
- General Heat Recovery in breweries etc, in larger facilities.

BARRIERS/CHALLENGES:
- Configurations for retrofit.
- Consistency of waste heat supply (changes between seasons)
- Source of heat
- Quality requirements / regulations for Fishing & Food/Bev
- Price
- Lack of understanding the concept of wasted energy. Think they are focused on energy costs but don't challenge.

STRATEGIES/SOLUTIONS:
- Get customers to re-consider their HVAC systems and not just accept the status quo
- Benchmarking vs. similar facilities to show they should be able to improve
- HR integrated with other HVAC opp assessment

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Newfoundland and Labrador Conservation and Demand Management Potential Study: 2015

Residential Sector Final Report

June 2015

Submitted to:
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Executive Summary

Background and Objectives

Since the initial launch of takeCHARGE, NL's Conservation and Demand Management (CDM) market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation all have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and the demand management potential in the province. Similar to the 2007 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

Scope

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).

- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.

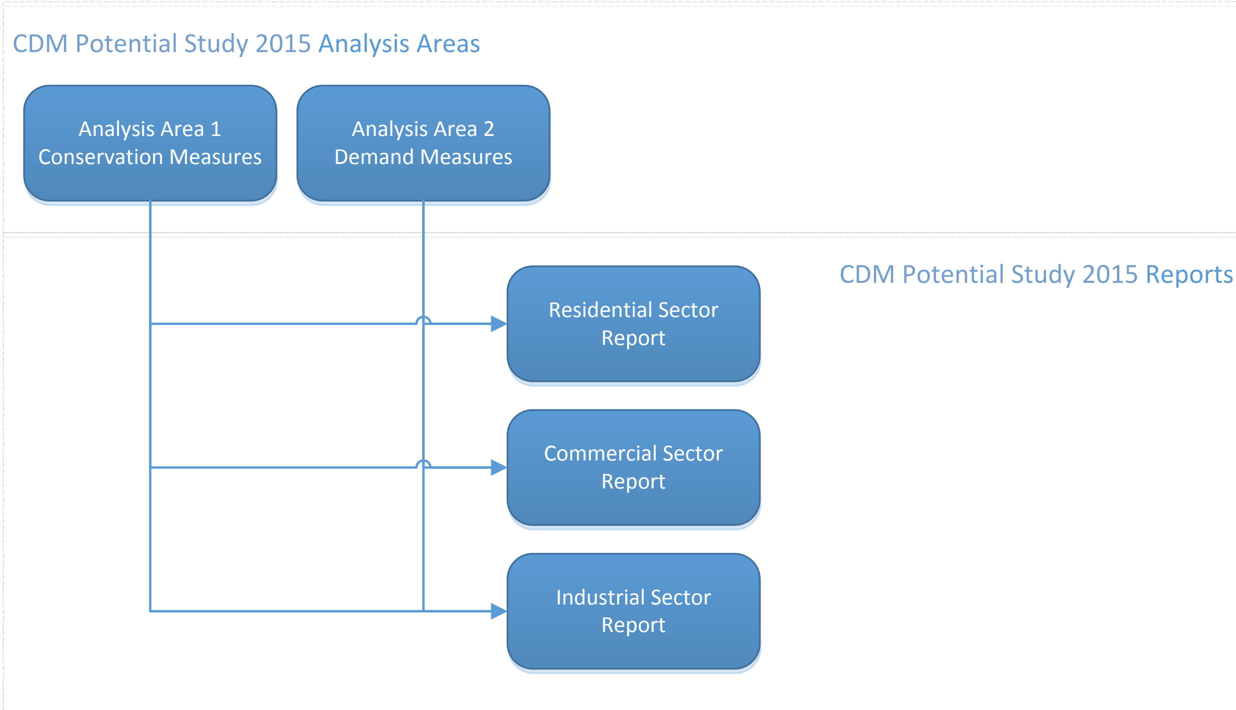
- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.

- **Technologies:** This study addresses a range of electricity conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

CDM Potential Study 2015 has been organized into two analysis areas and the results are presented in three reports, as show in Exhibit ES 1, below.

Exhibit ES 1 Overview of CDM POTENTIAL STUDY 2015 Organization – Analysis Areas and Reports



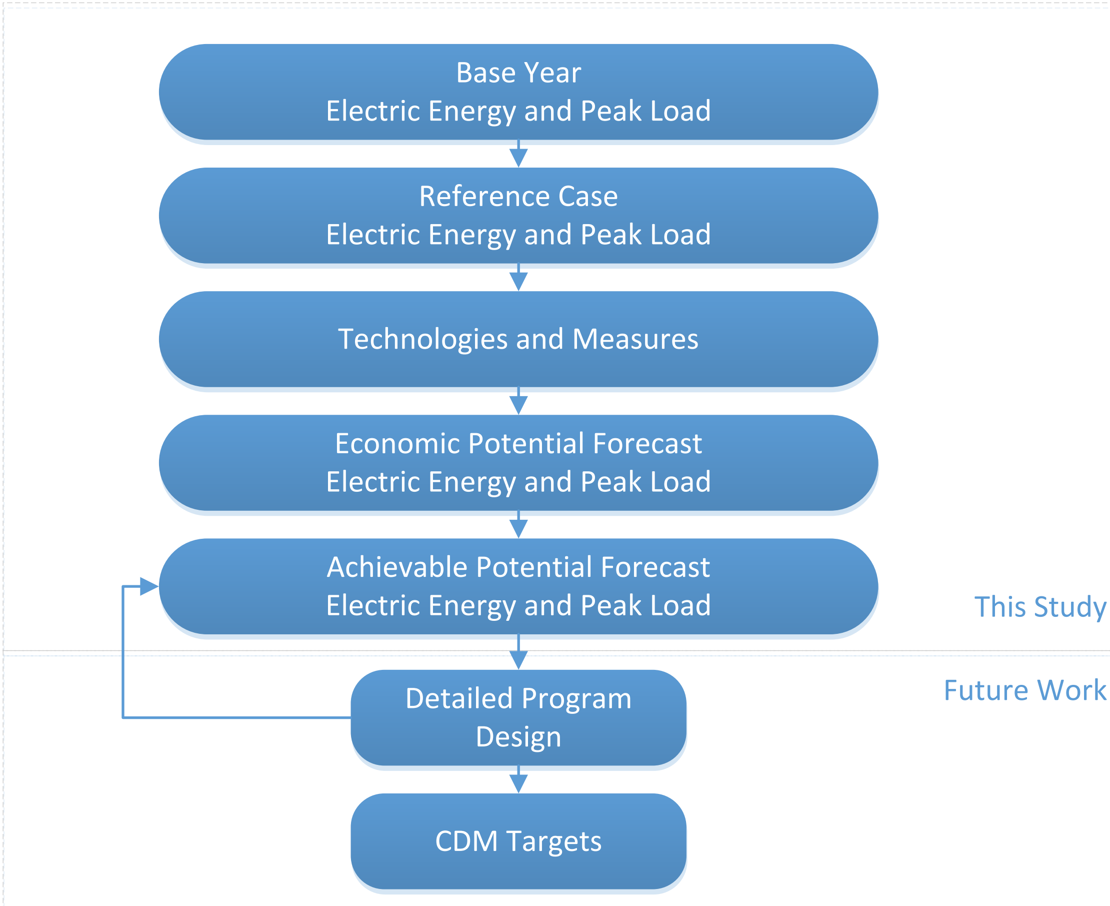
This report presents the results of both Analysis Area 1: Energy-efficiency Technologies and Behaviours and Analysis Area 2: Demand Measures, for Residential sector customers. This report addresses all commercially available electric energy-efficiency and peak load reduction measures that are applicable to NL's Residential sector. It includes the potential for electrical efficiency and peak load reduction technologies expected to be commercially viable by the year 2029; residential customer behaviour measures and commercial and industrial operation and maintenance (O&M) practices are also addressed.

Approach

The detailed end-use analysis of electrical efficiency opportunities in the Residential sector employed two linked modelling platforms: HOT2000,[1] a commercially supported, residential building energy-use simulation software, and RSEEM (Residential Sector Energy End-use Model), an ICF in-house spreadsheet-based macro model.

[1] Natural Resources Canada. *HOT2000 Software*. Download from: http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/software_tools/hot2000.html

Exhibit ES 2 CDM POTENTIAL STUDY 2015: Main Analytic Steps



The major steps involved in the analysis are shown in Exhibit ES 2 and are discussed in greater detail in Section 2 of this report. As illustrated in Exhibit ES 2, the results of *CDM Potential Study 2015*, and in particular the estimation of Achievable Potential,[2] support on-going conservation and demand management (CDM) work; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific CDM targets or with program design.

Overall Residential Study Findings

As in any study of this type, the results presented in this report are based on a number of important assumptions. Assumptions such as those related to the current penetration of efficient technologies and the rate of future growth in the building stock are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the NL utilities. However, the reader is referred to a number of caveats throughout the main text of the report. Given these assumptions, the CDM Potential Study 2015 findings confirm the existence of significant potential cost-effective opportunities for electricity consumption and peak load savings in NL's residential sector.

[2] The proportion of savings identified that could realistically be achieved within the study period.

Efficiency improvements would provide between 336 and 650 GWh/yr. of electricity consumption savings by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. The most significant Achievable Potential savings opportunities were in actions that addressed space heating. Besides space heating, there are significant savings to be found in domestic hot water, refrigerators, clothes dryers[3], televisions, and computers, as well as smaller opportunities in many of the other end uses.

The electricity consumption savings would provide associated peak load reductions of approximately 55 to 101 MW during NL's winter peak period by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. Demand reduction measures would provide further peak load reductions of approximately 12 to 41 MW by 2029 in, respectively, the Lower and Upper Achievable Potential scenarios. All told, this amounts to peak load reduction potential of between 6% and 12% with respect to the Reference Case residential peak load. Demand reductions do not include demand curtailment; rather, existing and future demand curtailment is included in the industrial sector report.

Summary of Electric Energy Savings in the Residential Sector

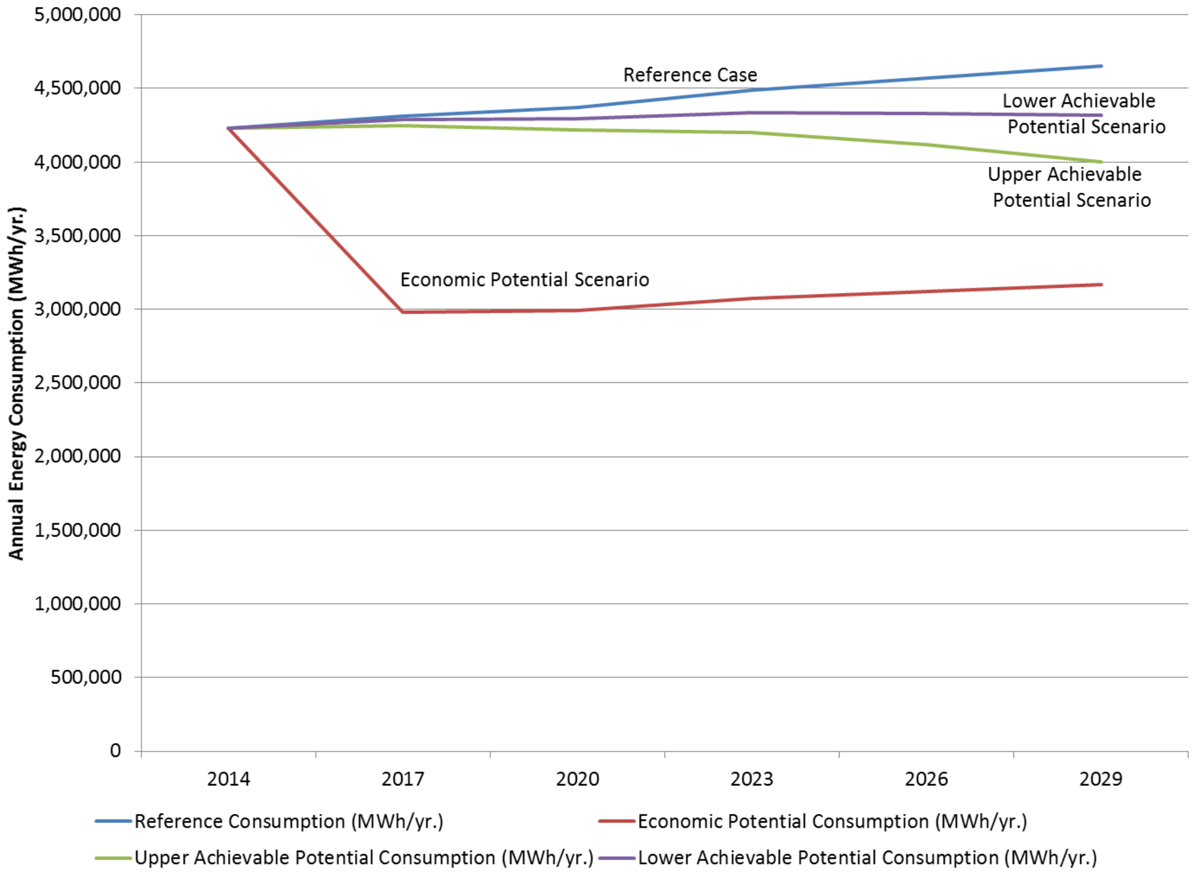
A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by CDM Potential Study 2015 is presented in Exhibit ES 3 and Exhibit ES 4, by milestone year.

Exhibit ES 3 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential		Upper Achievable		Lower Achievable	
	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	1,336	31%	63	1.5%	28	0.6%
2020	1,378	32%	157	3.6%	78	1.8%
2023	1,411	31%	286	6.4%	151	3.4%
2026	1,455	32%	456	10%	244	5.3%
2029	1,485	32%	650	14%	336	7.2%

[3] Note that the majority of the savings in clothes dryers comes from the adoption of more efficient clothes washers. Efficient clothes washers spin the clothes faster and reduce the drying time and therefore the energy consumption in the dryer. These savings are generally larger than the savings in the washer itself.

Exhibit ES 4 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Residential Sector, (MWh/yr.)



Base Year Electricity Use

In the Base Year of 2014, NL's Residential sector consumed about 4,227 GWh/yr. Exhibit ES 5 shows that space heating accounts for about 47% of total residential electricity use. Domestic hot water (DHW) accounts for the second largest percentage, at 13%. These are followed by lighting at 6%, clothes dryers and refrigerators at 5% each, and computers (with their peripherals) at 4%. Other end uses account for 3% or less of the total. Indeed, some end uses are extremely small. Air conditioning is assumed to exist only in dwellings where a heat pump has been installed, and even there it is used only occasionally. Block heaters and car warmers are assumed to be used only in Labrador. The same exhibit also presents the Reference Case consumption by end use in 2029, at the end of the study period, for comparison. Overall, NL's Residential sector is forecast to rise to about 4,652 GWh/yr. by 2029 in the absence of new utility CDM initiatives.

Exhibit ES 6 shows the distribution of Base Year electricity consumption by dwelling type. As illustrated, single detached housing dwellings account for the largest share (76%) of Residential sector Base Year electricity use. The same exhibit also presents the Reference Case consumption by dwelling type in 2029, at the end of the study period, for comparison.

Reference Case – Electric Energy

Exhibit ES 5 Electricity Use by End Use, Residential Sector, 2014 and 2029

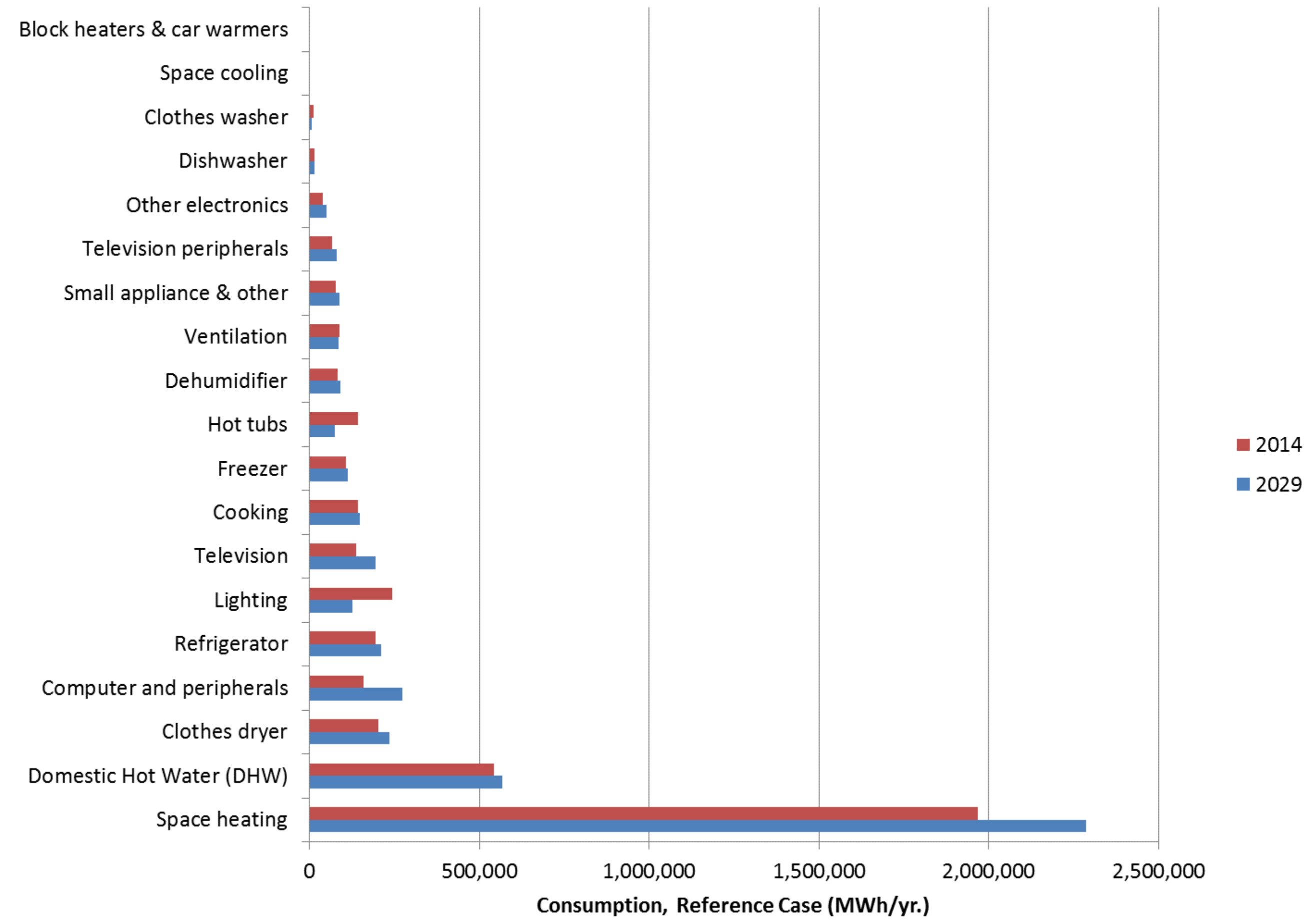
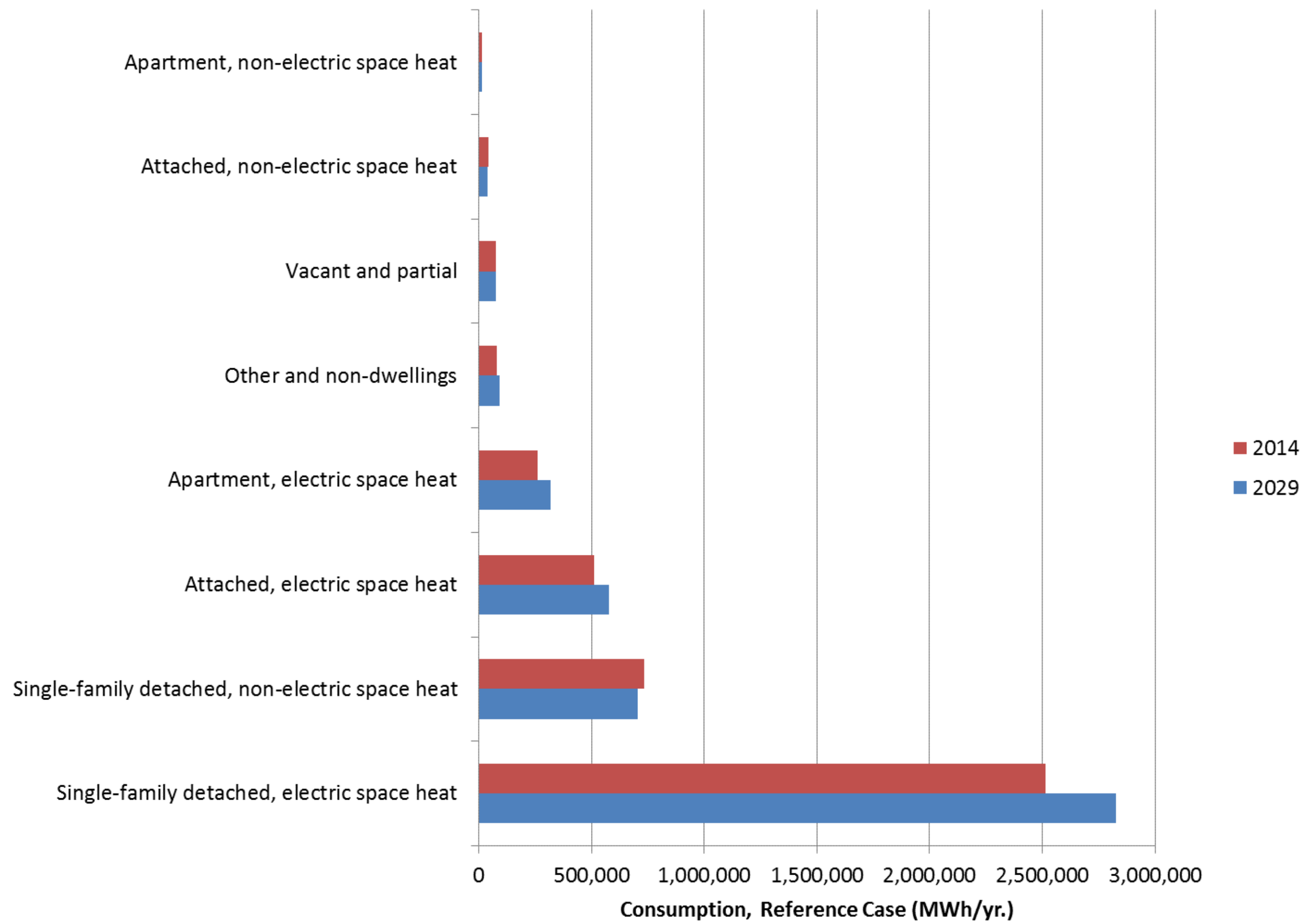


Exhibit ES 6 Electricity Use by Dwelling Type, Residential Sector, 2014 and 2029



Economic Potential Forecast – Electric Energy

Under the conditions of the Economic Potential scenario,[4] the study estimated that electricity consumption in the residential sector would decrease to approximately 3,167 GWh/yr. by 2029. Savings relative to the Reference case would be approximately 1,485 GWh/yr. or about 32%. The Economic Potential savings in the intermediate milestone years are 1,335 GWh/yr. in 2017, 1,378 GWh/yr. in 2020, 1,411 GWh/yr. in 2023, and 1,455 GWh/yr. in 2026. In each case, the savings amount to approximately 31-32% of the Reference case consumption. The Economic Potential savings are dominated by measures that are cost-effective based on their full cost (versus the “do-nothing” option), and therefore within the definitions of the scenario they would be adopted immediately and provide savings starting in the first milestone period.

Achievable Potential – Electric Energy

The Achievable Potential is the portion of the Economic Potential savings that could realistically be achieved within the study period.[5] In the residential sector, the Achievable Potential for electricity savings was estimated to be 336 and 650 GWh/yr., respectively, in the Lower and Upper Achievable Potential scenarios. The savings in the intervening milestone years show a more realistic ramp-up pattern than that observed in the Economic Potential scenario.

The most significant Achievable Potential savings opportunities were in actions that addressed space heating. In fact, space heating savings account for over 70% of the opportunities in 2029. Of this, the ductless mini-split heating systems offer the largest savings potential in the residential sector. Besides space heating, there are significant savings to be found in domestic hot water, refrigerators, clothes dryers, televisions, and computers, as well as smaller opportunities in many of the other end uses.

Summary of Peak Load Reductions

Based on discussions with utility personnel, the following peak period definition was used for this study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[6]

Exhibits ES 7 and ES 8 show the peak load reductions from both the energy efficiency measures and from measures targeted specifically at load management. More details on peak load reduction opportunities are provided in the main body of the report. Highlights of the findings include the following:

- Electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 55 to 101 MW by 2029, a decrease of between 4.5% and 8.5% relative to the reference case.

---

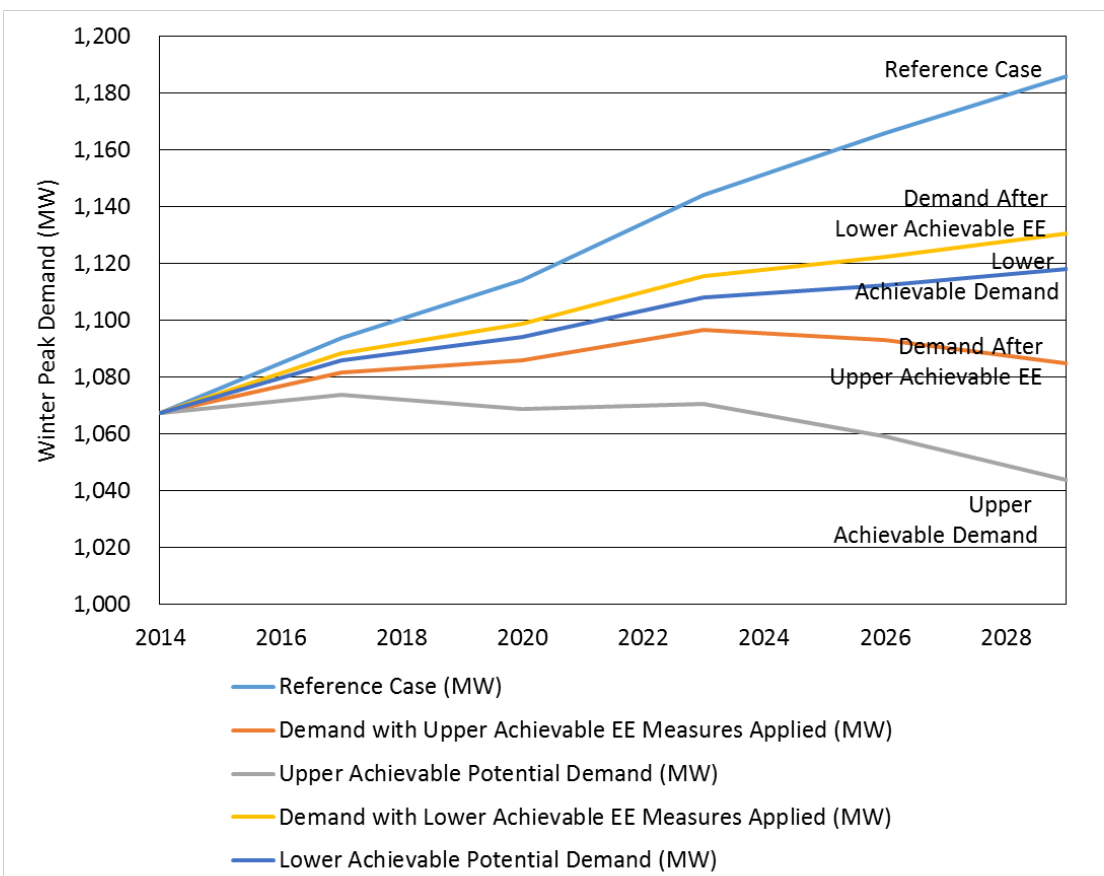
[4] The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value , which has been set at different prices per kWh for the different regions. (One kWh from the Labrador hydroelectric grid is much less expensive than one kWh from an isolated diesel grid.)
[5] The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.
[6] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

- Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 12 to 41 MW by 2029, a decrease of a further 1.0% to 3.5%.
- Demand reduction potential is dominated by the reductions associated with energy efficiency measures in both of the achievable potential scenarios.

Exhibit ES 7 Peak Demand Reductions by Milestone Year for Three Scenarios (MW)

Year	Economic Potential		Upper Achievable		Lower Achievable	
	Potential Reductions (MW)	% Reduction Relative to Reference Case	Potential Reductions (MW)	% Reduction Relative to Reference Case	Potential Reductions (MW)	% Reduction Relative to Reference Case
2017	485	44%	20	2%	8	1%
2020	528	47%	45	4%	20	2%
2023	539	47%	73	6%	36	3%
2026	550	47%	107	9%	54	5%
2029	556	47%	142	12%	68	6%

Exhibit ES 8 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Residential Sector (MW)



Base Year Demand

In the Base Year of 2014, NL's Residential sector demand was approximately 1,067 MW, averaged over the 36-hour peak period. This may be compared against the overall average residential demand for the year, which is:

*4,227 GWh / 8760 hours * 1000 MW/GW = 483 MW*

Exhibit ES 9 shows that space heating accounts for about 61% of total residential electricity use. Domestic hot water (DHW) accounts for the second largest percentage, at 15%. These are followed by lighting at 4% and clothes dryers, ventilation, and cooking at 3% each. Other end uses account for 2% or less of the total. Indeed, some end uses are extremely small. Air conditioning and dehumidification are not expected to operate during the winter peak at all. Block heaters and car warmers are assumed to be used only in Labrador, but in that region they contribute nearly 1.5% of the residential peak demand. The same exhibit also presents the Reference Case peak demand by end use in 2029, at the end of the study period, for comparison. Overall, NL's Residential sector is forecast to rise to about 1,186 MW by 2029 in the absence of new utility CDM initiatives, an increase of approximately 11%

Exhibit ES 10 shows the distribution of Base Year electric peak demand by dwelling type. As illustrated, single detached housing dwellings account for the largest share (77%) of Residential sector Base Year electricity use. The same exhibit also presents the Reference Case peak demand by dwelling type in 2029, at the end of the study period, for comparison.

Reference Case – Electric Peak Demand

Exhibit ES 9 Electric Peak Demand by End Use, Residential Sector, 2014 and 2029

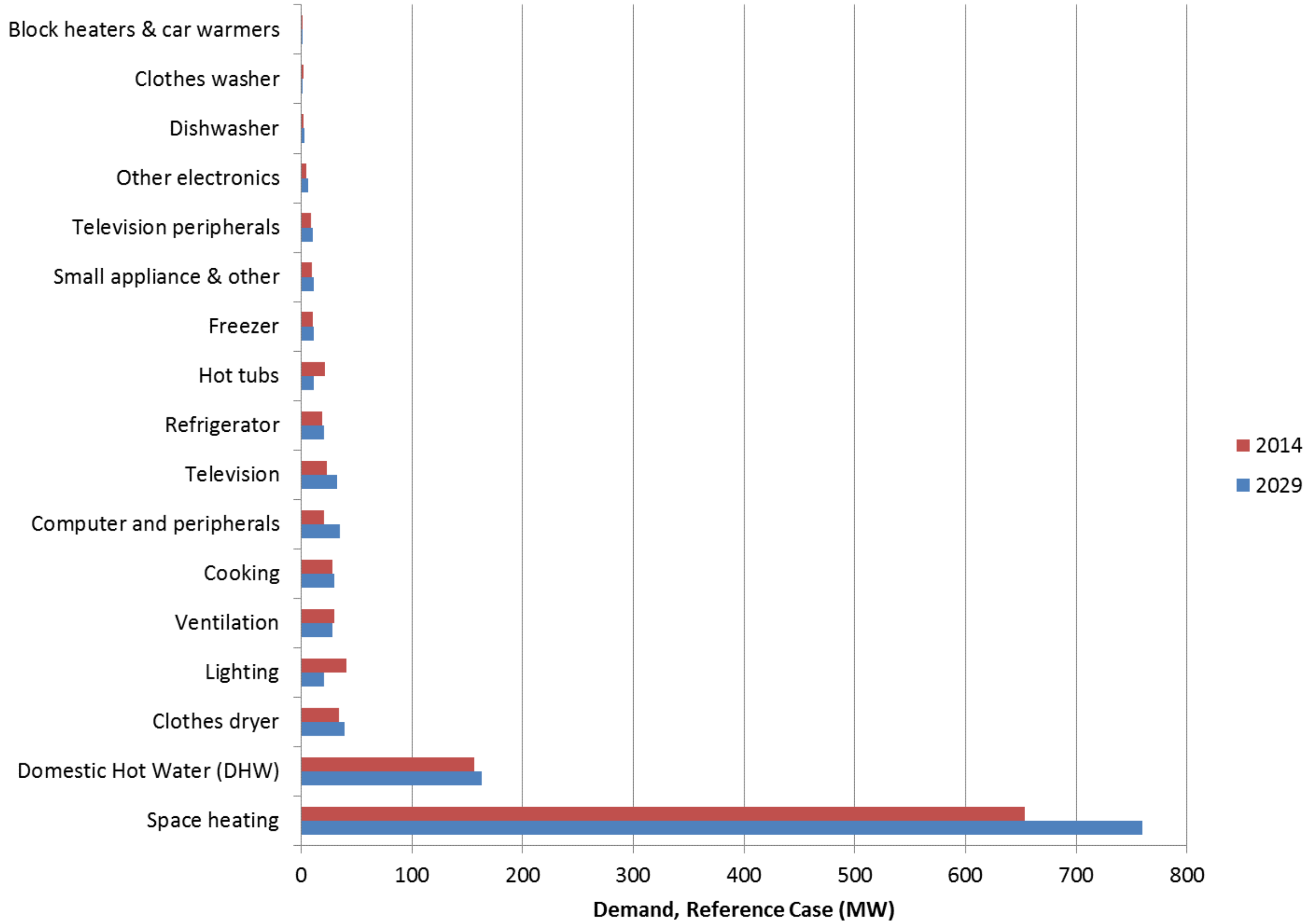
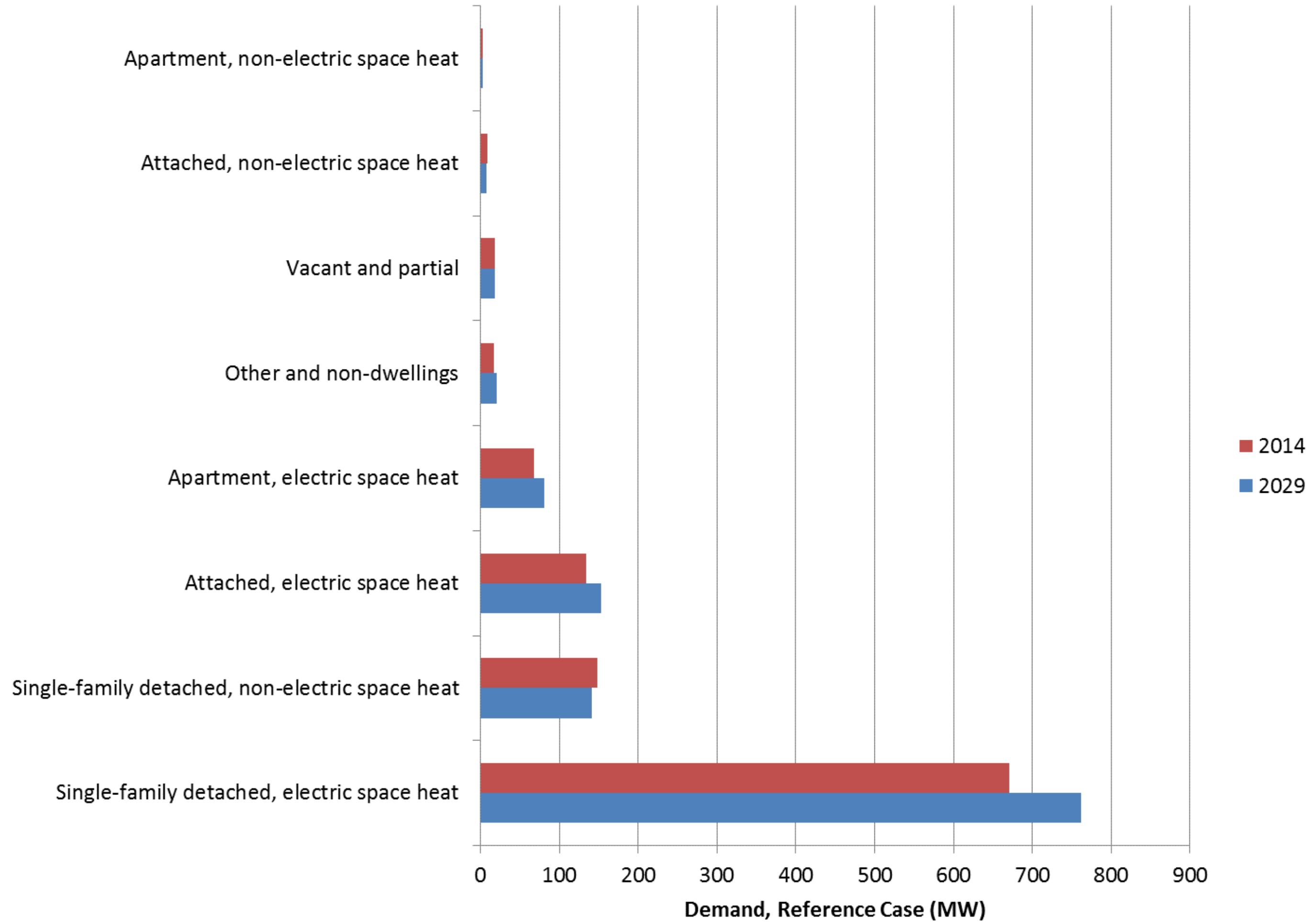


Exhibit ES 10 Electric Peak Demand by Dwelling Type, Residential Sector, 2014 and 2029



Economic Potential Forecast – Electric Peak Demand

Under the conditions of the Economic Potential scenario,[7] the study estimated that electric peak demand in the residential sector would decrease to approximately 630 MW by 2029. Reductions relative to the Reference case would be approximately 556 MW or about 47%. The Economic Potential reductions in the intermediate milestone years are 485 MW in 2017, 528 MW in 2020, 539 MW in 2023, and 550 MW in 2026. In each case, the reductions amount to approximately 44-47% of the Reference case peak demand. The Economic Potential reductions are dominated by measures that are cost-effective relative to the Utilities' cost of new capacity based on their full cost (versus the "do-nothing" option), and therefore within the definitions of the scenario they would be adopted immediately and provide reductions starting in the first milestone period.

Achievable Potential – Electric Peak Demand

The Achievable Potential is the portion of the Economic Potential reductions that could realistically be achieved within the study period. In the residential sector, electricity savings offered by the Lower and Upper Achievable Potential scenarios would provide peak load reductions of approximately 55 to 101 MW by 2029, a decrease of between 4.5% and 8.5% relative to the reference case. Demand reduction measures under the Lower and Upper Achievable Potential scenarios would provide peak load reductions of an additional 12 to 41 MW by 2029, a decrease of a further 1.0% to 3.5%. Thus, demand reduction potential is dominated by the reductions associated with energy efficiency measures in both of the achievable potential scenarios. The savings in the intervening milestone years show a more realistic ramp-up pattern than that observed in the Economic Potential scenario.

Among the demand reduction measures the most significant Achievable Potential savings opportunities were in actions that addressed domestic hot water (DHW). In fact, DHW reductions account for over 70% of the opportunities in 2029. Of this, the DHW cycling offers the largest demand reduction potential in the residential sector, aside from the demand reduction associated with energy efficiency measures. Besides DHW, there are significant reduction to be found in space heating measures. Block heater and car warmer measures offer demand reduction potential only in Labrador.

[7] The Economic Potential Electric Peak Load Forecast is the expected electric peak load that would occur in the defined peak period if demand is reduced by the reductions associated with the energy efficiency measures in the Economic Potential Electricity Efficiency Forecast, and all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were also fully implemented.

Table of Contents

List of Exhibits

1 Introduction

Newfoundland Power Inc. and Newfoundland and Labrador Hydro have been successfully delivering electricity conservation programs to their customers since 2009 under the joint brand, takeCHARGE.

Since the initial launch of takeCHARGE, NL's CDM market has changed both naturally and as a result of the Utilities' planned interventions. Since the last CDM Potential Study, energy efficient technologies have evolved and the takeCHARGE programs have impacted the province's awareness and adoption of CDM measures. In addition, new codes & standards have been drafted or come into effect.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency and conservation have a significant potential to reduce energy consumption, energy costs and emissions.

The objective of this CDM Potential Study, referenced as *CDM Potential Study 2015*, is to identify the achievable, cost-effective electric energy efficiency and demand management potential in province. Similar to the 2007 Study, the information in this report will be critical to developing the next generation of takeCHARGE programs that are equally responsive to customer expectations, support efforts to be responsible stewards of electrical energy resources and is consistent with provision of least cost, reliable electricity service. The *CDM Potential Study 2015*, provides a resource for the Utilities to develop a comprehensive vision of the province's future energy service needs.

1.1 Study Scope

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: residential households (Residential sector), commercial and institutional buildings (Commercial sector), and small, medium, and large industry (Industrial sector).
- **Geographical Coverage:** The study addresses all regions of NL that are served by the Utilities. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. The study results are estimated for three distinct regions: Newfoundland, Labrador, and Isolated Diesel.
- **Study Period:** This study addresses a 15 year period. The Base Year for the study is the calendar year 2014. The Base Year of 2014 was calibrated to the 2014 actual sales data. The study milestone years will be 2017, 2020, 2023, 2026 and 2029.

  It is recognized that the weather conditions in 2014 were not typical. The CDM Potential Study 2015 follows the same assumptions as in the Utilities' Load Forecast.
- **Technologies:** This study addresses a range of electricity conservation and demand management (CDM) measures and includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2029 as well as peak load reduction technologies.

1.1.1 Data Caveat

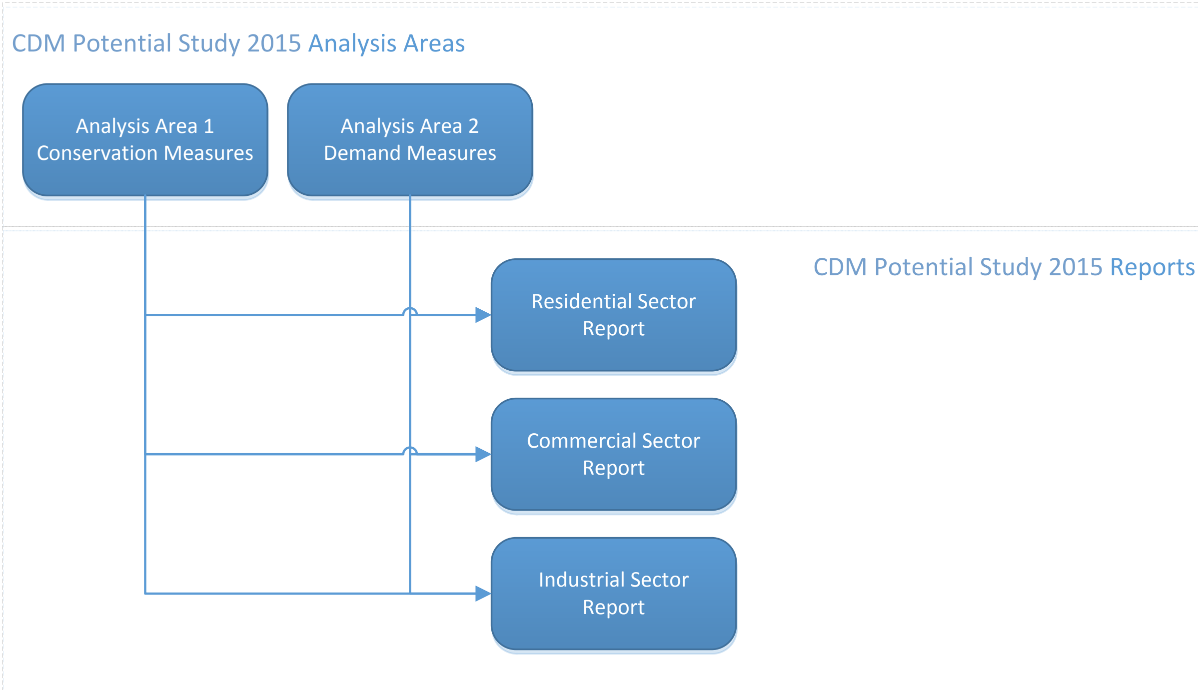
As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the stock of residential buildings and customer willingness to implement new energy efficiency measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgment of the consultant team, client personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.2 Study Organization

Exhibit 1 presents an overview of the study's organization; as illustrated, the study has been organized into two analysis areas and four individual reports.

A brief description of each analysis area and its report content is provided below.

Exhibit 1 Overview of *CDM Potential Study 2015* Organization – Analysis Areas and Reports



1.2.1 Analysis Area 1 – Conservation Measures

This area of the *CDM Potential Study 2015* assesses electric energy[8] reduction opportunities that could be provided by electrical efficiency technologies that are expected to be commercially viable by the year 2029; residential customer behaviour measures and commercial and industrial operation and maintenance (O&M) practices are also addressed. The results of Analysis Area 1 are presented in three individual sector reports.

1.2.2 Analysis Area 2 – Demand Measures

This area of the *CDM Potential Study 2015* assesses peak load reduction opportunities that could be provided by peak load reduction technologies that are expected to be commercially viable by the year 2029; customer behaviour and operational practices are also addressed. The results of Analysis Area 2 are presented in three individual sector reports.

1.3 Report Organization

This report presents the Residential sector results. It is organized and presented as follows:

- Section 2 presents an overview of the study methodology, including a definition of key terms and an outline of the major analytic steps involved.
- Section 3 presents a profile of Residential sector Base Year electricity use in NL.
- Section 4 presents a profile of Residential sector Base Year electric peak load, including the definition of peak periods that are included in this study.

[8] The term "electric energy" is used in this report to distinguish electricity consumption (in units of kWh or MWh) from electricity demand during a specific period (in units of MW).

- Section 5 presents the Reference Case, which provides a detailed estimate of electricity use in NL's Residential sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 6 presents the Reference Case electric peak loads, which provide a detailed estimate of peak load requirements in NL's Residential sector over the study period 2014 to 2029, in the absence of new utility CDM program initiatives.
- Section 7 identifies and assesses the economic attractiveness of the selected energy efficiency technology measures for the Residential sector.
- Section 8 presents the Residential sector Economic Potential Electricity Forecast for the study period 2014 to 2029, including the potential for both energy efficiency measures and capacity-only peak load reduction measures.
- Section 9 presents the estimated upper and lower Achievable Potential for electric energy savings for the study period 2014 to 2029, including the potential for both energy efficiency measures and capacity-only peak load reduction measures.
- Section 10 lists sources and references.
- Section 11 is the Glossary.

1.4 Results Presentation

The preparation of CDM Potential Studies involves the compilation and analysis of an enormous amount of market and technology data and a nearly infinite number of ways of organizing and presenting the results. It is recognized that readers will have differing needs with respect to the level of detail provided. Consequently, the results of this CDM Potential Study are presented at three levels of detail.

- **Main report body.** The main body of the report provides a relatively high-level reporting of the main steps involved in undertaking each stage of the study together with a concise summary of results, including comments and interpretation of key findings. It is assumed that the content and level of detail in the main report body is suitable for the majority of readers who wish to gain an understanding of the potential contribution of CDM options to NL's long-term electricity requirements.
- **Appendices.** A separate appendix accompanies each major section of the main report. Each appendix provides more detailed information on the methodology employed, including major assumptions or sample calculations as applicable, together with additional levels of results. It is assumed that this presentation is better suited to CDM analysts and managers wishing a more thorough understanding of the study results.
- **Software.** All of the data generated by the study is provided in two custom-designed Excel models: Data Manager and the measure TRM (technical resource manual) Workbook.
  - **Data Manager** is a custom-designed Excel workbook with query protocols that enable the user to search and report the study results in a virtually infinite number of combinations. Data Manager is intended to support the most detailed level of CDM activity such as program design, preparation of regulatory submissions, etc.
  - **The measure TRM Workbook** is a custom-designed model that provides comprehensive profiles of the CDM measures assessed within the study. Because the information is

provided in software form, any changes to economic, financial or performance data inputs can be easily accommodated and revised results generated automatically.

2 Study Methodology

This section provides an overview of the methodology employed for this study. More specifically, it addresses:

- Definition of terms
- Major analytic steps
- Analytic models.

2.1 Definition of Terms

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

A brief description of some of the most important terms and their application within this study is included below.

Base Year Electricity Use	The Base Year is the starting point for the analysis. It provides a detailed description of where and how electrical energy is currently used in the existing building stock. Building electricity use simulations were undertaken for the major sub-sector types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2014.
Base Year Electric Peak Load Profile	Electric peak load profiles refer to one specific time period throughout the year when NL's generation, transmission and distribution system experiences particularly high levels of electricity demand. This period is of particular interest to system planners; improved management of electricity demand during this peak period may enable deferral of costly system expansion. This study addresses one specific peak periods, as outlined in the main text.
Reference Case Electricity Use (includes "natural" conservation)	The Reference Case electricity use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2014) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable electricity savings potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the sub-sectors, estimation of the expected growth in building stock, and finally an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case is calibrated to the Utilities most recent load forecast, minus the impacts of new, future CDM initiatives.
Reference Case Electric Peak Load Profile	The Reference Case peak load profile estimates the expected electric peak loads in the defined peak period over the study period in the absence of new utility CDM program initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable Potentials for peak load reduction.

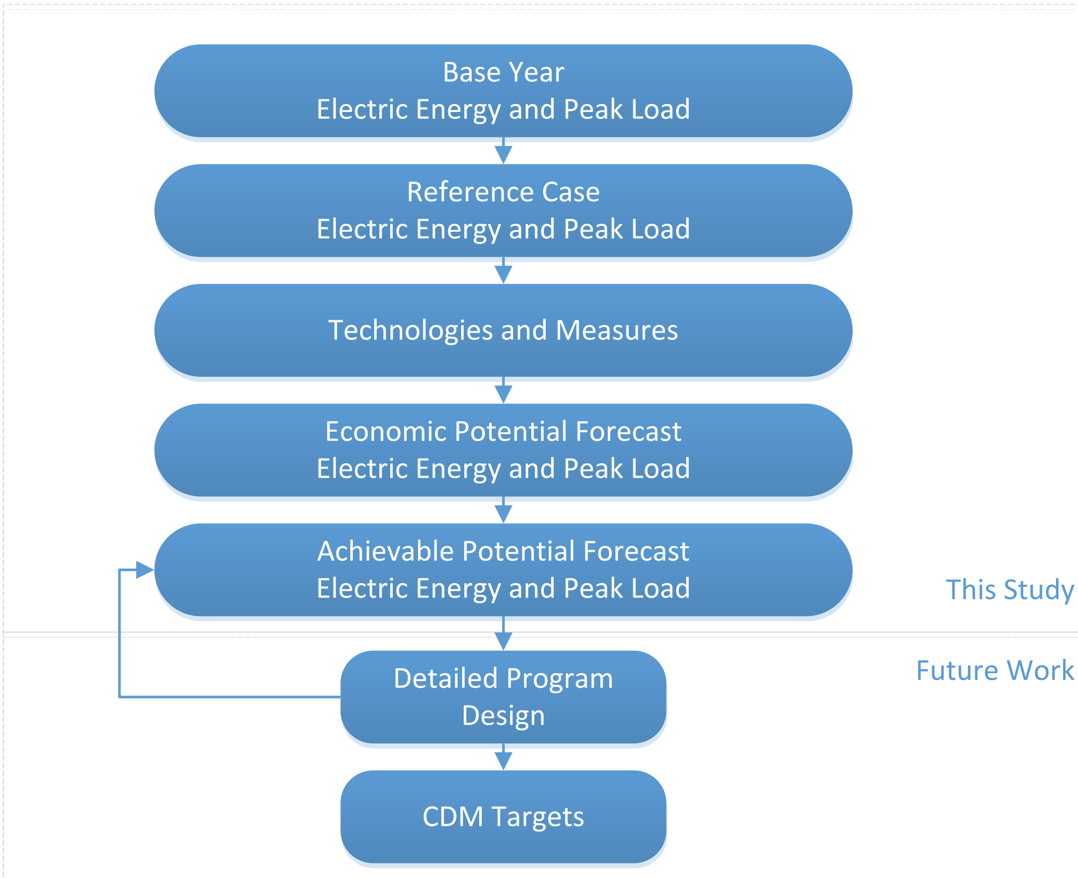
Conservation and Demand Management (CDM) Measures	CDM measures can include energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and customer-side generation (displace load off of grid). Customer–side generation and fuel switching are not included in this study.
The Cost of Conserved Energy (CCE)	The CCE is calculated for each energy efficiency technology measure. The CCE is the annualized incremental capital and O&M cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.
The Cost of Electric Peak Reduction (CEPR)	The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.
Electric Capacity-Only Peak Load Reduction Measures	Capacity-only measures are technologies or activities that result in the shifting of certain electrical loads from periods of peak system demand to periods of lower system demand.
Economic Potential Electricity Forecast	The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value[9], which has been set at different prices per kWh for the different regions. (One kWh from the Labrador hydroelectric grid is much less expensive than one kWh from an isolated diesel grid.) All the energy efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the economic threshold value for a given supply system were incorporated into the Economic Potential Forecast.
Economic Potential Electric Peak Load Forecast	The Economic Potential Electric Peak Load Forecast is the expected electric peak load that would occur in the defined peak period if all peak load reduction measures that are cost effective against the future avoided cost of new capacity in NL were fully implemented.
Achievable Potential	The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecasts that could realistically be achieved within the study period. The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as lower and upper.

[9] The economic threshold value is related to the cost of new avoided electrical supply. The values for each region are generally selected to provide the CDM Potential Study with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost effective over time. Further discussion is provided in Section 7 of this report.

2.2 Major Analytic Steps

The study was conducted within an iterative process that involved a number of well-defined steps, as illustrated in Exhibit 2.

Exhibit 2 Major Analytic Steps



A summary of the steps is presented below.

Step 1: Develop Base Year Electric Energy and Peak Load Calibration Using Actual Utility Billing Data

Build a model of electric energy and demand for the sector, disaggregated to all the building types and end uses, calibrated to sales of electricity in NL. This includes the following sub-steps:

- Compile and analyze available data on NL's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period.
- Calibrate the weather-sensitive load shape ratios for all three sectors to produce regional demand results that agree with the actual utility peak demand.

Step 2: Develop Reference Case Electric Energy Use and Peak Load Profile

Extend the base year model to the end of the study period, based on forecast building stock growth and expected natural changes in construction practices, equipment efficiency levels and/or practices. This includes the following sub-steps:

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with load forecasting data provided by the Utilities for the study period.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period over the study period.

Step 3: Identify and Assess Energy efficiency and Peak Load Reduction Measures

Compile information on upgrade measures that can save electric energy and/or reduce peak demand, and assess them for technical applicability and economic feasibility. This includes the following sub-steps:

- Develop list of energy efficiency upgrade and peak load reduction measures.
- Compile detailed cost and performance data for each measure.
- For energy efficiency measures, identify the baseline technologies employed in the Reference Case, develop energy efficiency upgrade options and associated electricity savings for each option, and determine the CCE for each upgrade option.
- For each peak load reduction measure, identify the affected end use, the potential load reduction or off-peak shifting and determine the CEPR.
- Based on the above results, prepare summary tables that show the amount of potential peak load reduction provided by each measure and at what cost ($/kW/yr.).
- Apply each peak load reduction measure to the affected end use, regardless of cost, and determine total peak reduction.
- Summarize the peak load reduction impacts in a supply curve.

Step 4: Estimate Economic Electric Energy Savings Potential

Develop an estimate of the electric energy savings potential that would result from implementing all of the economically feasible measures in all the buildings where they are applicable. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new electricity generation and set an economic threshold value; different economic threshold values were selected for each region and milestone year.
- Identify the combinations of energy efficiency upgrade options and building types where the cost of saving one kilowatt-hour of electricity is equal to, or less than, the cost of new electricity generation.
- Apply the economically attractive electrical efficiency measures from Step 3 within the energy-use simulation model developed previously for the Reference Case.
- Determine annual electricity consumption in each building type and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: Estimate Peak Load Impacts of Electricity Savings

Develop an estimate for the peak load impacts associated with the measures that save electric energy. This includes the following sub-steps:

- Convert the electricity (electric energy) savings (MWh) calculated in the preceding steps to peak load (electric demand) savings (kW).[10]
- Convert electricity savings to hourly demand, drawing on a library of specific sub-sector and end-use electricity load shapes. Using the load shape data, apply the following steps:
  - Disaggregate annual electricity savings for each combination of sub-sector and end use by month
  - Further disaggregate monthly electricity savings by day type (weekday, weekend day and peak day)
  - Finally, disaggregate each day type by hour.
- Produce a post-efficiency case for peak demand, by region, building type, end use, and milestone year, to serve as a base case for estimating the impacts of peak load measures.

Step 6: Estimate Peak Load Impacts of Electric Demand Measures

Develop an estimate for the peak load impacts associated with the measures that save electric energy. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new capacity and set an economic threshold value; different economic threshold values were selected for each region and milestone year.
- Identify the combinations of energy efficiency upgrade options and building types where the cost of reducing one kilowatt of demand is equal to, or less than, the cost of new electric capacity.
- Apply the economically attractive electrical efficiency measures from Step 3 within the demand simulation model developed previously for the Reference Case, using the post-efficiency case as the starting point for the demand measures.

[10] Peak load savings were modelled using the Cross-Sector Load Shape Library Model (LOADLIB).

- Determine annual electric demand in each building type and end use when the economic demand reduction measures are employed.
- Compare the electric demand levels when all economic demand reduction measures are used with the post-efficiency demand levels and calculate the total demand reduction.

Step 7: Estimate Achievable Potential Electricity Savings and Demand Reduction

Develop an estimated range for the portion of economic potential savings and demand reductions that would likely be achievable within realistic CDM programs. This includes the following sub-steps:

- Bundle the electric energy and peak load reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a high-level implementation framework, including measure description, cost and savings profile, target sub-sectors, potential delivery allies, barriers and possible synergies.
- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a full day workshop involving the client, the consultant team, trade allies and technical experts to reach general agreement on the upper and lower range of Achievable Potential for both efficiency and demand reduction.
- Total potential for demand reduction includes both the demand reductions associated with the energy efficiency measures and the demand reductions from demand management measures.

2.3 Analytical Models

The analysis of the Residential sector employed two linked modelling platforms:

- HOT2000,[11] a commercially supported, residential building energy-use simulation software
- RSEEM (Residential Sector Energy End-use Model), an ICF in-house spreadsheet-based macro model.

The consulting team has used this combination of modeling platforms for the residential analysis in conservation potential studies for clients across Canada, including BC Hydro, FortisBC, SaskPower, Manitoba Hydro, Enbridge Gas, Union Gas, NB Power, and Newfoundland Power and Newfoundland Labrador Hydro. During this over ten-year period, HOT2000 has undergone numerous version upgrades as NRCan maintains it. At the same time, each new project has provided an opportunity to refine and enhance the RSEEM model.

In this project, HOT2000 was used to define household heating, cooling and domestic hot water (DHW) electricity use for each of the residential building archetypes. HOT2000 uses state-of-the-art heat loss/gain and system modelling algorithms to calculate household electricity use. It addresses:

- Electric, natural gas (not applicable in NL), oil, propane and wood space heating systems
- DHW systems from conventional to high-efficiency condensing systems
- The interaction effect between space heating appliances and non-space heating appliances, such as lights and refrigerators.

The outputs from HOT2000 provide the space heating/cooling energy-use intensity (EUI) inputs for the thermal archetype module of RSEEM.

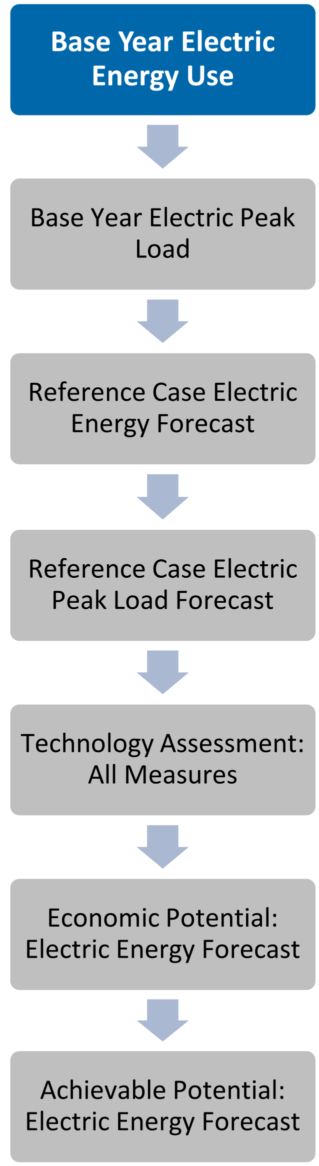
[11] Natural Resources Canada. *HOT2000 Software*. Download from: http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/software_tools/hot2000.html

RSEEM consists of three modules:

- A general parameters module that contains general sector data (e.g., number of dwellings, growth rates, etc.)
- A thermal archetype module, as noted above, which contains data on the heating and cooling loads in each archetype
- An appliance module that contains data on appliance saturation levels, fuel shares, unit electricity use, etc.

RSEEM combines the data from each of the modules and provides total use of electricity by service region, dwelling type and end use. RSEEM also enables the analyst to estimate the impacts of the electrical efficiency measures on a utility's on-peak system demand.

3 Base Year (2014) Electric Energy Use



3.1 Introduction

This section provides a profile of Base Year (2014) electricity use in NL's residential sector. The discussion is organized into the following sub-sections:

- Base Year housing stock
- End uses
- Average electricity use per unit
- Summary of model results.

3.2 Base Year Housing Stock

The first major task in developing the profile of Base Year electricity use involved the segmentation of the residential building stock on the basis of three factors:

- Dwelling type
- Region (Island Interconnected, Labrador Interconnected, and Isolated)
- Heating category (electrically heated versus non-electrically heated).

Based on discussions with the Utilities personnel, it was agreed that NL's existing residential stock would be segmented into the following dwelling types:

- Single-family detached, pre-2014 – electric space heat
- Single-family detached, pre-2014 – non-electric space heat
- Attached,[12] pre-2014 – electric space heat
- Attached, pre-2014 – non-electric space heat
- Apartment,[13] pre-2014 – electric space heat
- Apartment, pre-2014 – non-electric space heat
- Other – includes very low use facilities and non-dwellings such as cottages, garages, sheds, wells, etc. Does not include mobile homes, which are included among single-family dwellings.
- Vacant and Partial

As much as possible, utility customer billing data was used to develop a breakdown of the residential sector into the above dwelling types. Where billing data did not provide sufficient detail to subdivide accounts into these groups, it was augmented with results of NL's Residential End Use Survey (REUS).

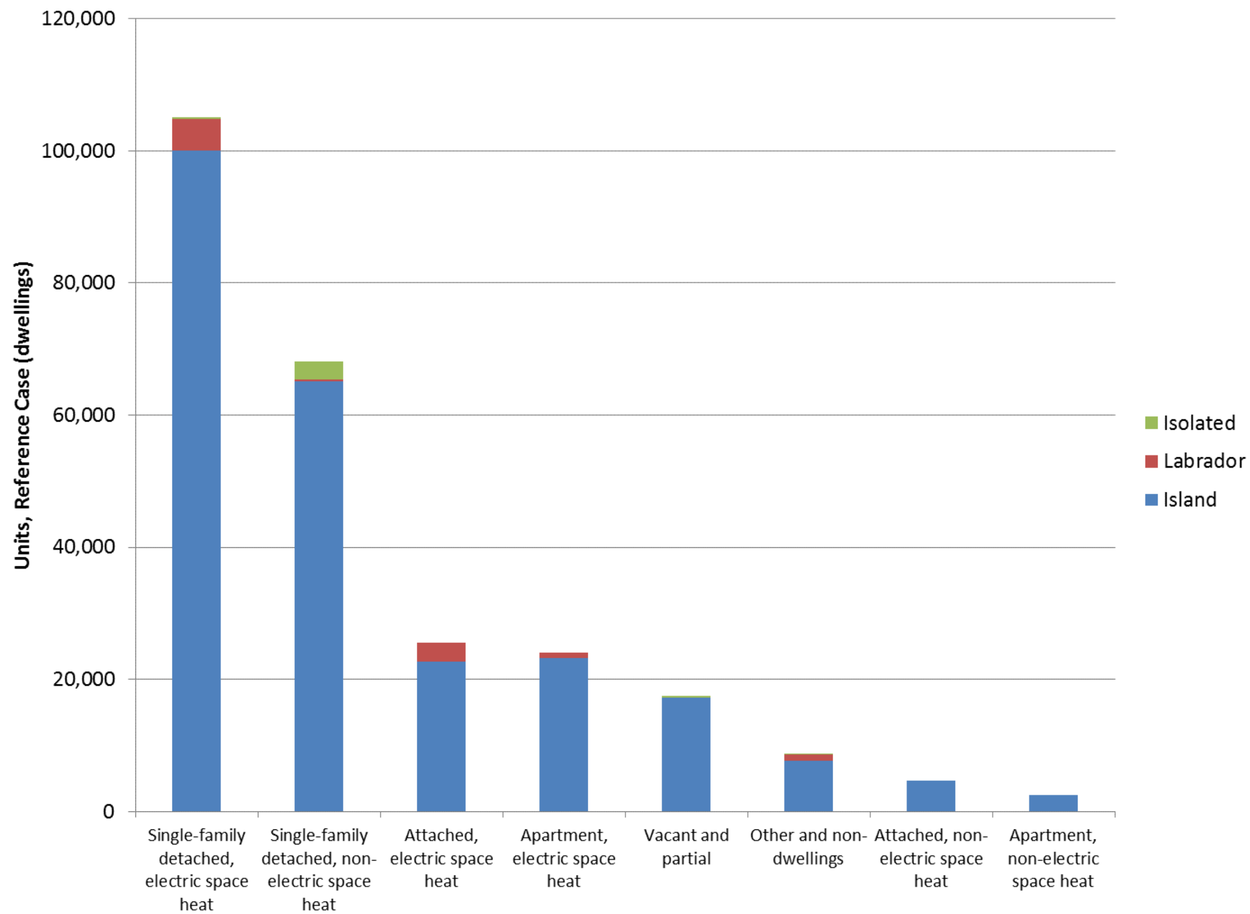
[12] As in the 2008 study, attached dwellings, either electrically or non-electrically heated, include the main dwelling in a house that has a basement apartment.
[13] As in the 2008 study, apartments, either electrically or non-electrically heated, include basement apartments. Basement apartments accounted for close to 50% of the apartment units. They do not include the common areas of the buildings, which are commercial customers.

A summary of the distribution of NL's residential dwellings is provided in Exhibit 3 and Exhibit 4. The first exhibit provides details of the estimated breakdown by dwelling type and region. The column chart shows the breakdown by dwelling type graphically, sorted from the most numerous to least numerous dwelling types.

Exhibit 3 Existing Newfoundland Residential Units by Dwelling Type and Region

Dwelling Types	Dwelling Units			
	Island	Labrador	Isolated	Grand Total
Single-family detached, electric space heat	100,059	4,723	350	105,133
Single-family detached, non-electric space heat	65,078	356	2,680	68,114
Attached, electric space heat	22,738	2,841	-	25,579
Attached, non-electric space heat	4,604	-	-	4,604
Apartment, electric space heat	23,253	822	-	24,075
Apartment, non-electric space heat	2,475	-	-	2,475
Other and non-dwellings	7,636	975	176	8,787
Vacant and partial	17,167	-	318	17,485
Grand Total	243,010	9,717	3,525	256,251

Exhibit 4 Existing NL Residential Units by Dwelling Type



As illustrated in Exhibit 3 and Exhibit 4:

- The NL electric utilities currently service about 256,000 residential accounts.[14]
- Approximately 95% of residential accounts are in the Island Interconnected region, approximately 4% are in the Labrador Interconnected region, and the remaining 1% are on various Isolated diesel grids.
- 68% of the residential accounts are single detached homes, approximately 12% are attached homes (including both side-by-side units and those above a basement apartment), approximately 10% are apartment units (including basement apartments), approximately 7% are vacant or partially occupied dwellings (such as seasonally occupied dwellings), and 3% are other residential buildings, such as cottages, garages and sheds.
- Electricity is the dominant heating fuel in NL. Overall, it is the main heating fuel in two-thirds of the dwellings. In the Island Interconnected region, for example, over 60% of the single detached dwellings are heated by electricity. In the Labrador Interconnected region, over 90% of the single detached dwellings are heated by electricity. Only in the Isolated region are a majority of the dwellings (nearly 90%) heated by fuels other than electricity.

3.3 End Uses

Electricity use within each of the dwelling types noted above is defined on the basis of specific end uses. In this study, an end use is defined as “the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy.”

A summary of the major residential sector end uses used in this study is provided in Exhibit 5, together with a brief description of each.

[14] This does not include area and yard lighting meters, which have been included in the commercial sector. The measures applicable to these lights are similar to those for lighting in parking lots and along roadways, so they have been included in commercial for ease of analysis.

Exhibit 5 Residential Electric End Uses

End Use	Description
Space heating	All space heating, including both central heating and supplementary heating. The heating provided by a heat pump system is included in this end use.
Space cooling	All space cooling, including both central cooling and window or wall units. The cooling provided by a heat pump system is included in this end use.
Ventilation	Primarily the furnace fan, but also includes the fan in heat recovery ventilators as well as kitchen and bathroom fans
Domestic Hot Water (DHW)	Heating of water for DHW use. Does not include hydronic space heating
Cooking	Includes ranges, separate ovens and cook tops and microwave ovens
Refrigerator	
Freezer	
Dishwasher	
Clothes washer	
Clothes dryer	
Dehumidifiers	
Lighting	Includes interior, exterior and holiday lighting
Computer and peripherals	Includes printers, scanners, modems, faxes, PDA and cell phone chargers
Television	
Television peripherals	Set top boxes, including digital cable converters and satellite converters
Other electronics	Stereos, DVD players, VCRs, boom boxes, radios, video gaming systems, security systems
Block heaters and other car devices	Block heaters, car warmers, and battery blankets
Hot tubs	Both indoor and outdoor hot tubs. Pools are not included.
Small Appliance & Other	There are hundreds of additional items within this category, each accounting for a fraction of a percent of household energy use, e.g., hair dryers, doorbells, garage door openers, block heaters, home medical equipment, electric lawnmowers.

3.4 Average Electricity Use per Dwelling Unit

Exhibit 6 provides a profile of average electricity use within each of the dwelling types that were identified previously. This exhibit is a blended average for all three regions. Individual regional exhibits are provided in Appendix A. The values shown in Exhibit 6 combine three factors:

- **Unit Energy Consumption (UEC).** This is the average amount of electricity that one appliance (e.g., a hot water tank) consumes annually in a given dwelling type.
- **Saturation.** This is the percentage of households within each dwelling type that have the given appliance. For example, in the case of a hot water tank, every household has one and, therefore, the saturation is 100%. However, for some appliances such as refrigerators or televisions, the saturation is often greater than 100%, as many households have more than one refrigerator or television.
- **Electric Fuel Share.** Several appliances, such as hot water tanks, clothes dryers, cooking ranges, etc., can operate on propane gas or other fuels as well as electricity. Electric fuel share, therefore, refers to the percentage of each appliance that operates with electricity.

For most end uses, the primary source of information for saturation and electric fuel share is NL's Residential End Use Survey (REUS). The sources of information for UEC are more varied, and are discussed in detail, end use by end use, in Appendix A.

A sample calculation is provided below for DHW use in single detached homes in the Island Interconnected region. Exhibit 6 shows a blended average of the results of such calculations for the three regions. The exhibits referenced below are contained in Appendix A, which accompanies this report.

Sample Calculation of Annual DHW Electricity Consumption for Single Detached Electrically Heated Homes

UEC, see Exhibit 93	2,629 kWh/yr.
Saturation, see Exhibit 106	100%
Electric Fuel Share, see Exhibit 109	100%[15]

Annual DHW Electricity Consumption = 2,629 x 100% x 100% = 2,629 kWh/yr.
(as shown in Exhibit 112.)

[15] Overall DHW electric share in single detached dwellings is not 100%, according to the NL REUS, but the share of non-electric DHW tanks is smaller than the proportion of houses with predominantly non-electric space heating. For the purposes of this study, the dwellings with non-electric DHW were assumed to be a subset of the dwellings with non-electric space heating, and therefore all the electrically heated dwellings were assumed to have electric DHW tanks.

Exhibit 6 Average Electricity Use per Dwelling Unit, Average of All NL (kWh/yr.)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	13,613	16	248	2,634	639	855	508	70	50	919
Single-family detached, non-electric space heat	1,413	-	739	1,785	541	845	513	62	46	833
Attached, electric space heat	10,369	1	216	2,704	671	881	402	76	52	967
Attached, non-electric space heat	866	-	648	1,500	570	868	390	64	45	831
Apartment, electric space heat	4,949	-	85	1,926	479	474	100	30	29	522
Apartment, non-electric space heat	907	-	205	1,035	324	472	99	21	19	353
Other and non-dwellings	2,710	-	88	1,272	352	590	426	17	27	504
Vacant and partial	1,549	-	25	583	161	122	88	8	12	231

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	395	1,144	701	634	291	170	7	759	266	23,918
Single-family detached, non-electric space heat	355	1,035	639	573	264	154	1	726	240	10,764
Attached, electric space heat	391	1,011	690	612	291	170	18	444	83	20,047
Attached, non-electric space heat	346	874	595	523	251	147	-	380	72	8,970
Apartment, electric space heat	225	508	604	344	249	145	-	-	125	10,795
Apartment, non-electric space heat	179	342	476	270	196	114	-	-	99	5,111
Other and non-dwellings	-	459	366	255	117	68	-	-	1,650	8,900
Vacant and partial	-	280	159	157	72	42	-	-	795	4,285

There have been some changes in assumed average consumption for the end uses, as compared with the similar exhibit included in the 2008 study. The following comments provide some background for these changes:

- Space cooling, dehumidifiers, block heaters and car warmers, and hot tubs, are end uses the previous study did not separate out from the small appliance & other category. The consumption for these four end uses has been removed from the small appliance & other category, so it is smaller than it was in 2008.
- Space cooling in residential primarily occurs in homes that have installed heat pump systems for space heating. Average consumption per dwelling is therefore very low, since most homes do not have the end use at all.
- Block heaters are virtually nonexistent outside of Labrador. The consumption for this end use in Labrador is divided by the total stock of dwellings in the three regions, so the usage per dwelling is very small. The end use consumption per dwelling appears larger for single family dwellings because Labrador single family dwellings are a smaller portion of all single family dwellings in NL compared to Labrador attached dwellings as a portion of all attached dwellings in NL.
- The average consumption for ventilation is assumed to be substantially higher in electrically-heated houses and somewhat lower in non-electrically heated houses. This is because of the high incidence of heat recovery ventilators in NL dwellings – the fan energy for these units is included in this end use. In the homes with forced air systems (most of the non-electrically heated dwellings), improved furnace fan motors have reduced average consumption.
- Domestic hot water systems are assumed to use approximately 20% less energy than was assumed in 2008. This is largely because updated clothes washers and dishwashers use less hot water. In a seven-year period, a substantial number of these appliances reach end of life and are replaced. Clothes washers at the ENERGY STAR® level of performance and above have become very common choices for NL appliance purchasers, as have ENERGY STAR® dishwashers. Utility appliance program activity in the province has further accelerated this uptake.
- Consumption of the large appliances have been updated based on the latest data from NRCan, as discussed in Appendix A, as well as updated information on the number of large appliances in households, from NL's recent Residential End Use Survey (REUS). With this new data, the average consumption values for refrigerators and freezers are somewhat smaller and the consumption values for dryers are somewhat higher. Dishwasher consumption is assumed to be higher, but primarily because more dwellings now have dishwashers.
- Lighting energy is assumed to have dropped by approximately 25%, primarily because of the advent of compact fluorescent and LED lamps.
- Overall, the consumption of the electronic end uses – computers, televisions, television peripherals, and other electronics – are assumed to have increased. There has been some shifting among these four end uses, based on updated assumptions on usage per device and updated information on the number of computers and televisions per dwelling from the REUS.

3.5 Summary of Residential Base Year Electricity Use

This section combines the data on average annual electricity use by dwelling type, shown in the preceding exhibit, with data on the number of each dwelling type to produce a summary of the total electricity use in NL's Residential sector in the Base Year. The results are measured at the customer's point-of-use and do not include line losses; they are presented in five separate exhibits:

- Exhibit 7 presents the results in tabular form by dwelling type and end use
- Exhibit 8, Exhibit 9, and Exhibit 10 present the model results graphically by dwelling type, by region, and by end use, respectively

- Exhibit 11 presents the model results as a series of stacked bars, showing the percentage consumed by end use for each dwelling type.

Additional highlights are provided below.

By Dwelling Type

Single detached dwellings account for the majority of residential electricity use in NL, with approximately 77% of residential electricity consumed. Attached houses (duplexes, row houses, townhouses, and the main house of a building with a basement apartment) account for approximately 13% of residential electricity. Apartment buildings, including only the suites and not the common areas (which are commercial customers), as well as basement apartments, account for the next largest share, using 6% of residential electricity. Other residential buildings, such as cottages, sheds and garages, account for approximately 2% of residential electricity. Vacant and partially occupied dwellings account for the last 2% of residential electricity.

By Region

The Island Interconnected region accounts for 92% of residential electricity consumption. The Labrador Interconnected region accounts for 7% of residential electricity consumption. Residential accounts connected to isolated diesel grids consume the remaining 1% of residential electricity.

By End Use

HVAC accounts for 49% of consumption, with 47% of that being electric space heating and the remainder being fans and pumps, including furnace fans, boiler circulation pumps, HRV fans, and bathroom and kitchen exhaust. Space cooling is well under 1% of residential consumption.

Domestic appliances (white goods) consume approximately 18% of total residential electricity. Of this, clothes dryers and refrigerators each account for 5%. Cooking appliances and freezers each consume approximately 3%. Dehumidifiers account for approximately 2%. Dishwashers and clothes washers consume less than 1% each, but this does not include the associated DHW consumption if DHW is heated electrically.

Domestic water heating accounts for approximately 13% of residential electricity consumption.

Household electronics consume approximately 10% of residential electricity, including 4% by computers and their peripherals, 3% by televisions, 2% by the various set-top boxes associated with televisions, and 1% by other home entertainment electronics.

Indoor, outdoor, and holiday lighting together account for 6% of residential electricity consumption; 5% of this is indoor lighting and 1% is outdoor lighting. Holiday lighting is well under 1%.

Other end uses account for 5% of residential electricity consumption. Of this, 3% is consumed by spa heaters and pumps and 2% is small appliances and other. Less than 1% is consumed by block heaters and car warmers, all of it in Labrador.

By Dwelling Type and End Use

The last exhibit in this section highlights the differences among dwelling types. In general, for example, attached dwellings show a lower percentage of consumption for HVAC and a higher percentage for electronics and appliances than single detached houses.

The exhibit also highlights how much more of the electricity is used for HVAC in an electrically heated dwelling.

Finally, in apartment buildings consumption in the suites is dominated by appliances and electronics. Most of the “other” end uses in an apartment building, such as spas or block heaters, are likely in the common areas of the building, which are not included in the residential sector.

Data Manager – Reference Case Edition

As part of this report, an Excel application called Data Manager is provided. This Excel workbook includes all the exhibits that were produced using the Data Manager for Chapters 3, 4, 5, and 6, and the corresponding Appendices. It also has the ability to produce charts and tables looking at the data filtered and segmented in other ways. For example:

- The user can produce a pie chart of electricity consumption by end use for an individual dwelling type of interest, such as the electrically heated detached house.
- The user can produce a column chart showing the electricity consumption for kitchen and laundry appliances in each of several dwelling types, with each dwelling type as a separate column and the different appliance consumption values shown stacked on top of each other.
- The user can produce a line chart showing consumption for a particular dwelling type by year.
- The user can produce a column chart showing the consumption of different house types in each rate class (different rate classes within residential distinguish between Island dwellings served by NP versus NLH, for example).
- The user can produce a chart and accompanying table showing the number of refrigerators in NL, by region and house type.

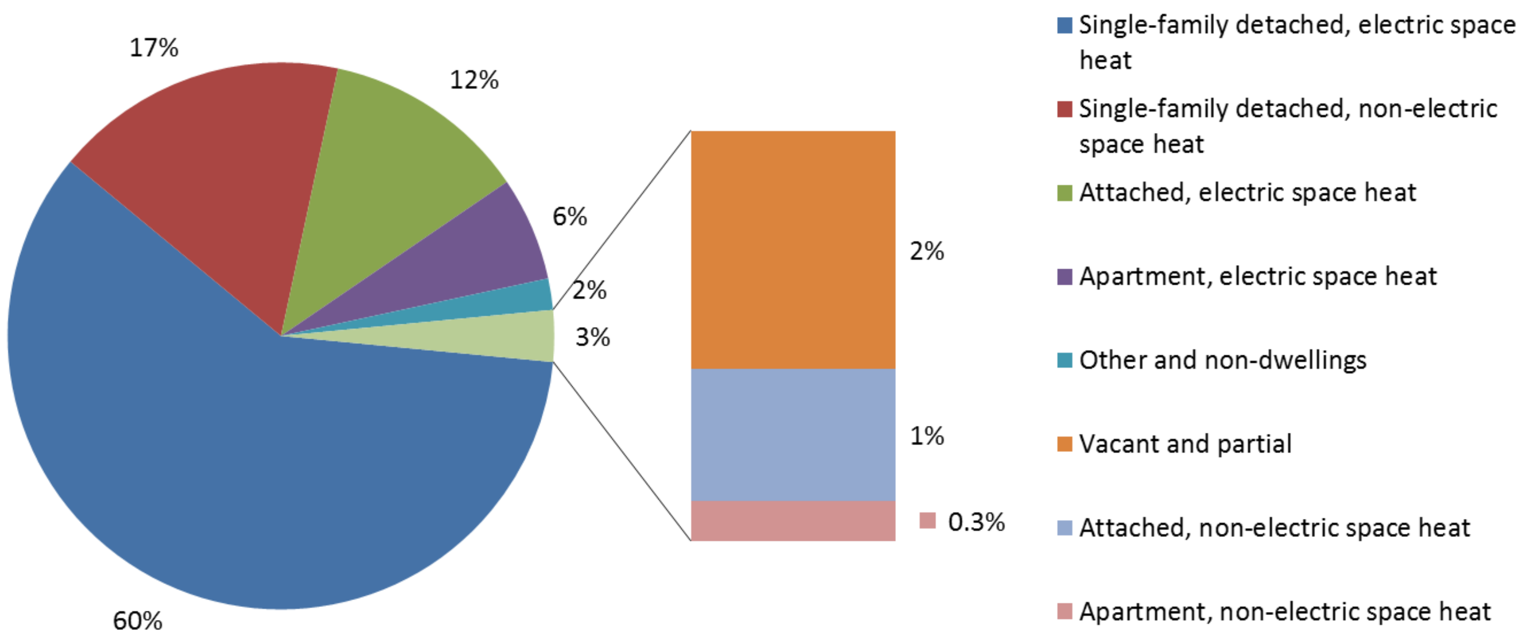
Data Manager has a user interface designed for someone with basic knowledge of Excel.

Exhibit 7 Electricity Consumption by End Use and Dwelling Type in the Base Year (2014), All of NL (MWh/yr.)

Dwelling Types	Reference Case Consumption (MWh/yr.)									
	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	1,431,206	1,723	26,037	276,870	67,172	89,850	53,389	7,350	5,278	96,605
Single-family detached, non-electric space heat	96,232	-	50,318	121,571	36,844	57,569	34,952	4,248	3,106	56,751
Attached, electric space heat	265,226	22	5,529	69,174	17,176	22,527	10,293	1,937	1,325	24,724
Attached, non-electric space heat	3,990	-	2,982	6,908	2,622	3,998	1,798	296	205	3,825
Apartment, electric space heat	119,147	-	2,055	46,365	11,533	11,403	2,416	734	689	12,571
Apartment, non-electric space heat	2,244	-	507	2,561	802	1,167	246	51	48	874
Other and non-dwellings	23,808	-	777	11,173	3,090	5,188	3,742	152	238	4,426
Vacant and partial	27,088	-	436	10,202	2,821	2,129	1,536	139	217	4,041
Grand Total	1,968,940	1,745	88,642	544,824	142,060	193,832	108,372	14,906	11,107	203,817

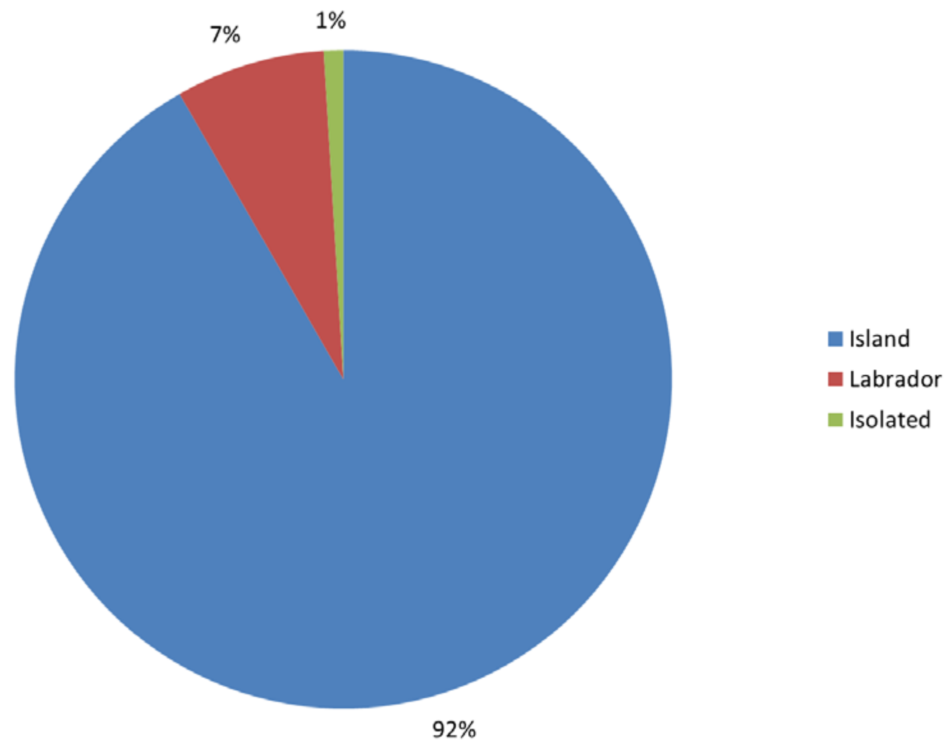
Dwelling Types	Reference Case Consumption (MWh/yr.)									
	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other	Grand Total
Single-family detached, electric space heat	41,535	120,251	73,694	66,679	30,557	17,828	755	79,804	27,937	2,514,522
Single-family detached, non-electric space heat	24,203	70,523	43,495	39,002	17,992	10,498	57	49,467	16,378	733,206
Attached, electric space heat	9,989	25,852	17,658	15,645	7,435	4,338	450	11,368	2,129	512,799
Attached, non-electric space heat	1,592	4,026	2,738	2,407	1,158	675	-	1,750	332	41,302
Apartment, electric space heat	5,422	12,236	14,549	8,272	5,990	3,495	-	-	3,015	259,891
Apartment, non-electric space heat	442	848	1,178	668	486	283	-	-	244	12,650
Other and non-dwellings	-	4,031	3,219	2,241	1,025	598	-	-	14,496	78,204
Vacant and partial	-	4,903	2,785	2,740	1,253	731	-	-	13,900	74,921
Grand Total	83,184	242,671	159,318	137,653	65,895	38,446	1,263	142,388	78,431	4,227,494

Exhibit 8 Distribution of Electricity Consumption, by Dwelling Type in the Base Year (2014)



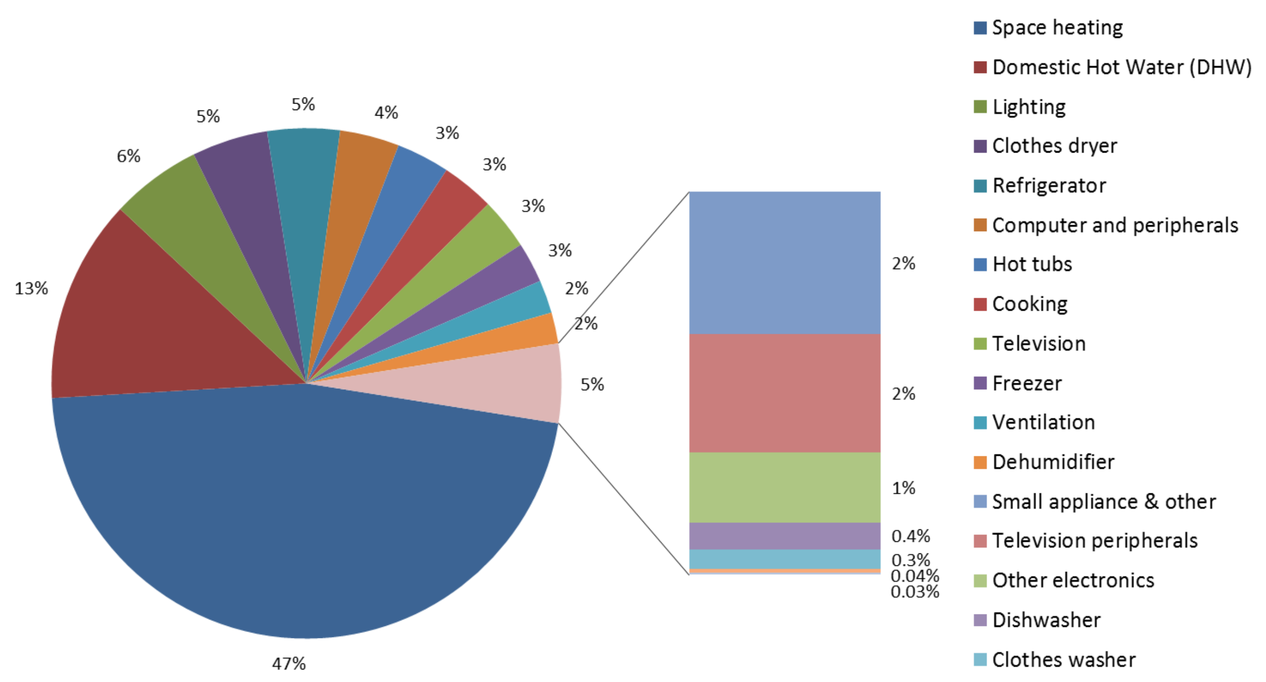
Totals may not add to 100% due to rounding.

Exhibit 9 Distribution of Electricity Consumption, by Region in the Base Year (2014)



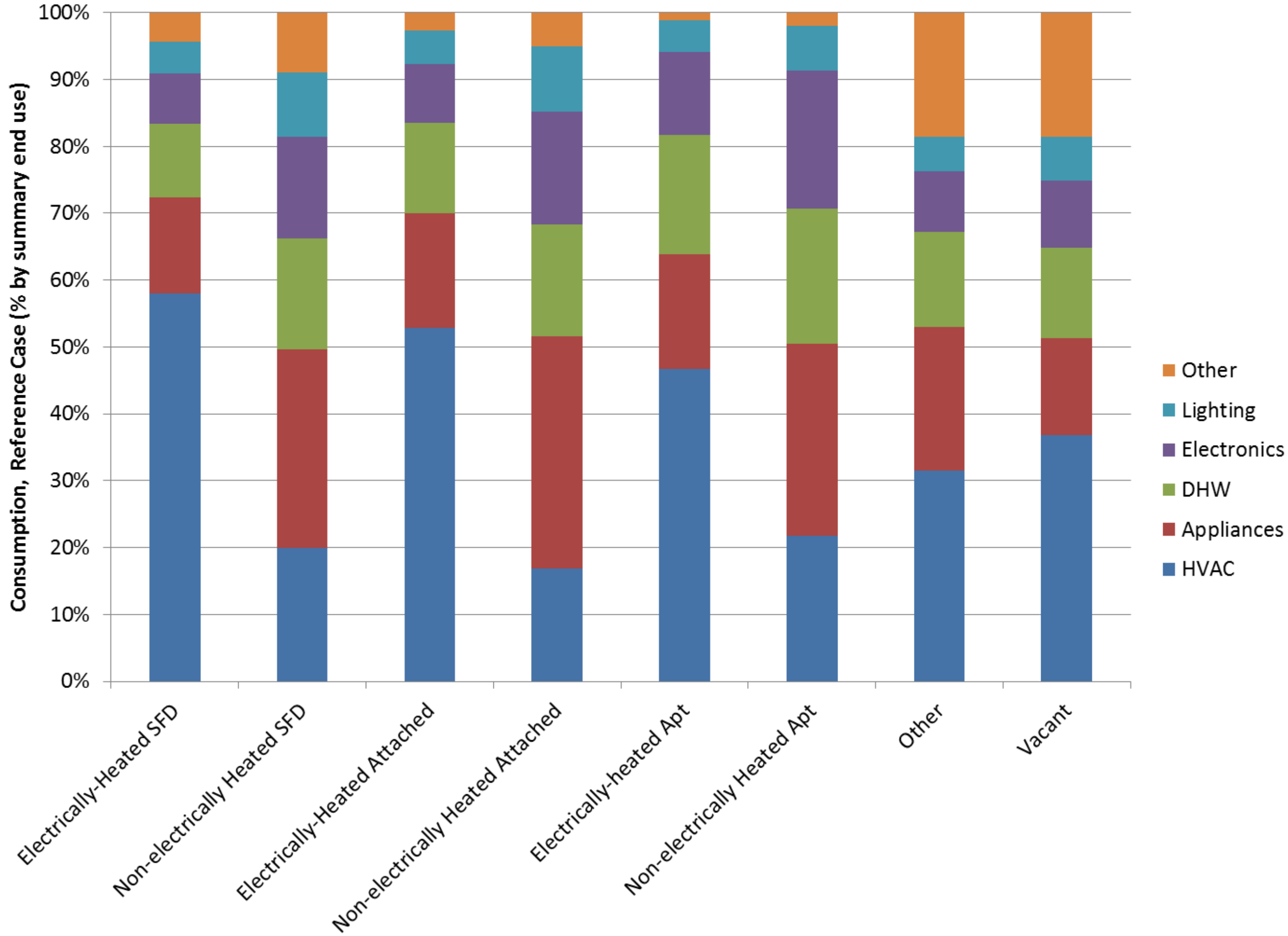
Totals may not add to 100% due to rounding.

Exhibit 10 Distribution of Electricity Consumption, by End Use in the Base Year (2014)

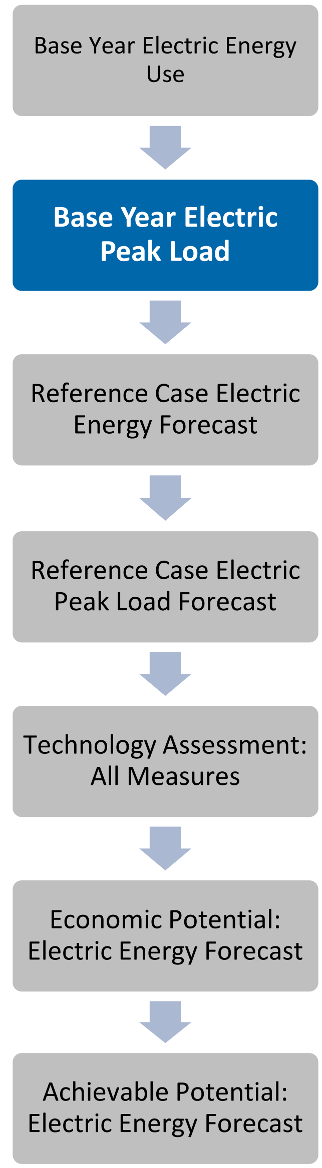


Totals may not add to 100% due to rounding.

Exhibit 11 Distribution of Electricity Consumption, by Dwelling Type and End Use in the Base Year (2014)



4 Base Year (2014) Electric Peak Load



4.1 Introduction

This section provides a profile of the Base Year electric peak load for NL's Residential sector. The discussion is organized into the following sub-sections:

- Peak period definitions
- Methodology
- Summary of results.

Additional details are provided in Appendix B.

4.2 Peak Period Definitions

Based on discussions with utility personnel, the peak period of interest was the same as in the 2007-2008 study:

Peak Period – The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.[16]

The system capacity constraints are very dependent on cold weather. The NL utilities are do not currently experience capacity constraints in the summer. In future, there may be financial advantages to reducing system demand in summer in order to market more power to summer-peaking utilities in the U.S. That possibility was not explored in this study.

4.3 Methodology

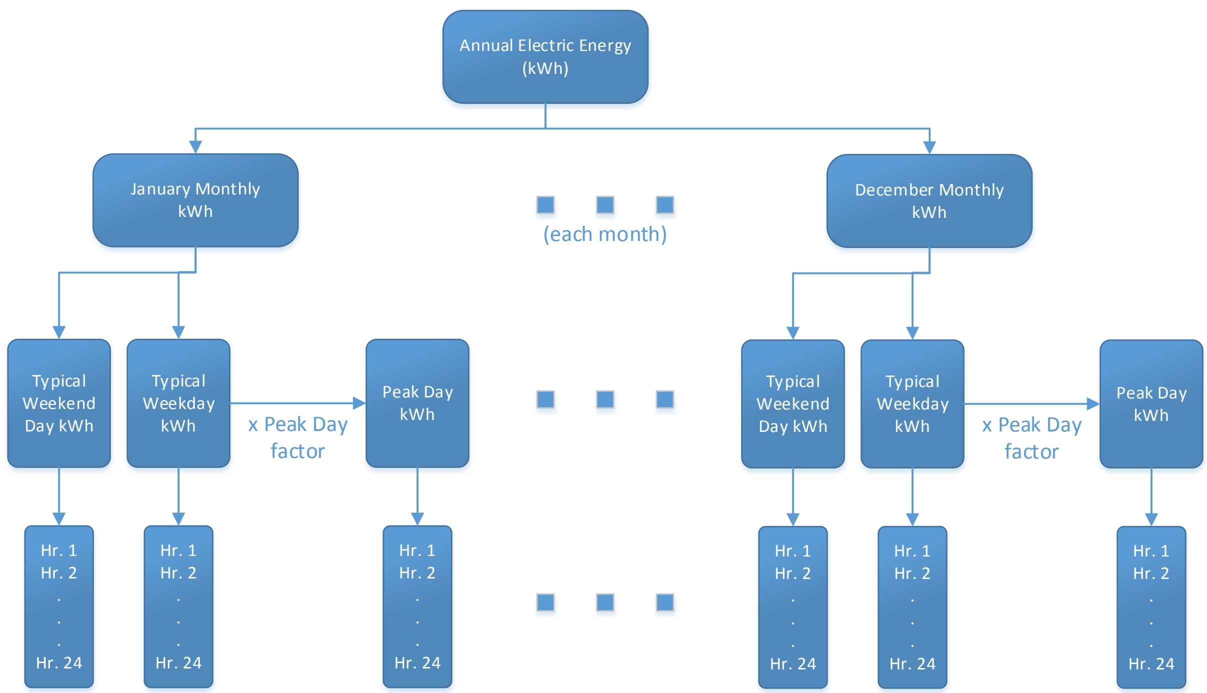
The electric peak load profile converts the annual electric energy use (MWh) presented in Section 3 to hourly demand (MW). Development of the electric peak load estimates employs four specific factors, which are described below and shown graphically in Exhibit 12.

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. In decreasing order of priority, this allocation factor can be obtained from either:
  - Monthly consumption statistics from end-use load studies
  - Monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months, or
  - Heating or cooling degree days applied to an appropriate base.

[16] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.
- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.
- **Per Unit Hourly Factor:** This factor reflects the operating hours of the residential electric equipment or end uses among different hours of the day for each day type (weekday, weekend day, peak day) and for each month. For example, for lighting, this would be affected by time of day and season (affected by daylight).

Exhibit 12 Overview of Peak Load Profile Methodology



4.4 Summary of Results

The factors defined above provided the basis for converting the annual residential electricity use presented in Section 3 to aggregate peak loads in the peak period.

Exhibit 13 presents the results for the Residential sector Base Year. The results are presented for each of the three regions in NL, by dwelling type. In each case, the results show the contribution of Residential sector demand that is coincident with the total demand in the peak period.

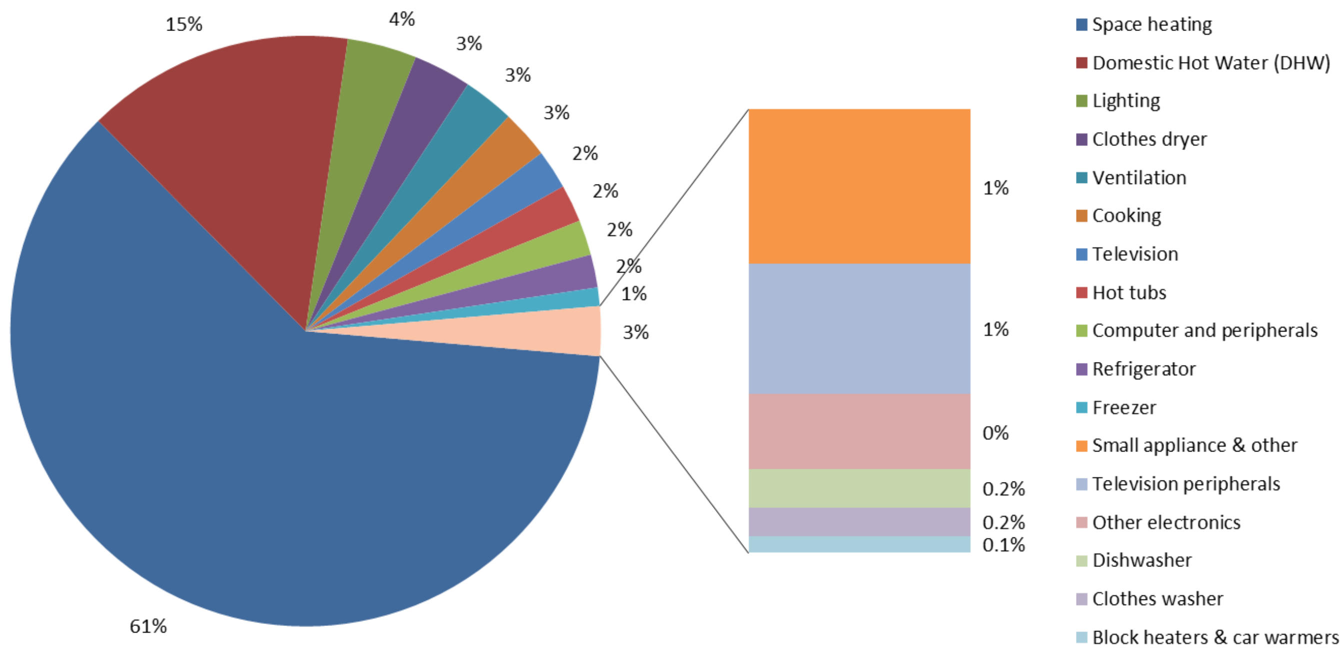
Exhibit 13 Residential Sector Base Year (2014) Aggregate Peak Demand by Region (MW)

Dwelling Types	Reference Case Peak Demand (MW)			
	Island	Labrador	Isolated	Grand Total
Single-family detached, electric space heat	620	48	3	671
Single-family detached, non-electric space heat	141	2	6	149
Attached, electric space heat	109	25	-	134
Attached, non-electric space heat	8	-	-	8
Apartment, electric space heat	65	3	-	68
Apartment, non-electric space heat	3	-	-	3
Other and non-dwellings	15	2	0	17
Vacant and partial	17	-	0	18
Grand Total	979	78	9	1,067

Exhibit 14 shows the contribution, by end use, to the residential component of the peak demand. Some key observations may be made:

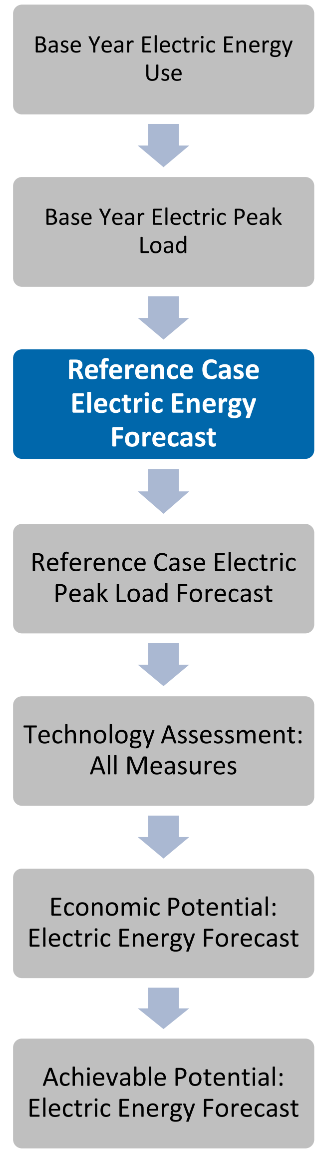
- Space heating is the largest residential component of peak demand. As shown in the previous section, space heating is one of the largest end uses in terms of annual electrical consumption. It also tends to be concentrated in the winter when the NL system peaks.
- Domestic hot water is the second largest residential component of peak demand. It is a large end use and is heavily used during the morning hours when the morning peak occurs.
- Lighting is the third largest residential component of peak demand. As shown in the previous section, indoor lighting is a relatively large end use in terms of annual electrical consumption. It also tends to be used heavily during the evening and morning hours when the NL system peaks.
- Clothes dryers are the fourth largest residential contributor to peak demand. The peak use of clothes dryers coincides fairly closely with the evening part of the peak period.
- Ventilation is the fifth largest residential contributor to peak demand. This is largely because the fan energy for furnaces and heat recovery ventilators peaks at similar times to space heating.
- Hot tubs are not in the top five residential contributors to peak demand for the province as a whole, but if a version of Exhibit 14 is replicated with Labrador Interconnected results only, hot tubs are the fourth largest contributor to residential peak demand in that region. This is because many of them are outside and therefore require considerable heat in a severe climate. Their consumption is relatively coincident with the system's peak during the coldest part of the winter.
- Block heaters and car warmers are a small contributor to the system peak, because they are virtually nonexistent outside Labrador, but their share of peak demand is over three times as large as their share of annual consumption. This is because their consumption is highly concentrated in the morning peak period on the coldest days of the winter. In Labrador they are the seventh largest residential end use contributing to peak demand, as shown in Appendix B.

Exhibit 14 Contribution by End Use to Residential Aggregate Peak Demand, All NL (%)



Additional detail is provided in Appendix B.

5 Reference Case Electric Energy Forecast



5.1 Introduction

This section presents the Residential sector Reference Case for the study period (2014 to 2029). The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new utility-based CDM initiatives. The Reference Case, therefore, provides the point of comparison for the calculation of electricity saving opportunities associated with each of the scenarios that are assessed within this study.

The Reference Case discussion is presented within the following sub-sections:

- Methodology
- Summary of model results.

5.2 Methodology

Development of the Reference Case involved the following six steps:

Step 1: The growth in the number of residential dwellings was estimated for each type of dwelling.

Step 2: The net space heating and cooling loads for each new dwelling type were estimated. New dwellings are those built after the base year, 2014.

Step 3: Naturally-occurring changes in net space heating loads were estimated for existing dwelling types.

Step 4: Naturally-occurring changes in annual electricity use were estimated for the evolving stock of major residential appliances.

Step 5: Future appliance saturation trends were estimated for each dwelling type.

Step 6: Changes in electricity share for each appliance were estimated for each dwelling type.

Exhibit 15 shows the estimated number of residential units in each milestone period, by dwelling type. The estimates shown are derived from the Utilities' load forecasts.

Higher rates of growth have been applied to the attached houses, compared to the rate of growth for single detached houses. The attached houses are assumed to increase in number 1.08 times as fast as the single detached houses in the Island Interconnected region, and 1.77 times as fast as the single detached houses in the Labrador Interconnected region. (The customer data provided indicated there are no attached homes in the Isolated region, and this was assumed to remain unchanged.) This is based on the ages of houses of different types reported in the NL Residential End Use Survey (REUS). Overall growth rate was calibrated to the expected increase in number of accounts assumed in the load forecast.[17]

Growth rates for electrically heated dwellings are assumed to be much larger than for non-electrically heated dwellings in the Island Interconnected region. According to the REUS, approximately 85% of new homes are being constructed with heating systems that are predominantly electric. In the Labrador Interconnected region, all new dwellings were assumed to be electrically heated. In the Isolated region, 85% of new dwellings were assumed to be electrically heated, including all new homes constructed in L'Anse au Loup.

[17] Note that growth in number of accounts does not translate directly into growth in consumption because the dwelling types have different overall consumption and different mixes of end uses.

Exhibit 15 Residential Accounts by Dwelling Type and Milestone Year

Year	Dwelling Types	Dwelling Units			
		Island	Labrador	Isolated	Grand Total
2014	Single-family detached, electric space heat	100,059	4,723	350	105,133
	Single-family detached, non-electric space heat	65,078	356	2,680	68,114
	Attached, electric space heat	22,738	2,841	-	25,579
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	23,253	822	-	24,075
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	7,636	975	176	8,787
	Vacant and partial	17,167	-	318	17,485
	Year Total	243,010	9,717	3,525	256,251
2017	Single-family detached, electric space heat	104,513	4,899	384	109,797
	Single-family detached, non-electric space heat	65,602	356	2,686	68,643
	Attached, electric space heat	23,831	3,029	-	26,861
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	24,370	876	-	25,247
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	7,872	1,022	178	9,072
	Vacant and partial	17,700	-	322	18,021
	Year Total	250,968	10,182	3,571	264,721
2020	Single-family detached, electric space heat	108,309	5,011	407	113,727
	Single-family detached, non-electric space heat	66,047	356	2,690	69,093
	Attached, electric space heat	24,766	3,151	-	27,918
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	25,326	912	-	26,238
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	8,074	1,052	180	9,306
	Vacant and partial	18,153	-	325	18,478
	Year Total	257,756	10,481	3,602	271,839
2023	Single-family detached, electric space heat	112,551	5,080	451	118,082
	Single-family detached, non-electric space heat	66,547	356	2,698	69,600
	Attached, electric space heat	25,814	3,228	-	29,042
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	26,398	934	-	27,332
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	8,300	1,070	183	9,553
	Vacant and partial	18,661	-	330	18,991
	Year Total	265,349	10,668	3,662	279,679
2026	Single-family detached, electric space heat	115,531	5,146	493	121,169
	Single-family detached, non-electric space heat	66,902	356	2,705	69,963
	Attached, electric space heat	26,552	3,303	-	29,855
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	27,152	956	-	28,108
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	8,459	1,088	186	9,733
	Vacant and partial	19,018	-	335	19,353
	Year Total	270,693	10,848	3,719	285,260
2029	Single-family detached, electric space heat	118,196	5,200	532	123,929
	Single-family detached, non-electric space heat	67,220	356	2,712	70,287
	Attached, electric space heat	27,214	3,365	-	30,579
	Attached, non-electric space heat	4,604	-	-	4,604
	Apartment, electric space heat	27,829	974	-	28,803
	Apartment, non-electric space heat	2,475	-	-	2,475
	Other and non-dwellings	8,601	1,104	189	9,893
	Vacant and partial	19,337	-	340	19,677
	Year Total	275,476	10,998	3,773	290,247

A detailed discussion of the methodology employed in each of the remaining steps is provided in Appendix C.

5.3 Summary of Results

This section presents the results of the model runs for the entire study period. The results are measured at the customer's point-of-use and do not include line losses. They are presented in four exhibits:

- Exhibit 16 presents the model results in tabular form, by dwelling type, end use and milestone year
- Exhibit 17 presents the model results for 2029 by dwelling type
- Exhibit 18 presents the model results for 2029 by by region
- Exhibit 19 presents the model results for 2029 by end use
- Exhibit 20 shows the evolving relative contribution of different summary end uses towards the total consumption in different dwelling types.

Selected highlights of electricity use in 2029 are provided below.

By Dwelling Type

Single detached dwellings will continue to account for the majority of residential electricity use in NL, consuming approximately 76% of residential electricity in 2029. Attached houses (duplexes, row houses, townhouses, and the main house of a building with a basement apartment) are expected to account for approximately 13% of residential electricity in 2029. Apartment buildings, including only the suites and not the common areas, as well as basement apartments, are expected account for 7% of residential electricity in 2029. Other residential buildings, such as cottages, sheds and garages, are expected to account for approximately 2% of residential electricity in 2029. Vacant and partially occupied dwellings are expected to account for the last 2% of residential electricity.

By Region

The division of electricity consumption by region is expected to remain stable over the study period, with the Island Interconnected region continuing to account for 92% of residential electricity consumption, the Labrador Interconnected region accounting for 7%, and accounts connected to isolated diesel grids consuming the remaining 1%.

By End Use

HVAC is expected to account for approximately 51% of consumption in 2029. 49% of the 51% is expected to be electric space heating and the remainder being fans and pumps, including furnace fans, boiler circulation pumps, HRV fans, and bathroom and kitchen exhaust. Space cooling is well under 1% of residential consumption.

Domestic appliances (white goods) are expected to consume approximately 18% of total residential electricity in 2029. Of this, clothes dryers and refrigerators will each account for 5%. Cooking appliances consume approximately 3% and freezers will consume approximately 2.5%. Dehumidifiers will account for approximately 2%. Dishwashers and clothes washers will consume less than 1% each, but this does not include the associated DHW consumption if DHW is heated electrically.

Household electronics consume approximately 13% of residential electricity in 2029, which is an increase from the base year. Computers and their peripherals are expected to account for nearly 6% of the 12%, with 4% consumed by televisions, nearly 2% by the various set-top boxes associated with televisions, and approximately 1% by other home entertainment electronics.

Domestic water heating is expected to account for approximately 12% of residential electricity consumption in 2029. This decline is expected to occur primarily because of the steady replacement of clothes washers and dishwashers with newer models that require less hot water. This is a continuation of the trend observed between the 2008 study and the base year for the current study, based on changes observed in Residential End Use Surveys conducted in NL and national appliance data.

Indoor, outdoor, and holiday lighting together are expected to account for only 3% of residential electricity consumption in 2029; 2.5% of this is indoor lighting and 0.5% is outdoor lighting. Holiday lighting is well under 1%. The decrease is expected to occur because of the steady replacement of incandescent lighting with more efficient options.

Other end uses are expected to account for 4% of residential electricity consumption in 2029. Of this, approximately 1.5% is expected to be consumed by spa heaters and pumps and 2% is small appliances and other. Less than 1% is consumed by block heaters and car warmers, all of it in Labrador. The decrease in consumption by spa heaters is primarily due to an assumed increase in the use of heat pump spa heaters. The increase in small appliances and other is partly to account for unknown new end uses that may emerge in the next 15 years.

By Dwelling Type and End Use

The last exhibit in this section shows the trends in consumption by major end-use groupings. The following key observations can be made:

- Heating, ventilation and circulation, and cooling are expected to modestly increase in share of residential electricity consumption between now and 2029.
- The overall consumption of appliances will account for a relatively stable share of consumption between now and 2029, because the forecast increase in the number of appliances per home will likely be cancelled out by gains in efficiency.
- DHW will account for a reduced share of residential electricity consumption, largely because of reduced consumption in dishwashers and clothes washers.
- Electronics in the home, including computers, televisions and set-top boxes, and other electronics, are expected to account for an increasing share of residential consumption. Even though some of these devices are becoming more efficient, their increasing numbers will more than cancel out any efficiency gains.
- Lighting is expected to account for a steadily diminishing share of residential electricity consumption between now and 2029, even without new CDM intervention, largely because of the growing use of compact fluorescent lamps and LEDs.
- Past experience suggests that electricity consumption per household remains remarkably stable over long periods. As more efficient equipment is introduced for some of the older end uses, new uses for electricity tend to emerge. This is reflected in the increase in consumption for “other” between now and 2029.
- The exhibit also permits comparisons of end-use consumption proportions from one dwelling type to another. These patterns are expected to remain relatively consistent through the study period.

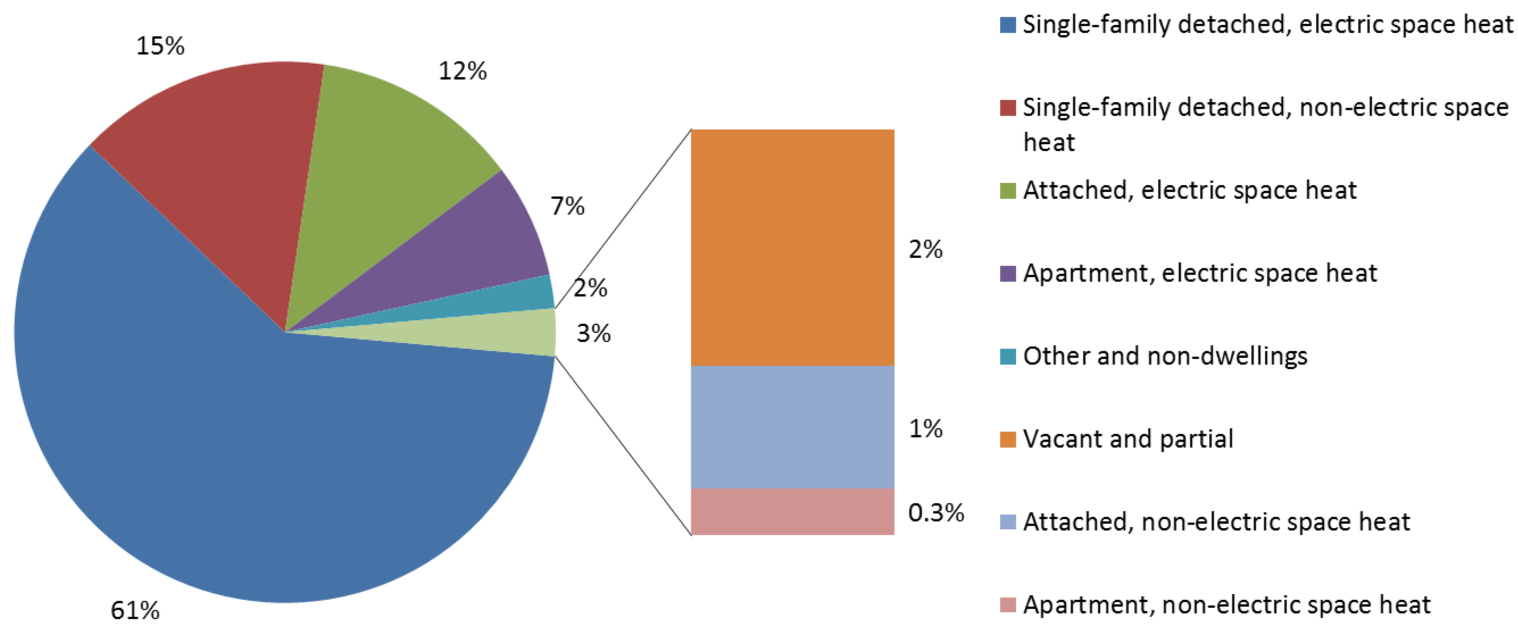
Exhibit 16 Reference Case Electricity Consumption, All Regions, Modelled by End Use, Dwelling Type and Milestone Year (MWh/yr.)

Dwelling Types	Year	Consumption						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	1,458,966	361,180	276,870	188,758	108,496	120,251	2,514,522
	2017	1,519,696	370,415	283,854	211,447	94,458	90,026	2,569,897
	2020	1,571,019	377,322	288,523	231,226	78,272	74,924	2,621,285
	2023	1,627,172	386,829	293,863	250,746	78,988	68,488	2,706,085
	2026	1,668,288	392,891	295,698	266,645	79,083	65,783	2,768,387
	2029	1,705,386	398,254	296,450	281,051	79,537	65,294	2,825,972
Single-family detached, non-electric space heat	2014	146,550	217,672	121,571	110,987	65,903	70,523	733,206
	2017	145,409	226,075	120,321	129,093	53,993	50,971	725,861
	2020	144,106	224,067	118,899	137,318	43,300	41,243	708,933
	2023	142,919	222,804	117,543	144,573	42,686	36,596	707,121
	2026	141,436	221,424	115,918	150,675	42,152	34,449	706,054
	2029	139,874	220,137	114,206	156,092	41,948	33,602	705,858
Attached, electric space heat	2014	270,777	87,972	69,174	45,076	13,947	25,852	512,799
	2017	283,874	83,351	71,340	50,781	10,600	19,508	519,454
	2020	294,350	86,053	72,794	55,726	7,968	16,331	533,222
	2023	304,787	89,222	74,311	60,544	7,474	14,992	551,330
	2026	312,695	91,315	74,938	64,496	7,138	14,459	565,040
	2029	319,737	93,136	75,268	68,093	6,911	14,404	577,548
Attached, non-electric space heat	2014	6,972	14,337	6,908	6,978	2,081	4,026	41,302
	2017	6,837	15,336	6,779	8,363	1,649	2,891	41,855
	2020	6,703	15,104	6,650	8,841	1,261	2,327	40,885
	2023	6,568	14,908	6,521	9,242	1,227	2,052	40,517
	2026	6,434	14,735	6,392	9,582	1,198	1,923	40,265
	2029	6,300	14,576	6,263	9,876	1,182	1,869	40,066
Apartment, electric space heat	2014	121,202	44,768	46,365	32,306	3,015	12,236	259,891
	2017	126,454	54,821	47,724	40,980	2,817	9,032	281,826
	2020	130,898	55,993	48,665	45,173	3,018	7,406	291,152
	2023	135,792	57,567	49,722	49,269	3,238	6,670	302,258
	2026	139,282	58,590	50,135	52,563	3,427	6,306	310,303
	2029	142,406	59,504	50,350	55,507	3,611	6,159	317,537
Apartment, non-electric space heat	2014	2,751	3,630	2,561	2,616	244	848	12,650
	2017	2,727	5,265	2,513	3,802	181	596	15,084
	2020	2,703	5,182	2,465	4,042	197	470	15,059
	2023	2,680	5,111	2,417	4,238	213	407	15,065
	2026	2,656	5,048	2,370	4,401	228	374	15,077
	2029	2,632	4,992	2,322	4,538	244	356	15,084
Other and non-dwellings	2014	24,585	16,835	11,173	7,083	14,496	4,031	78,204
	2017	25,310	22,302	11,344	11,806	10,115	2,981	83,859
	2020	25,908	22,304	11,432	12,215	11,636	2,457	85,952
	2023	26,543	22,430	11,519	12,687	13,239	2,223	88,642
	2026	27,007	22,487	11,518	13,093	14,807	2,121	91,031
	2029	27,421	22,554	11,484	13,491	16,391	2,092	93,435
Vacant and partial	2014	27,524	10,883	10,202	7,509	13,900	4,903	74,921
	2017	28,268	9,694	10,320	6,865	16,666	3,621	75,434
	2020	28,902	9,691	10,382	7,120	16,495	2,983	75,573
	2023	29,618	9,756	10,464	7,418	16,342	2,698	76,296
	2026	30,121	9,783	10,453	7,673	16,030	2,572	76,633
	2029	30,572	9,816	10,423	7,926	15,664	2,541	76,941

Notes:

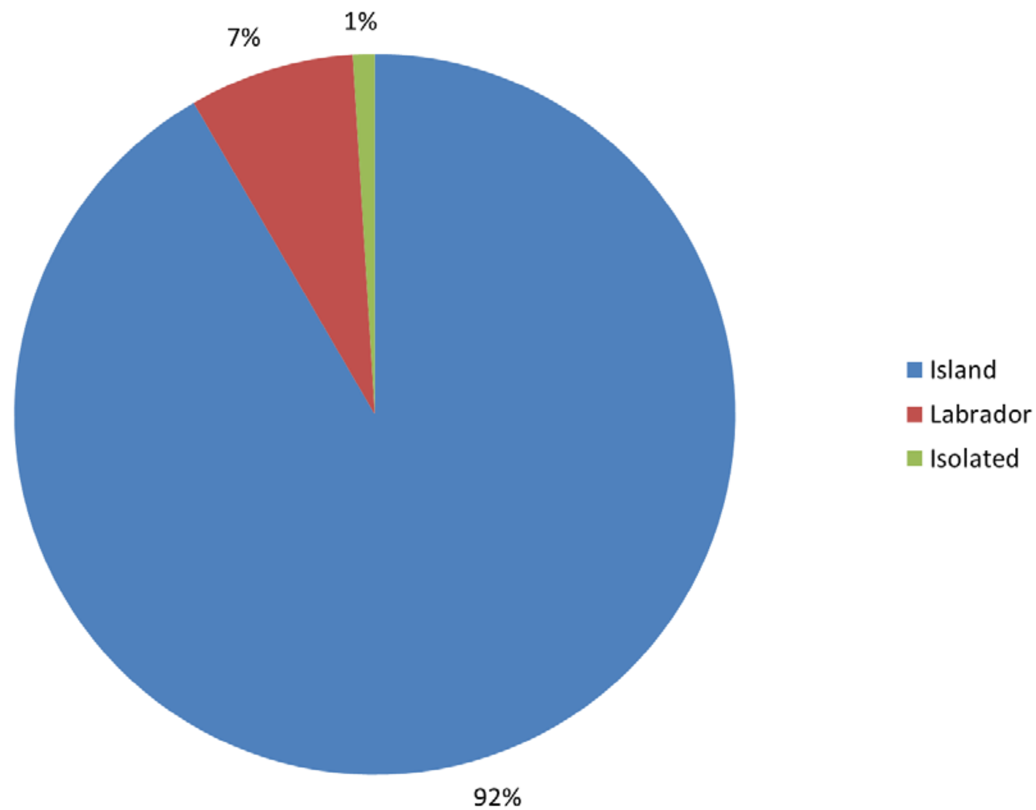
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) The end uses in this exhibit are summary groupings. Data Manager can be used to display the more disaggregated results.

Exhibit 17 Distribution of Electricity Consumption in 2029 by Dwelling Type



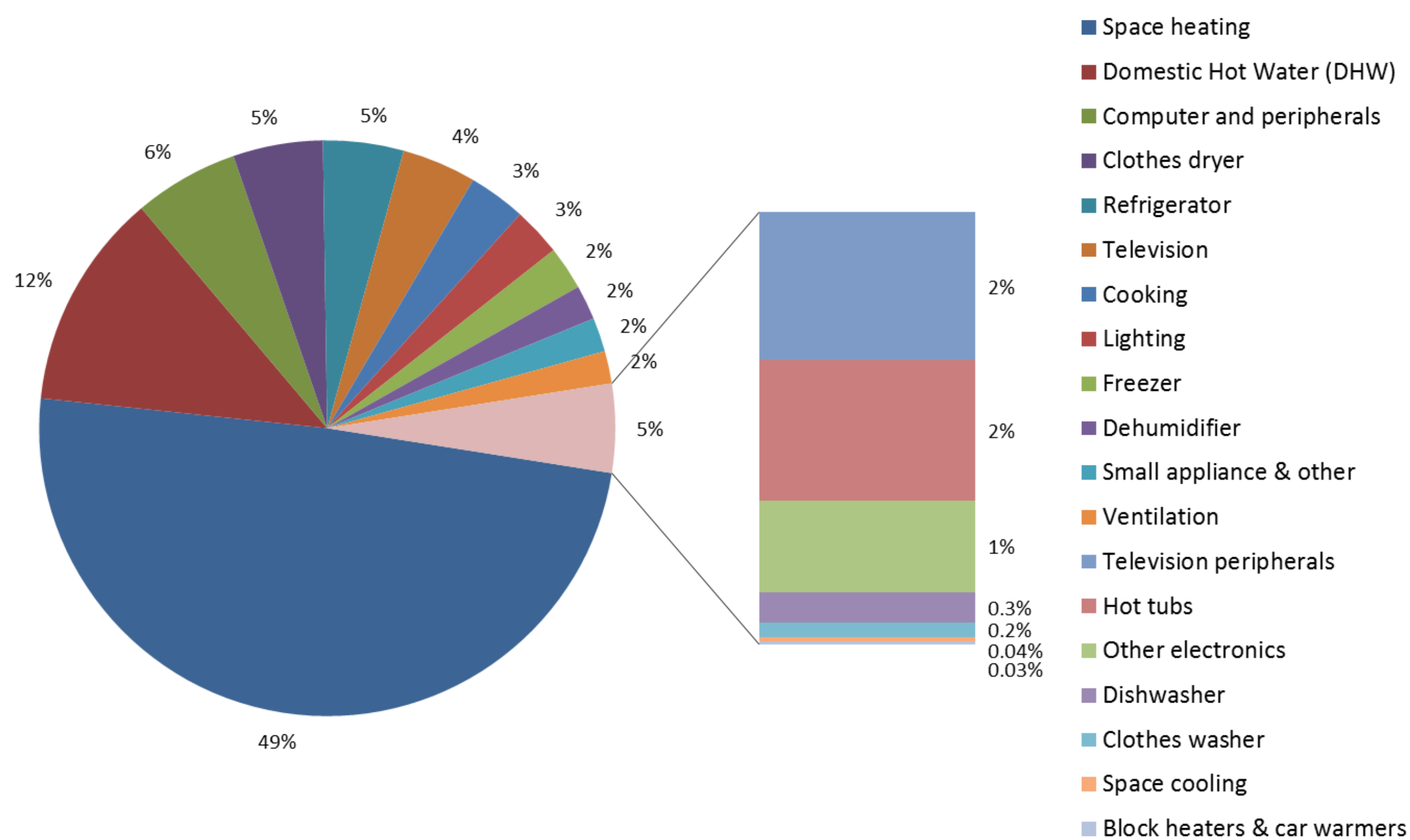
Totals may not add to 100% due to rounding.

Exhibit 18 Distribution of Electricity Consumption, by Region in 2029



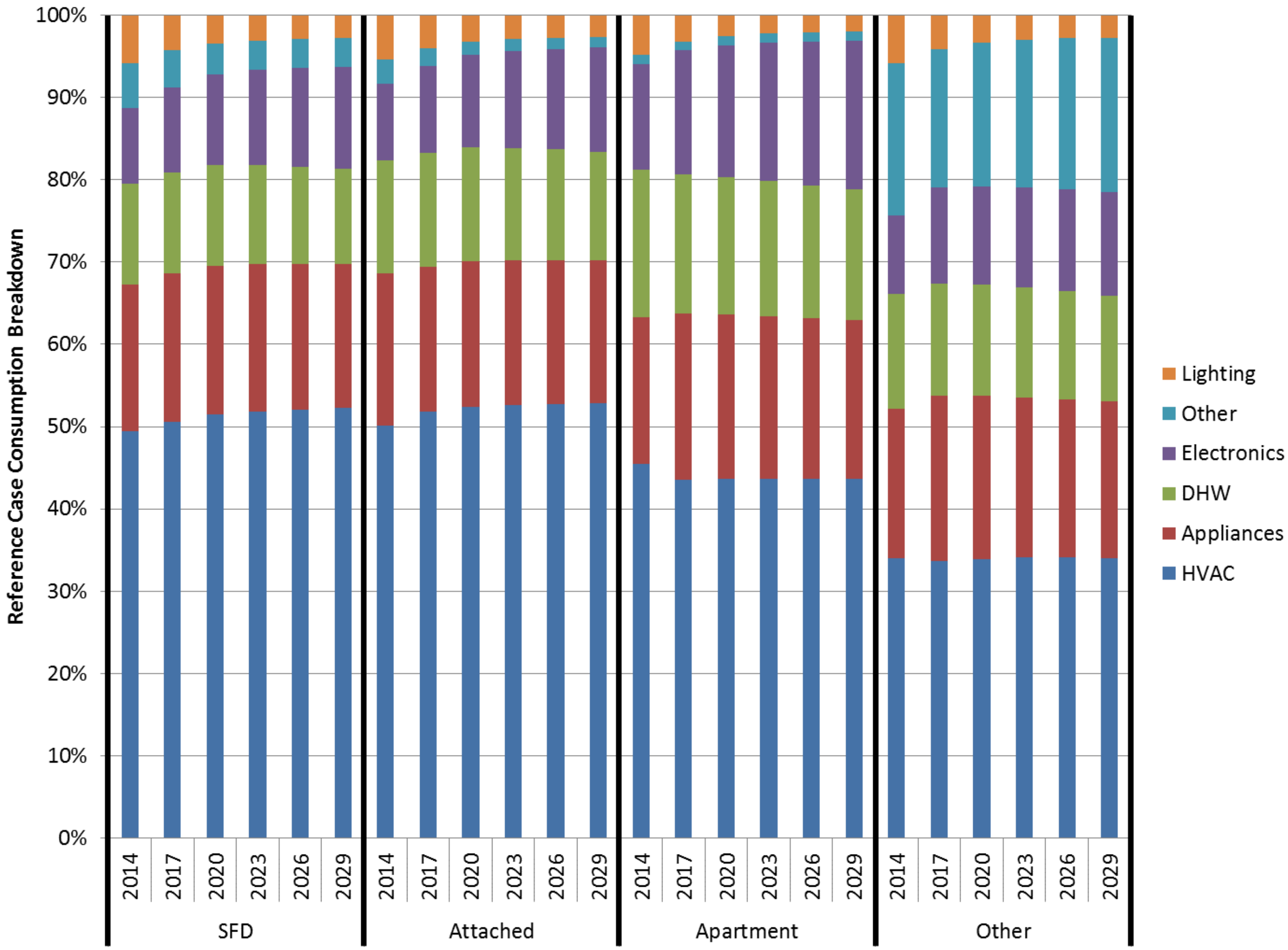
Totals may not add to 100% due to rounding.

Exhibit 19 Distribution of Electricity Consumption in 2029 by End Use

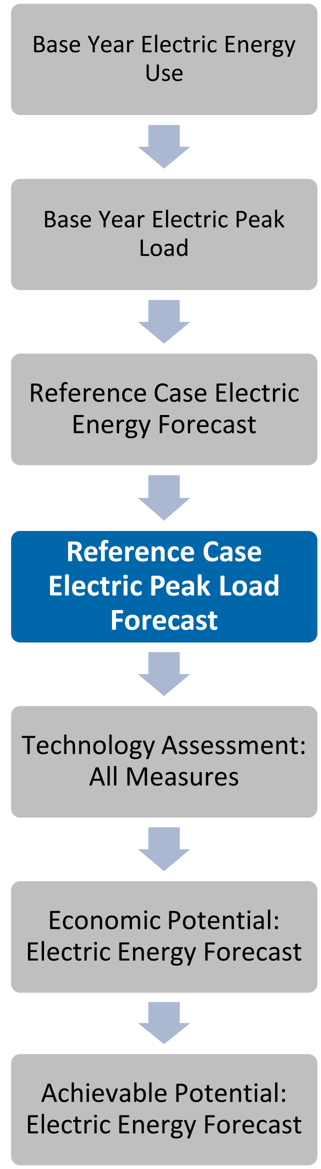


Totals may not add to 100% due to rounding.

Exhibit 20 Distribution of Electricity Consumption, by Dwelling Type and End Use, Trends to 2029



6 Reference Case Electric Peak Load Forecast



6.1 Introduction

This section provides a profile of the electric peak load for NL's residential sector over the Reference Case period of 2014 to 2029. The Reference Case peak load profile estimates the expected level of demand in the peak period that would occur over the study period in the absence of new CDM initiatives or rate changes. The Reference Case, therefore, provides the point of comparison for the calculation of peak load savings associated with each of the subsequent scenarios that are assessed within this study.

The discussion is organized into the following sub-sections:

- Methodology
- Summary of results.

6.2 Methodology

The electric peak loads for each combination of end use, dwelling type and milestone year were calculated in exactly the same manner as shown in Section 4, which presented the Base Year peak load profiles.

For this Reference Case, the electric energy consumption (from Section 5) is converted to a demand value for the peak period by dividing the applicable electric energy value for each dwelling type and end use by the corresponding Residential sector load shape hours-use factors, as presented in Appendix B.

6.3 Summary of Results

A summary of the Reference Case peak load profiles is presented in Exhibit 21.

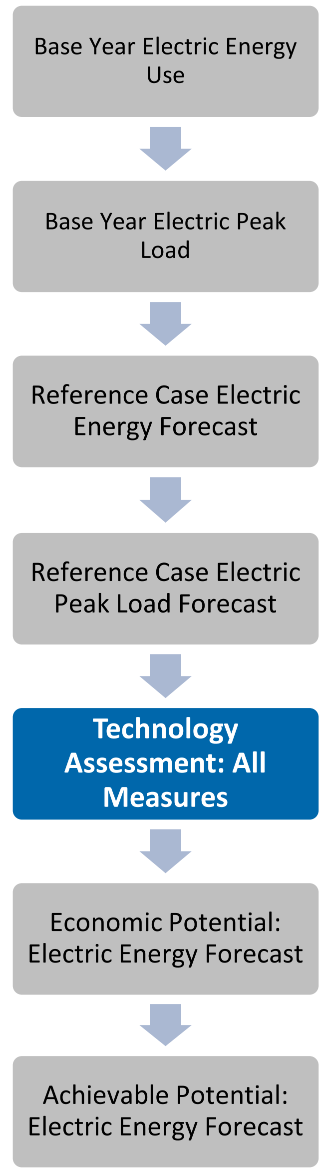
Exhibit 21 Electric Peak Loads, by Milestone Year, Region and Dwelling Type (MW)

Dwelling Types	Year	Reference Case Peak Demand (MW)			
		Island	Labrador	Isolated	Grand Total
Single-family detached, electric space heat	2014	620	48	3	671
	2017	637	49	4	690
	2020	653	50	4	707
	2023	675	51	4	730
	2026	690	52	5	747
	2029	704	52	5	762
Single-family detached, non-electric space heat	2014	141	2	6	149
	2017	140	1	6	147
	2020	137	1	5	144
	2023	136	1	5	143
	2026	135	1	5	142
	2029	135	1	6	141
Attached, electric space heat	2014	109	25	-	134
	2017	111	26	-	137
	2020	114	27	-	141
	2023	118	28	-	146
	2026	121	29	-	150
	2029	124	29	-	153
Attached, non-electric space heat	2014	8	-	-	8
	2017	8	-	-	8
	2020	8	-	-	8
	2023	8	-	-	8
	2026	8	-	-	8
	2029	8	-	-	8
Apartment, electric space heat	2014	65	3	-	68
	2017	69	3	-	72
	2020	71	3	-	74
	2023	74	3	-	77
	2026	76	3	-	79
	2029	77	3	-	80
Apartment, non-electric space heat	2014	3	-	-	3
	2017	3	-	-	3
	2020	3	-	-	3
	2023	3	-	-	3
	2026	3	-	-	3
	2029	3	-	-	3
Other and non-dwellings	2014	15	2	0	17
	2017	16	2	0	18
	2020	17	2	0	19
	2023	17	2	0	19
	2026	17	2	0	20
	2029	18	2	0	20
Vacant and partial	2014	17	-	0	18
	2017	17	-	0	18
	2020	18	-	0	18
	2023	18	-	0	18
	2026	18	-	0	18
	2029	18	-	0	18
Grand Total	2014	979	78	9	1,067
	2017	1,003	81	10	1,094
	2020	1,021	83	10	1,114
	2023	1,049	85	10	1,144
	2026	1,069	87	11	1,166
	2029	1,086	88	11	1,186

Selected highlights include:

- Since the hours-use factors applied are not assumed to change during the study period, trends in peak demand contributions for specific dwelling types are expected to follow the electricity consumption trends for those dwelling types. Single detached houses, for example, will continue to make the largest residential contribution to peak demand throughout the study period.
- The overall electricity consumption for electric space heating is expected to grow over the study period, and consequently the contribution it makes to the peak demand will also grow, continuing to dominate the peak demand in the residential sector.
- Similarly, peak demand contributions for specific end uses are expected to follow the electricity consumption trends for those end uses. Lighting, because of natural gains in efficiency as compact fluorescent lamps and LEDs are adopted, will make a gradually declining contribution towards the peak demand.
- The overall electricity consumption of the electronics end uses trend upwards during the study period, so they would be expected to make a gradually larger contribution towards the peak demand over the course of the study period.

7 Technology Assessment: Energy Efficiency and Peak Load Measures



7.1 Introduction

This section identifies and assesses the economic attractiveness of the selected energy efficiency measures for the Residential sector. It also identifies and assesses the economic attractiveness of selected Residential sector electric capacity-only peak load reduction measures, which in this study are defined as those measures that affect electric peak but have minimal or no impact on daily, seasonal or annual electric energy use. The discussion is organized and presented as follows:

- Methodology
- Energy efficiency technologies
- Electric peak load reduction measures
- Summary of unbundled results
- Energy efficiency supply curves
- Demand reduction supply curves.

7.2 Methodology

The following steps were employed to assess the measures:

- Select candidate measures
- Establish technical performance for each option
- Establish the capital, installation and operating costs for each option
- Calculate the cost of conserved energy (CCE) for each energy efficiency technology and O&M measure
- Calculate the cost of electric peak load reduction (CEPR) for each option.

A brief description of each step is provided below.

Step 1 Select Candidate Measures

The candidate measures were selected in close collaboration with client personnel based on a combination of a literature review and previous study team experience. The selected measures are all considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs, which will be addressed in this section, were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources, including the experience and on-going research work of study team members. In the case of some of the peak load reduction measures, comfort may be affected and the trade-off between benefits (e.g., cost savings) and costs (including reduction in comfort) were judged based on past experience with similar technologies and customer acceptance.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources, including the experience and on-going research work of study team members.

In the case of energy efficiency measures, the incremental cost is applicable when a measure is installed in a new facility, or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy efficiency measure relative to the baseline technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.[18]

Unlike energy efficiency measures, in which major equipment, such as heating and water heating systems are typically replaced, or thermal envelope measures such as insulation upgrades affect systems directly, capacity-only measures are typically implemented via add-on control equipment, although some built-in control equipment exists. The incremental cost is thus defined as the control equipment itself or incremental cost for a controllable appliance or device relative to the baseline appliance cost (e.g., remote accessible thermostat vs. standard thermostat), plus any required infrastructure (e.g., automatic meter reading or communications gateways). In cases where a more efficient appliance with peak control functions replaces a standard appliance, both electric energy and electric peak reduction are achieved, with some splitting of incremental costs attributable to each function. Where a new or replacement end use is installed that operates off peak, thus achieving electric peak reduction without significant energy impacts, incremental costs for the electric peak reduction device will be compared with standard equipment without assuming any early replacement and, thus, salvage value.

In all cases the costs and savings are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs. All costs are expressed in constant 2014 dollars.

Step 4 Calculate CCE for Each Energy Efficiency Measure

One of the important sets of information provided in this section is the CCE associated with each energy efficiency measure. The CCE for an energy efficiency measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the accompanying TRM Workbook is expressed in constant 2014 dollars.

$$\frac{C_A + M}{S}$$

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CCE is calculated according to the following formula:

[18] With some exceptions, many measures could conceivably be applied as either a full-cost measure (applicable immediately) or as an incremental cost measure (upon end of service life), depending on how financially attractive it is. Therefore, for all but a few measures, the TRM Workbook is configured to evaluate the measure at full cost and include it on that basis if it passes the screen, then roll to evaluating it on an incremental basis, and only fail it completely if it fails both tests. Where a measure is always full cost (such as attic insulation, where the baseline technology is the “do nothing” option), the incremental cost option is excluded. Where a measure is always incremental cost (such as high-performance homes, where the baseline technology has to be a standard construction home, not no home at all), the full cost option is excluded.
It is recognized that some measures can be implemented prior to the end of their useful life, that is, early retirement. This intermediate option between full and incremental cost could increase the rate of adoption for some of the incremental measures, raising the Economic Potential savings modestly. However, in this study early retirement is treated as a program option.

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O&M)
S is the annual kWh electricity savings

And *A* is the annualization factor

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:

i is the discount rate
n is the life of the measure

The detailed CCE tables (see TRM Workbook) show both incremental and full installed costs for the energy efficiency measures, as applicable. If the measure or technology is installed in a new facility or at the point of natural replacement in an existing facility, then the incremental cost of the measure versus the cost of the baseline technology is used. If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the full cost of the efficient measure is used.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations that accompany this document, a discount rate of 7% (real) is used.

Step 5 Calculate CEPR for Each Peak Load Measure

The CEPR for a peak load reduction measure is defined as the annualized incremental cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the TRM Workbook is in constant (2014) dollars.

The CEPR provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 8). The CEPR is calculated according to the following formula:

$$\frac{C_A + M}{S_p}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of operation and maintenance (O & M)
S_p is the annual kW load reduction associated with peak definition p.

And A is the annualization factor.

$$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where:

i is the discount rate;
n is the life of the measure.

Note that the annual O&M cost will include, in some cases, amortized costs associated with infrastructure considered a prerequisite for implementation of the measure. This could include automated metering infrastructure (AMI), such as advanced metering, communications gateways and other related system investments. These costs would typically support multiple applications (e.g., communications gateways could enable control of heating, air conditioning, water heating, pool pumps, spas and small appliances), as well as facilitate time-differentiated rates that would be required for a feasible and cost-effective program implementation (e.g., thermal energy storage). It should also be noted that the measure lifetime is for the control device, function or feature, rather than that of the unit it is controlling. The study does not presume any specific technology or infrastructure, but does assume that a marketplace will develop for such systems, whether or not NL utilities adopt them, or develops access directly or indirectly to customer control equipment.

The CEPR can be compared to benefits, which include the value of reduced peak for the utility (avoided capacity and transmission and distribution (T&D) investment or purchase costs), the customer (e.g., bill savings) and society (e.g., value of environmental benefits) to determine its cost effectiveness from various perspectives (societal, utility, participant and non-participant).

As with the CCE for energy savings, the CEPR calculation is sensitive to the chosen discount rate, which, as for the CCE, used a 7% (real) discount rate. Higher discount rates will tend to reduce savings and decrease cost effectiveness where costs are incurred upfront and benefits accrue over many years.

Step 6 Estimate Approximate Unbundled Electric Energy Savings Potential for Each Energy Efficiency Measure and Demand Reduction for Each Peak Load Measure

The next step in the assessment was to prepare an approximate estimate of the potential unbundled electric energy savings that could theoretically be provided by each energy efficiency measure over the study period, and similarly to prepare an estimate of demand reductions that could be provided by each peak load measure. The term “unbundled” means that the savings for each measure are calculated in isolation from other important factors that ultimately determine the potential for real life savings.

The strength of this approach is that it provides insight into the relative size of the potential electric energy savings or demand reductions associated with individual measures; this perspective is often of particular value to utility CDM program design personnel who may need to consider combinations of measures that differ from those selected for the CDM potential analysis.

However, it should be noted that the savings from individual measures cannot be used directly to calculate total savings potential or demand reduction. This is due primarily to two factors:

- **More than one upgrade may affect a given end use.** For example, improved insulation reduces space heating electricity use, as does the installation of a heat pump. On its own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of bundles of measures that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a heat pump heating system). Similarly, more than one peak load measure may affect a given end use, or peak load measures may be applied to the same end use that one or more energy efficiency measures may also affect.

- **There are interactive effects among end uses.** For example, the electricity savings from more efficient appliances and lighting result in reduced waste heat. During the space heating season, appliance and lighting waste heat contributes to the building's internal heat gains, which lower the amount of heat that must be provided by the space heating system. The magnitude of the interactive effects can be significant, both on energy consumption and peak demand. Based on selected building energy use simulations, a 100 kWh savings in appliance or lighting electricity use results, on average, in an increased space heating load of 60 kWh in Newfoundland and 70 kWh in Labrador, depending on housing detachment type and vintage.

The above factors are incorporated in later stages of the analysis.

Step 7 Prepare Energy Efficiency and Demand Reduction Supply Curves

The final step in the assessment of the selected energy efficiency measures was the generation of an energy efficiency supply curve and a demand reduction supply curve. Energy efficiency supply curves are built up based on the conserved electricity and the CCE for each measure. Similarly, demand reduction supply curves are built up based on the demand reduction and the CEPR for each measure. The RSEEM model was used to model the application of all technically feasible measures, accumulating the electricity savings or demand reduction and associated implementation costs for each dwelling type.

Measures were applied sequentially to account, at least approximately, for interaction between measures. The impact of building shell measures was modelled using HOT2000, but only individually. The full package of measures was not modelled together, nor was the impact of internal gains on space heating and cooling included. These effects are modelled more thoroughly for the Economic Potential calculation, when all the measures that pass the economic screen are modelled together. Similarly, the demand measures were also applied sequentially, but began with the demand reference case, not the demand that would remain after all the efficiency measures were applied. Thus the interaction between energy efficiency and demand reduction is neglected for this supply curve.

The accumulated savings and costs for each measure were added together to present the overall energy efficiency supply curve for the province. They were sorted in order from lowest cost per kWh saved to highest cost, and presented on a graph showing CCE versus electricity savings.

The accumulated demand reduction and costs for each measure were added together to present the overall demand reduction supply curve for the province. They were sorted in order from lowest cost per kW reduction to highest cost, and presented on a graph showing CEPR versus demand reduction.

7.3 Energy Efficiency Technology Assessment

Exhibit 22 shows the energy efficiency technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 22 Energy Efficiency Technologies Included in this Study

Heating: Equipment

- Air-Source Heat Pumps
- Cold Climate Heat Pumps
- Mini-Split Heat Pumps
- Integrated Heating and Domestic Hot Water (DHW) Air-to-Water Heat Pumps
- High Efficiency Heat Recovery Ventilators (HRVs)
- Premium Motors for Apartment Building Ventilation Systems
- Apartment Building Recommissioning
- Electronic Thermostats
- Programmable Thermostats (Central Heating)
- Programmable Thermostats (Baseboard Heating)
- High-Efficiency Furnace Blower Motors (ECPM)
- Temperature Setback (Overnight)
- Temperature Setback (During Day)
- Increase Temperature of AC

Heating: Shell Measures

- Maintain Weather Stripping
- Homeowner Air Sealing
- Professional Air Sealing
- Air Leakage Sealing and Attic Insulation (Old (pre-1980) homes)
- Attic Insulation
- Wall Insulation
- Crawl Space Insulation
- Foundation (Basement) Insulation
- High-Performance (ENERGY STAR®) Solid Exterior Doors
- High-Performance (ENERGY STAR®) Windows and Patio Doors
- Super High-Performance Windows
- Close Windows and Blinds

Heating: Shell (New Homes)

- Net-Zero-Ready Homes
- High-Performance Homes (EGH 80/R2000/ENERGY STAR®)
- LEED Certified Apartment Buildings

Water Heating

- Kitchen faucet aerators
- Low-Flow Faucets
- Ultra Low-Flow Showerheads
- DHW Pipe Insulation
- DHW Tank Insulation
- High Efficiency Electric Storage Water Heaters
- Reduce Temperature of DHW

Lighting

- LED Lamps
- Motion Detectors for Indoor Lighting
- Timers for Outdoor Lighting
- Only Necessary Outdoor Lighting
- Motion Detectors for Outdoor Lighting
- Efficient Fluorescent Fixtures (Replace T12s with T8s) in Common Areas
- Redesign with High-Performance T8 Fluorescent Fixtures (Apartment Buildings)
- Turn Off Lights in Unoccupied Rooms

Appliances

- Convection Ovens - Electric
- High-Efficiency Cooktops (Induction)
- ENERGY STAR® Dehumidifiers
- High-Efficiency (ENERGY STAR®) Dishwashers
- Use Sensor for Clothes Dryer
- Efficient Clothes Dryers
- Heat Pump Clothes Dryers
- Clothes Lines and Drying Racks
- Minimize Hot and Warm Clothes Wash
- High-Efficiency (CEE Tier II) Clothes Washers
- Super High-Efficiency (CEE Tier III) Clothes Washers
- High-Efficiency (ENERGY STAR®) Freezers
- Super High-Efficiency (CEE Tier III) Freezers
- Maintain Proper Freezer Temperature
- High-Efficiency (CEE Tier II) Refrigerators
- Super High-Efficiency (CEE Tier III) Refrigerators
- Maintain Proper Refrigerator Temperature
- Appliance Retirement for Extra Refrigerators

Other

- Unplug Brick Chargers
- Activate PC Power Management
- Energy Efficient (ENERGY STAR®) Computers
- Smart Power Bars (Computers and Peripherals)
- Insulating Hot Tub Covers
- Turn Off TVs When Not in Use
- Energy Efficient (ENERGY STAR®) Televisions
- Smart Power Bars (Televisions and Home Entertainment)
- Timers for Car Warmers
- Timer/Thermostat for Block Heaters
- Timers for Electric Battery Blankets
- Social Benchmarking and Home Energy Monitoring

7.3.1 Technology Screening Results

A summary of the results is provided in Exhibit 23. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[19] for the CCE that is shown, e.g., full versus incremental
- The measure's average CCE when applied to existing dwellings and to new dwellings. Average CCE refers to a weighted average of the CCE values for the measure in different dwelling types and regions.[20]

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 23 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some dwelling types and on an incremental cost basis in others is shown as "Full/Incr."

[19] See Step 4 in Section 7.2 for a fuller description.
[20] In the subsequent modeling described in Section 8, measure pass or fail the economic screen on the basis of their CCE in the individual dwelling type and region, not on the basis of this weighted average value.

Exhibit 23 Residential Sector Energy Efficiency Technology Measures, Screening Results[21]

Measure Name	Island			Labrador			Isolated		
	Basis (Full/ Incremental)	Average CCE (¢/kWh)		Basis (Full/ Incremental)	Average CCE (¢/kWh)		Basis (Full/ Incremental)	Average CCE (¢/kWh)	
		Existing Homes	New Homes		Existing Homes	New Homes		Existing Homes	New Homes
Timers for Electric Battery Blankets	Incr.	N/A	N/A	Full	59.3	59.3	Incr.	N/A	N/A
Timer/Thermostat for Block Heaters	Incr.	N/A	N/A	Full	5.9	5.9	Incr.	N/A	N/A
Timers for Car Warmers	Incr.	N/A	N/A	Full	0.9	0.9	Incr.	N/A	N/A
Use Sensor for Clothes Dryer	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Clothes Lines and Drying Racks	Full	0.5	0.5	Full	0.5	0.5	Full	0.5	0.4
Efficient Clothes Dryers	Incr.	101.6	94.7	Incr.	102.5	94.0	Incr.	104.0	92.8
Heat Pump Clothes Dryers	Incr.	72.2	67.4	Incr.	72.9	66.9	Incr.	74.0	66.0
High-Efficiency (CEE Tier II) Clothes Washers	Incr.	6.9	6.6	Incr.	6.9	6.6	Full/Incr.	17.8	17.9
Super High-Efficiency (CEE Tier III) Clothes Washers	Incr.	10.3	10.0	Incr.	10.4	10.0	Full/Incr.	20.2	20.0
Energy Efficient (ENERGY STAR®) Computers	Incr.	6.6	6.6	Incr.	6.6	6.6	Incr.	6.6	6.6
Activate PC Power Management	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Smart Power Bars (Computers and Peripherals)	Full/Incr.	7.3	7.6	Incr.	4.3	3.9	Full/Incr.	8.5	7.6
Convection Ovens - Electric	Incr.	82.1	84.9	Incr.	82.8	84.2	Incr.	84.0	83.1
High-Efficiency Cooktops (Induction)	Incr.	403.3	417.1	Incr.	407.2	413.9	Incr.	413.0	408.6
ENERGY STAR® Dehumidifiers	Incr.	9.4	10.3	Incr.	7.8	8.8	Incr.	5.3	5.3
High-Efficiency (ENERGY STAR®) Dishwashers	Incr.	14.4	14.4	Incr.	14.4	14.6	Incr.	14.6	14.8
DHW Pipe Insulation	Full	1.4	1.4	Full	1.4	1.4	Full	1.4	1.4
DHW Tank Insulation	Full	11.1	11.1	Full	11.2	11.5	Full	11.4	11.6
Reduce Temperature of DHW	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
High Efficiency Electric Storage Water Heaters	Incr.	31.3	31.3	Incr.	31.6	32.4	Incr.	32.1	32.7
Kitchen faucet aerators	Full	0.8	0.8	Full	0.8	0.8	Full	0.8	0.8
Low-Flow Faucets	Full/Incr.	5.8	5.6	Incr.	1.0	1.0	Full	7.3	7.4
Minimize Hot and Warm Clothes Wash	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Ultra Low-Flow Showerheads	Full	1.2	1.2	Full	1.2	1.2	Full	1.2	1.2
High-Efficiency (ENERGY STAR®) Freezers	Incr.	5.8	5.8	Incr.	5.8	5.8	Incr.	5.8	5.8
Maintain Proper Freezer Temperature	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Super High-Efficiency (CEE Tier III) Freezers	Incr.	14.5	14.5	Incr.	14.5	14.5	Incr.	14.5	14.5
Insulating Hot Tub Covers	Full/Incr.	2.8	3.0	Full/Incr.	2.6	2.4	Full/Incr.	2.8	3.6
LED Lamps	Full	3.6	3.6	Full	3.6	3.6	Full	3.6	3.6
Only Necessary Outdoor Lighting	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Motion Detectors for Indoor Lighting	Full	26.4	26.4	Full	26.4	26.4	Full	26.4	26.4
Motion Detectors for Outdoor Lighting	Full	2.8	5.7	Full/Incr.	3.2	4.6	Full	2.6	5.2

21 Average CCE does not include program costs.

Exhibit 23 Continued: Residential Sector Energy Efficiency Technology Measures, Screening Results

Measure Name	Island			Labrador			Isolated		
	Basis (Full/ Incremental)	Average CCE (¢/kWh)		Basis (Full/ Incremental)	Average CCE (¢/kWh)		Basis (Full/ Incremental)	Average CCE (¢/kWh)	
		Existing Homes	New Homes		Existing Homes	New Homes		Existing Homes	New Homes
Efficient Fluorescent Fixtures (Replace T12s with T8s) in Common Areas	Incr.	2.4	2.4	Incr.	2.4	2.4	Incr.	2.4	2.4
Timers for Outdoor Lighting	Full	11.0	11.0	Full	11.0	11.0	Full	11.0	11.0
Turn Off Lights in Unoccupied Rooms	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Unplug Brick Chargers	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
High-Efficiency (CEE Tier II) Refrigerators	Incr.	40.4	40.4	Incr.	40.4	40.4	Incr.	40.4	40.4
Appliance Retirement for Extra Refrigerators	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Maintain Proper Refrigerator Temperature	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Super High-Efficiency (CEE Tier III) Refrigerators	Incr.	23.5	23.5	Incr.	23.5	23.5	Incr.	23.5	23.5
Increase Temperature of AC	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Homeowner Air Sealing	Full	16.6	N/A	Full	27.1	N/A	Full	25.9	N/A
Air-Source Heat Pumps	Incr.	17.7	18.9	Incr.	17.9	20.2	Full/Incr.	23.3	25.1
Integrated Heating and Domestic Hot Water (DHW) Air-to-Water Heat Pumps	Incr.	22.2	23.5	Incr.	22.6	24.9	Full/Incr.	26.4	28.1
Attic Insulation	Full	8.4	N/A	Full	8.8	N/A	Full	9.6	N/A
Foundation (Basement) Insulation	Full	10.6	N/A	Full	6.2	N/A	Full	6.4	N/A
Social Benchmarking and Home Energy Monitoring	Full	2.7	3.1	Full	2.8	3.3	Full	3.2	3.7
Close Windows and Blinds	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Cold Climate Heat Pumps	Incr.	17.3	18.5	Incr.	17.6	19.8	Full	10.4	11.2
Crawl Space Insulation	Full	4.2	N/A	Full	5.7	N/A	Full	4.9	N/A
Temperature Setback (During Day)	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
High-Performance (ENERGY STAR®) Solid Exterior Doors	Full/Incr.	3.9	N/A	Full/Incr.	2.1	N/A	Full	4.6	N/A
Electronic Thermostats	Incr.	8.0	8.5	Incr.	8.0	9.2	Full/Incr.	14.5	15.5
High-Performance (ENERGY STAR®) Windows and Patio Doors	Incr.	14.8	N/A	Incr.	35.5	N/A	Incr.	19.9	N/A
High-Performance Homes (EGH 80/R2000/ENERGY STAR®)	Full	N/A	19.2	Full	N/A	22.8	Full	N/A	26.0
LEED Certified Apartment Buildings	Full	N/A	30.5	Full	N/A	30.5	Incr.	N/A	N/A
Mini-Split Heat Pumps	Full/Incr.	9.8	10.4	Incr.	9.3	10.4	Full/Incr.	11.8	12.7
Net-Zero-Ready Homes	Full	N/A	92.1	Full	N/A	106.3	Full	N/A	96.0
Temperature Setback (Overnight)	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
Professional Air Sealing	Full	27.2	N/A	Full	59.8	N/A	Full	51.2	N/A
Programmable Thermostats (Baseboard Heating)	Full/Incr.	8.0	6.2	Incr.	6.0	6.8	Full	10.2	10.9
Programmable Thermostats (Central Heating)	Full	1.9	2.0	Full/Incr.	1.9	2.2	Full	2.0	2.1
Air Leakage Sealing and Attic Insulation	Full	13.5	N/A	Full	22.9	N/A	Full	10.5	N/A
Super High-Performance Windows	Incr.	21.0	N/A	Incr.	26.5	N/A	Incr.	29.4	N/A
Wall Insulation	Full	60.0	N/A	Full	75.0	N/A	Full	73.6	N/A
Maintain Weather Stripping	Full	0.0	N/A	Full	0.0	N/A	Full	0.0	N/A
Energy Efficient (ENERGY STAR®) Televisions	Incr.	8.0	8.0	Incr.	8.0	8.0	Incr.	8.0	8.0
Smart Power Bars (Televisions and Home Entertainment)	Full/Incr.	5.9	5.6	Incr.	3.3	2.9	Full/Incr.	5.7	0.0
Turn Off TVs When Not in Use	Full	0.0	0.0	Full	0.0	0.0	Full	0.0	0.0
High-Efficiency Furnace Blower Motors (ECPM)	Incr.	7.3	8.8	Incr.	9.0	9.6	Full/Incr.	14.1	13.1
High Efficiency Heat Recovery Ventilators (HRVs)	Incr.	34.1	37.1	Incr.	37.5	42.6	Incr.	30.2	32.0

7.4 Demand Reduction Technology Assessment

Exhibit 24 shows the demand reduction technologies and measures that are included in this study. A description and detailed financial and economic assessment of each measure is provided in the TRM Workbook that accompanies this report.

Exhibit 24 Demand Reduction Technologies Included in this Study

Heating: Equipment	Water Heating
▪ Air-source heat pump cycling ▪ Sole-Electric heat cycling ▪ Dual-Fuel heat cycling ▪ Electric thermal storage (baseboard heating) ▪ Electric thermal storage (central heating)	▪ Electric DHW cyclic ▪ Three-element water heater Other ▪ Timer for block heaters ▪ Timer for car warmers

7.4.1 Technology Screening Results

A summary of the results is provided in Exhibit 25. For each of the measures reviewed, the exhibit shows:

- The name of the measure
- The cost basis[22] for the CEPR that is shown, e.g., full versus incremental
- The measure's average CEPR when applied to existing dwellings and to new dwellings.

Measures analyzed on the basis of full cost have been placed towards the top of Exhibit 25 because they are qualitatively different from the measures that pass only on an incremental basis. A measure that passes on a full-cost basis can be applied immediately, even if the piece of equipment it replaces or improves is currently working properly. That means the rate at which the measure can be implemented as a utility CDM measure is limited only by market and program constraints. A measure that passes only on an incremental basis, on the other hand, is limited by the rate of natural replacement (due to failure or obsolescence) or purchase of the piece of equipment it replaces. A measure that passes on a full-cost basis in some dwelling types and on an incremental cost basis in others is shown as "Full/Incr."

[22] See Step 4 in Section 7.2 for a fuller description.

Exhibit 25 Residential Sector Demand Reduction Technology Measures, Screening Results[23]

Measure Name	Island			Labrador			Isolated		
	Basis (Full/ Incremental)	Average CEPR ($/kW)		Basis (Full/ Incremental)	Average CEPR ($/kW)		Basis (Full/ Incremental)	Average CEPR ($/kW)	
		Existing Homes	New Homes		Existing Homes	New Homes		Existing Homes	New Homes
Timer/Thermostat for Block Heaters (Demand)	Incr.	N/A	N/A	Full	0.01	0.01	Incr.	N/A	N/A
Timers for Car Warmers (Demand)	Incr.	N/A	N/A	Full	0.00	0.00	Incr.	N/A	N/A
Three-Element Water Heater (Demand)	Incr.	87.38	87.26	Incr.	88.21	90.32	Incr.	89.48	91.18
Electric DHW Cycling (Demand)	Full	41.79	41.74	Full	42.19	43.20	Full	42.80	43.61
Dual Fuel Heat Cycling (Demand)	Full	10.60	11.27	Full	10.76	12.30	Full	11.39	12.24
Sole-Electric Heat Cycling (Demand)	Full	36.61	39.93	Full	38.39	44.27	Full	41.00	44.05
Air-Source Heat Pump Cycling (Demand)	Full	36.61	39.93	Full	38.39	44.27	Full	41.00	44.05
Electric Thermal Storage (Baseboard Heating, Demand)	Incr.	253.55	268.72	Incr.	266.25	301.54	Incr.	298.48	320.71
Electric Thermal Storage (Central Heating, Demand)	Incr.	404.74	429.21	Incr.	425.93	482.77	Incr.	460.36	494.58

[23] Average CEPR does not include program costs.

7.5 Energy Efficiency Supply Curve

This sub-section includes energy efficiency supply curves for each of the three regions studied. It is important to present the supply curves for each region separately, because the avoided costs are different. The supply curves presented are for the year 2029, but the Data Manager can be used to generate supply curves for the other years. Each supply curve shows the avoided cost for that region as a horizontal line, with dashed lines showing the upper and lower edge of the range of reasonableness.

The supply curves were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 23. The following approach was used:

- Measures were introduced in sequence
- Where more than one measure affected the same end use, the savings shown for the second measure are incremental to those already shown for the first
- Sequence was determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It included consideration of CCE results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CCE, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in six exhibits:

- Exhibit 26 presents the potential by measure for the Island Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 27 the supply curve for the Island Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 26.
- Exhibit 28 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 29 presents the supply curve for the Labrador Interconnected region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 28.
- Exhibit 30 presents the potential by measure for the Isolated region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 31 presents the supply curve for the Isolated region. A few of the larger measures are numbered as landmarks. The numbers match those in Exhibit 30.

Exhibit 26 Island Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	Refrigerator Retirement	59,731	59,731	$0.00
2	Min Hot Wash	57,241	116,973	$0.00
3	DHW Temperature	24,438	141,411	$0.00
4	Overnight Setback	19,491	160,902	$0.00
5	Close Blinds	12,812	173,714	$0.00
6	Daytime Setback	11,687	185,401	$0.00
7	Weather Stripping Maintenance	7,243	192,644	$0.00
8	Refrigerator Temperature	3,414	196,058	$0.00
9	Turn Off TVs	2,381	198,440	$0.00
10	Unplug Chargers	2,292	200,732	$0.00
11	Clothes Dryer Sensor	2,058	202,790	$0.00

Exhibit 26 Continued: Island Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
12	PC Power Management	1,529	204,319	$0.00
13	Min Outdoor Lighting	1,519	205,838	$0.00
14	Freezer Temperature	1,374	207,211	$0.00
15	AC Temperature	488	207,699	$0.00
16	Turn Off Lights	100	207,799	$0.00
17	Clothes Lines	100,472	308,271	$0.00
18	Faucet Aerator	9,719	317,990	$0.01
19	Showerheads	27,358	345,348	$0.01
20	DHW Pipe Insulation	3,222	348,570	$0.01
21	Prog. Thermostats (Central)	1	348,571	$0.02
22	T8 Fixtures	54	348,625	$0.02
23	Benchmarking	7,019	355,644	$0.03
24	Hot Tub Covers	13,095	368,739	$0.03
25	Door Systems	29,714	398,453	$0.03
26	LED Lamps	8,252	406,704	$0.04
27	Crawl Space Insulation	152,664	559,368	$0.04
28	Motion Detectors - Outdoor	4,760	564,128	$0.04
29	ECPM Fan Motors	22,683	586,811	$0.05
30	ESTAR Freezers	3,128	589,939	$0.06
31	Power Bars (TVs)	36,464	626,402	$0.06
32	Faucets	24,609	651,011	$0.06
33	ESTAR Computers	5,119	656,130	$0.07
34	Basement Insulation	173,942	830,072	$0.07
35	Efficient Clothes Washers	35,767	865,839	$0.07
36	Electronic Thermostats	5,000	870,838	$0.07
37	Power Bars (PCs)	46,238	917,076	$0.07
38	Attic Insulation	43,918	960,995	$0.08
39	ESTAR TVs	85,572	1,046,566	$0.08
40	ESTAR Dehumidifiers	5,108	1,051,674	$0.08
41	Prog. Thermostats	1,814	1,053,487	$0.09
42	Mini-Splits	366,379	1,419,866	$0.09
43	Timers - Outdoor	3,226	1,423,092	$0.11
44	DHW Tank Insulation	5,052	1,428,144	$0.11
45	Sealing & Insul. - Old Homes	96,237	1,524,381	$0.13
46	Super Efficient Clothes Washers	14,768	1,539,149	$0.13
47	Air Sealing	21,000	1,560,149	$0.13
48	ESTAR Windows	11,128	1,571,277	$0.14
49	ESTAR Dishwashers	3,038	1,574,315	$0.14
50	Super Efficient Freezers	8,802	1,583,116	$0.14
51	Air-Source Heat Pump	25,073	1,608,190	$0.17
52	Cold Climate Heat Pump	10,350	1,618,540	$0.18
53	High-Perf. New Homes	44,911	1,663,451	$0.19
54	Air-to-Water Heat Pumps	57,615	1,721,066	$0.20
55	Professional Air Sealing	30,687	1,751,754	$0.22
56	Super Efficient Refrigerators	17,429	1,769,183	$0.24
57	Super Windows	25,144	1,794,327	$0.26
58	Motion Detectors - Indoor	1,594	1,795,920	$0.26
59	LEED Apartments	3,109	1,799,030	$0.31

Exhibit 26 Continued: Island Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
60	HRVs	4,764	1,803,794	$0.33
61	Efficient Refrigerators	5,170	1,808,963	$0.40
62	Wall Insulation	124,481	1,933,445	$0.60
63	Convection Ovens	10,034	1,943,479	$0.86
64	Heat Pump Clothes Dryers	54,018	1,997,497	$0.88
65	Net Zero Homes	19,596	2,017,094	$1.00
66	Induction Cooktops	5,169	2,022,263	$4.21

Exhibit 27 Island Interconnected Energy Efficiency Supply Curve

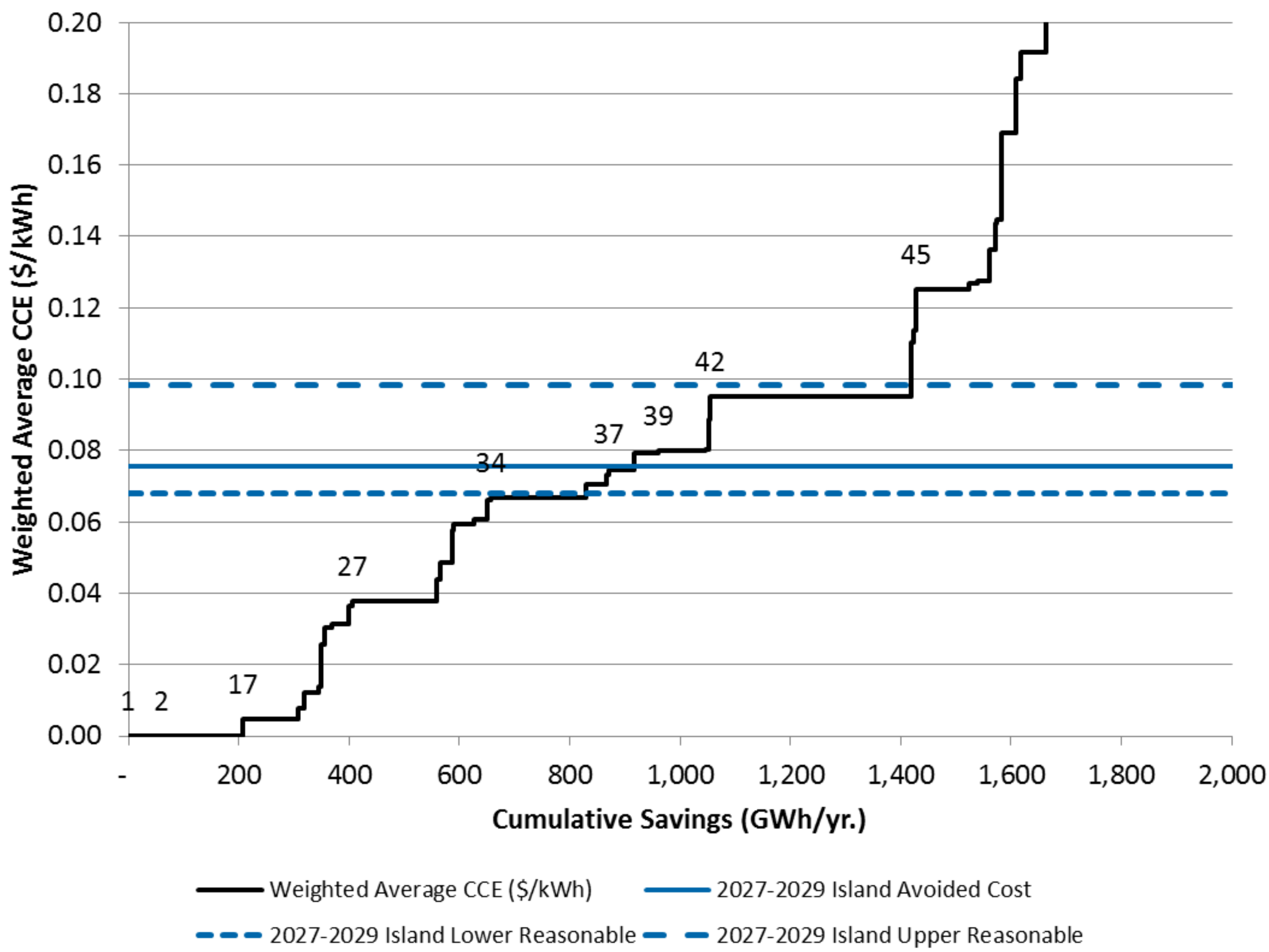


Exhibit 28 Labrador Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	Min Hot Wash	2,854	2,854	$0.00
2	Refrigerator Retirement	2,797	5,651	$0.00
3	Overnight Setback	1,633	7,284	$0.00
4	DHW Temperature	1,218	8,502	$0.00
5	Daytime Setback	955	9,457	$0.00
6	Close Blinds	951	10,408	$0.00
7	Weather Stripping Maintenance	657	11,066	$0.00
8	Refrigerator Temperature	161	11,227	$0.00
9	Turn Off TVs	103	11,330	$0.00
10	Unplug Chargers	91	11,421	$0.00
11	Clothes Dryer Sensor	86	11,506	$0.00
12	Freezer Temperature	70	11,577	$0.00
13	PC Power Management	66	11,643	$0.00
14	Min Outdoor Lighting	64	11,707	$0.00
15	Turn Off Lights	4	11,712	$0.00
16	Clothes Lines	4,170	15,882	$0.00
17	Faucet Aerator	478	16,360	$0.01
18	Car Warmer Timers	240	16,600	$0.01
19	Faucets	939	17,539	$0.01
20	Showerheads	1,345	18,885	$0.01
21	DHW Pipe Insulation	158	19,043	$0.01
22	Prog. Thermostats (Central)	0	19,043	$0.02
23	Benchmarking	338	19,381	$0.02
24	T8 Fixtures	2	19,384	$0.02
25	Power Bars (TVs)	1,566	20,950	$0.03
26	Hot Tub Covers	1,154	22,104	$0.03
27	LED Lamps	370	22,474	$0.04
28	Motion Detectors - Outdoor	195	22,669	$0.04
29	Door Systems	2,914	25,584	$0.04
30	Power Bars (PCs)	2,009	27,593	$0.04
31	Basement Insulation	31,707	59,299	$0.05
32	Crawl Space Insulation	14,604	73,903	$0.05
33	ESTAR Freezers	160	74,063	$0.06
34	Block Heater Timers	339	74,402	$0.06
35	Prog. Thermostats	173	74,575	$0.06
36	Electronic Thermostats	624	75,199	$0.07
37	ESTAR Computers	222	75,422	$0.07
38	ECPM Fan Motors	380	75,801	$0.07
39	Efficient Clothes Washers	1,565	77,367	$0.07
40	ESTAR Dehumidifiers	173	77,540	$0.07
41	Attic Insulation	6,380	83,920	$0.07
42	ESTAR TVs	3,699	87,620	$0.08
43	Mini-Splits	46,137	133,757	$0.08
44	DHW Tank Insulation	248	134,005	$0.11
45	Timers - Outdoor	145	134,150	$0.11
46	Super Efficient Clothes	654	134,804	$0.12

Exhibit 28 Continued: Labrador Interconnected Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
	Washers			
47	ESTAR Dishwashers	148	134,952	$0.14
48	Super Efficient Freezers	450	135,401	$0.14
49	Air-Source Heat Pump	1,964	137,366	$0.16
50	Cold Climate Heat Pump	787	138,153	$0.17
51	Sealing & Insul. - Old Homes	9,594	147,747	$0.19
52	Air-to-Water Heat Pumps	3,836	151,583	$0.20
53	High-Perf. New Homes	3,753	155,336	$0.20
54	Air Sealing	1,728	157,064	$0.22
55	Super Efficient Refrigerators	821	157,885	$0.24
56	Super Windows	4,869	162,753	$0.24
57	Motion Detectors - Indoor	72	162,825	$0.26
58	LEED Apartments	132	162,957	$0.31
59	ESTAR Windows	607	163,563	$0.31
60	HRVs	303	163,867	$0.35
61	Efficient Refrigerators	243	164,110	$0.40
62	Professional Air Sealing	1,947	166,057	$0.47
63	Battery Blanket Timers	31	166,088	$0.59
64	Wall Insulation	15,658	181,746	$0.62
65	Heat Pump Clothes Dryers	2,254	184,001	$0.81
66	Convection Ovens	442	184,443	$0.82
67	Net Zero Homes	3,189	187,632	$0.92
68	Induction Cooktops	228	187,860	$4.05

Exhibit 29 Labrador Interconnected Energy Efficiency Supply Curve

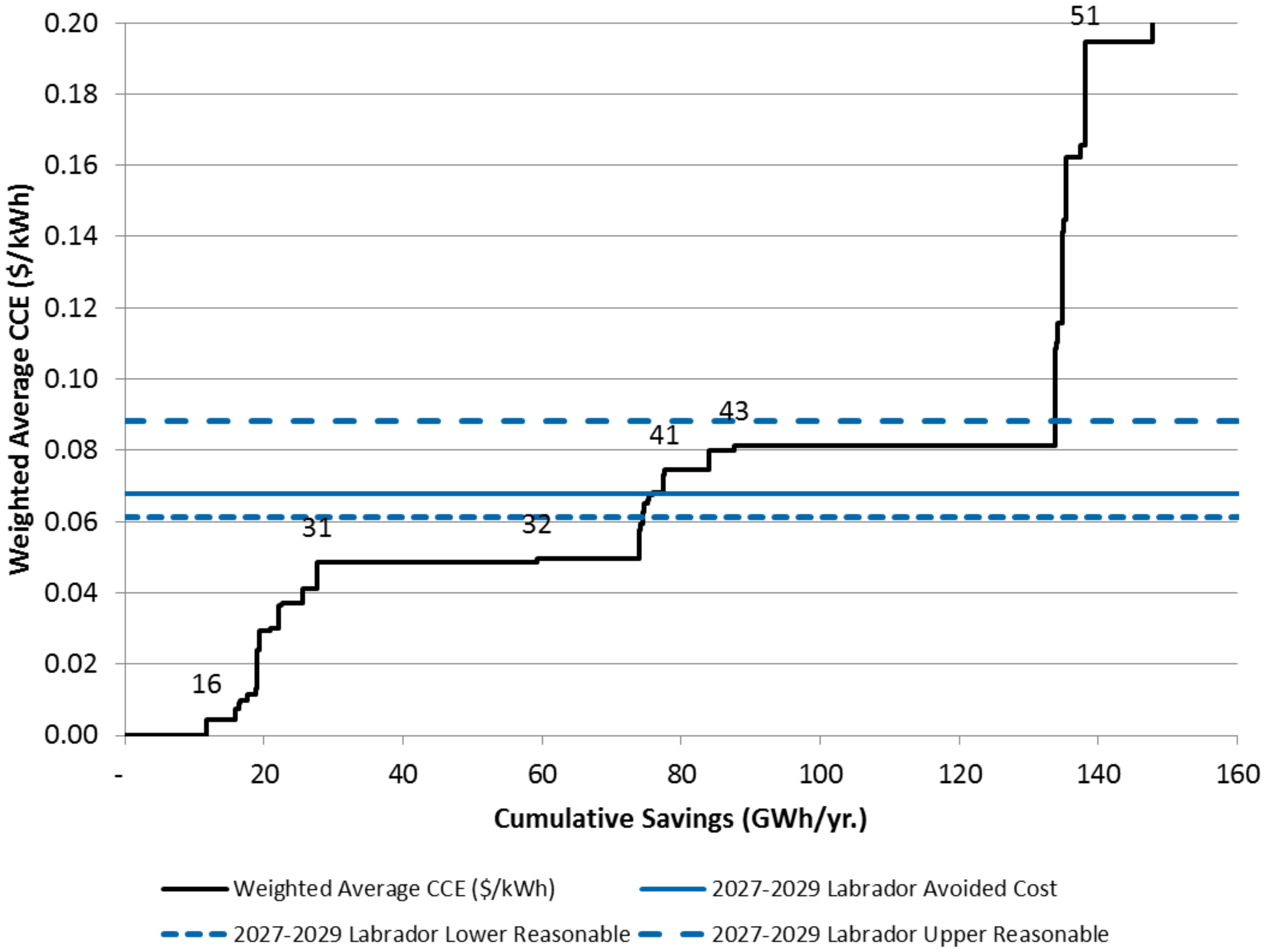


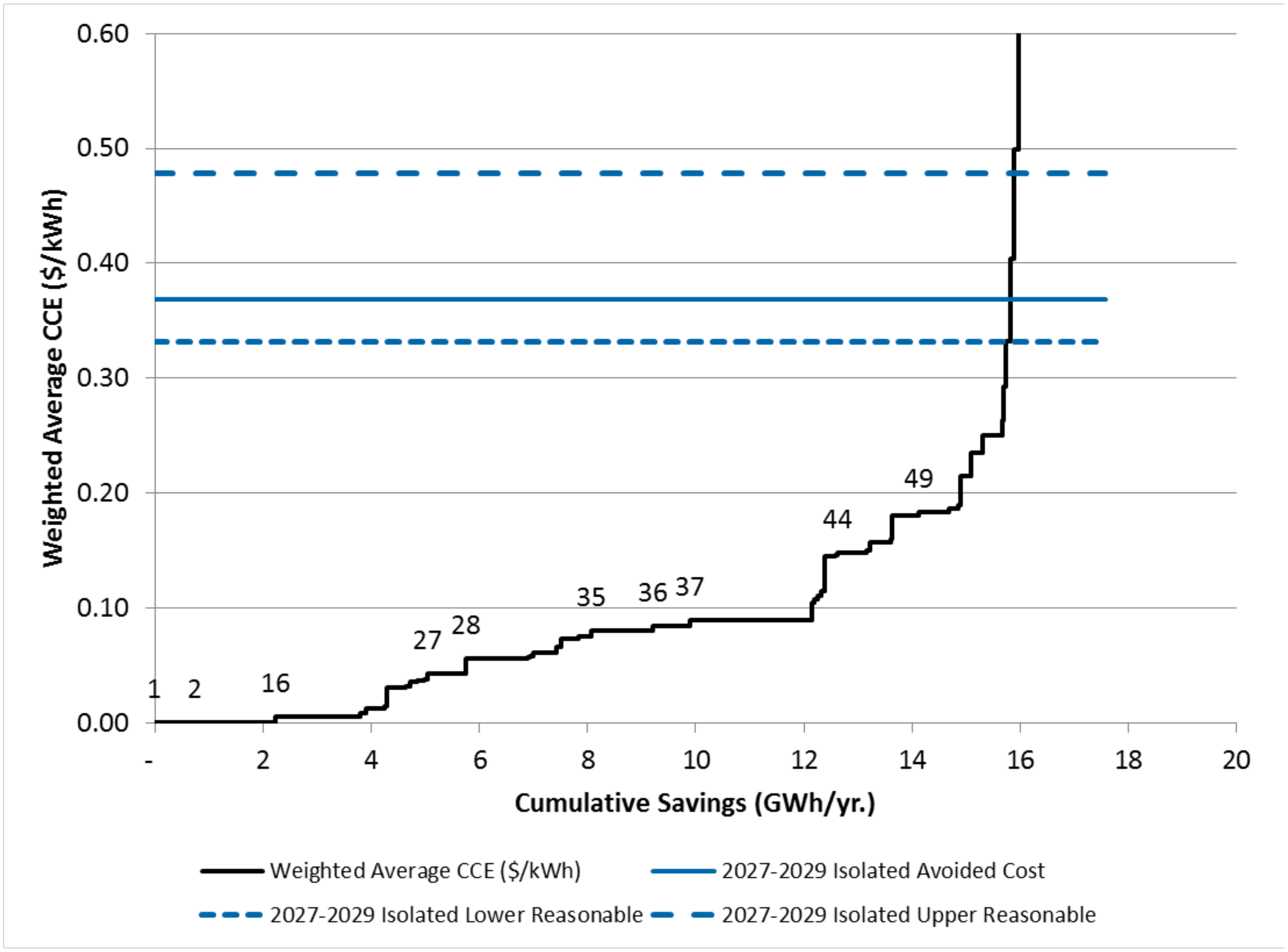
Exhibit 30 Isolated Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
1	Min Hot Wash	740	740	$0.00
2	Refrigerator Retirement	738	1,479	$0.00
3	DHW Temperature	316	1,795	$0.00
4	Overnight Setback	98	1,893	$0.00
5	Daytime Setback	58	1,952	$0.00
6	Close Blinds	58	2,010	$0.00
7	Refrigerator Temperature	38	2,048	$0.00
8	Turn Off TVs	33	2,081	$0.00
9	Unplug Chargers	33	2,114	$0.00
10	Freezer Temperature	32	2,146	$0.00
11	Clothes Dryer Sensor	29	2,175	$0.00
12	PC Power Management	23	2,198	$0.00
13	Min Outdoor Lighting	20	2,219	$0.00
14	Weather Stripping Maintenance	17	2,236	$0.00
15	Turn Off Lights	2	2,237	$0.00
16	Clothes Lines	1,557	3,794	$0.00
17	Faucet Aerator	122	3,916	$0.01
18	Showerheads	343	4,259	$0.01
19	DHW Pipe Insulation	40	4,299	$0.01
20	T8 Fixtures	1	4,300	$0.02
21	Hot Tub Covers	332	4,632	$0.03
22	Benchmarking	99	4,731	$0.03
23	Prog. Thermostats (Central)	0	4,731	$0.03
24	Door Systems	123	4,854	$0.04
25	LED Lamps	129	4,983	$0.04
26	Motion Detectors - Outdoor	64	5,047	$0.04
27	Crawl Space Insulation	712	5,758	$0.04
28	Basement Insulation	1,133	6,892	$0.06
29	ESTAR Dehumidifiers	38	6,930	$0.06
30	ESTAR Freezers	73	7,004	$0.06
31	Power Bars (TVs)	430	7,433	$0.06
32	ESTAR Computers	77	7,511	$0.07
33	Faucets	319	7,829	$0.07
34	Attic Insulation	242	8,072	$0.08
35	ESTAR TVs	1,133	9,204	$0.08
36	Power Bars (PCs)	698	9,902	$0.08
37	Mini-Splits	2,256	12,159	$0.09
38	Electronic Thermostats	45	12,203	$0.10
39	Cold Climate Heat Pump	63	12,267	$0.11
40	Timers - Outdoor	50	12,317	$0.11
41	DHW Tank Insulation	63	12,381	$0.11
42	Super Efficient Freezers	206	12,587	$0.14
43	ESTAR Dishwashers	37	12,623	$0.15
44	ECPM Fan Motors	527	13,151	$0.15
45	Air Sealing	82	13,233	$0.15
46	Sealing & Insul. - Old Homes	387	13,620	$0.16

Exhibit 30 Continued: Isolated Measure Potential and CCE

Ref #	Measure Name	Savings (MWh/yr.)	Cumulative Savings (MWh/yr.)	CCE ($/kWh)
47	Prog. Thermostats	13	13,633	$0.16
48	Efficient Clothes Washers	487	14,120	$0.18
49	High-Perf. New Homes	572	14,693	$0.18
50	Air-Source Heat Pump	169	14,862	$0.19
51	ESTAR Windows	38	14,899	$0.19
52	Super Efficient Clothes Washers	199	15,099	$0.22
53	Super Efficient Refrigerators	201	15,299	$0.24
54	Air-to-Water Heat Pumps	372	15,671	$0.25
55	Motion Detectors - Indoor	25	15,696	$0.26
56	HRVs	43	15,739	$0.29
57	Professional Air Sealing	81	15,820	$0.33
58	Efficient Refrigerators	60	15,879	$0.40
59	Super Windows	94	15,974	$0.50
60	Wall Insulation	623	16,597	$0.63
61	Heat Pump Clothes Dryers	755	17,352	$0.87
62	Convection Ovens	137	17,489	$0.88
63	Net Zero Homes	12	17,501	$1.06
64	Induction Cooktops	71	17,572	$4.35

Exhibit 31 Isolated Energy Efficiency Supply Curve



7.6 Demand Reduction Supply Curve

This sub-section includes demand reduction supply curves for each of the three regions studied. It is important to present the supply curves for each region separately, because the avoided costs are different. The supply curves presented are for the year 2029, but the Data Manager can be used to generate supply curves for the other years. Each supply curve shows the avoided cost for that region as a horizontal line, with dashed lines showing the upper and lower edge of the range of reasonableness.

The supply curves were constructed based on the approximate Technical Potential savings associated with the measures listed in Exhibit 24. The following approach was used:

- Measures were introduced in sequence
- Where more than one measure affected the same end use, the reduction shown for the second measure are incremental to those already shown for the first
- Sequence was determined by listing first the items that reduce the electrical load, then those that meet residual load with the most efficient technology. It included consideration of CEPR results from the preceding exhibit, but not for the purposes of economic screening.
- Items appear in order, starting with the lowest average CEPR, but do not stop at the avoided cost threshold. Hence, the supply curve presents a type of Technical Potential scenario.

The results are presented in six exhibits:

- Exhibit 32 presents the potential by measure for the Island Interconnected region. The columns provide the reduction for the measure, cumulative reduction, and CEPR, with measures sorted and numbered in order of increasing CEPR.
- Exhibit 33 presents the supply curve for the Island Interconnected region. The numbers match those in Exhibit 32.
- Exhibit 34 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 35 presents the supply curve for the Labrador Interconnected region. The numbers match those in Exhibit 34.
- Exhibit 36 presents the potential by measure for the Labrador Interconnected region. The columns provide the savings for the measure, cumulative savings, and CCE, with measures sorted and numbered in order of increasing CCE.
- Exhibit 37 presents the supply curve for the Isolated region. The numbers match those in Exhibit 36.

Exhibit 32 Island Interconnected Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Dual Fuel Heat Cycling	71	71	$10.84
2	Heat Pump Cycling	8	78	$26.95
3	Electric Heat Cycling	171	250	$33.63
4	DHW Cycling	154	403	$42.72
5	3-Element DHW	29	432	$89.31
6	Thermal Storage (Baseboard)	259	691	$217.22
7	Thermal Storage (Central)	14	706	$329.78

Exhibit 33 Island Interconnected Demand Reduction Supply Curve

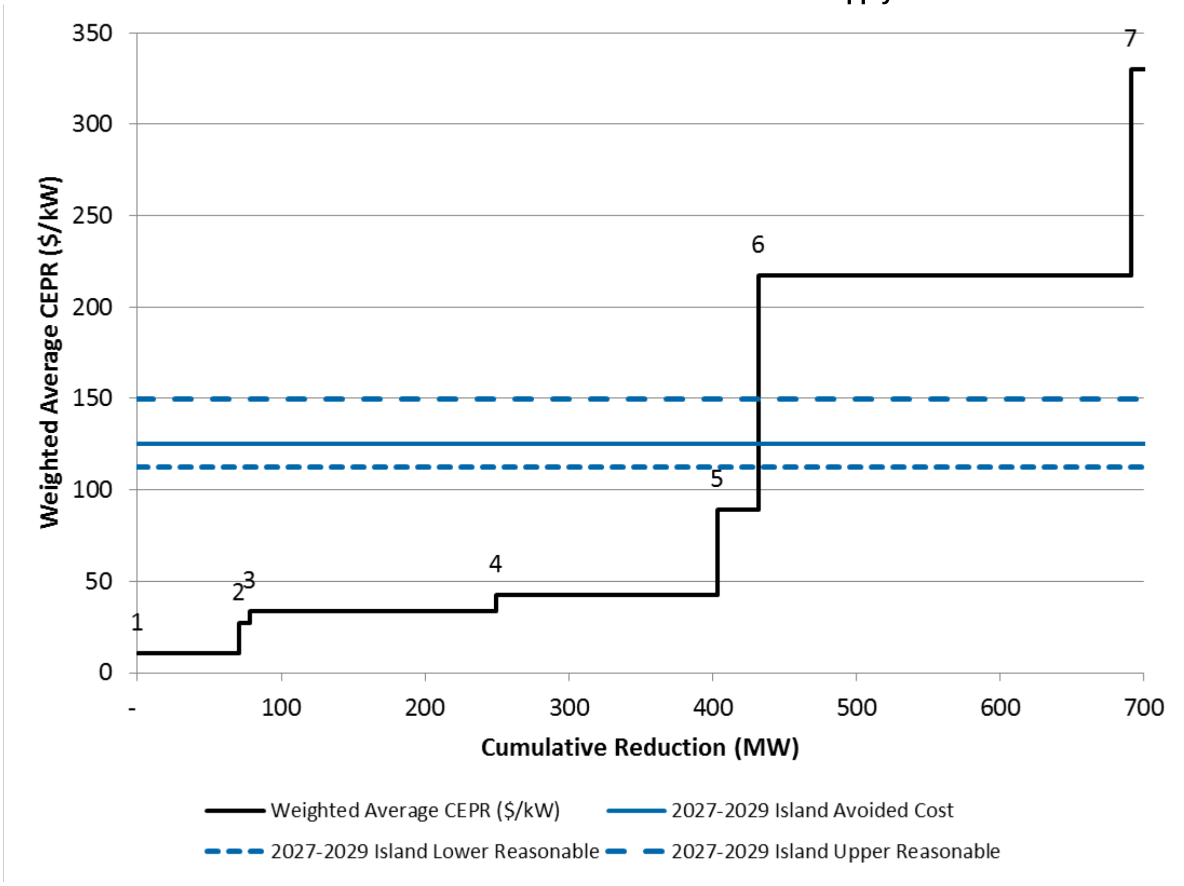


Exhibit 34 Labrador Interconnected Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Car Warmer Demand	0	0	$0.00
2	Block Heater Demand	0	1	$0.01
3	Dual Fuel Heat Cycling	2	3	$12.05
4	Heat Pump Cycling	0	4	$27.16
5	Electric Heat Cycling	17	21	$32.47
6	DHW Cycling	8	28	$40.83
7	3-Element DHW	1	30	$85.36
8	Thermal Storage (Baseboard)	28	57	$222.67
9	Thermal Storage (Central)	1	58	$338.03

Exhibit 35 Labrador Interconnected Demand Reduction Supply Curve

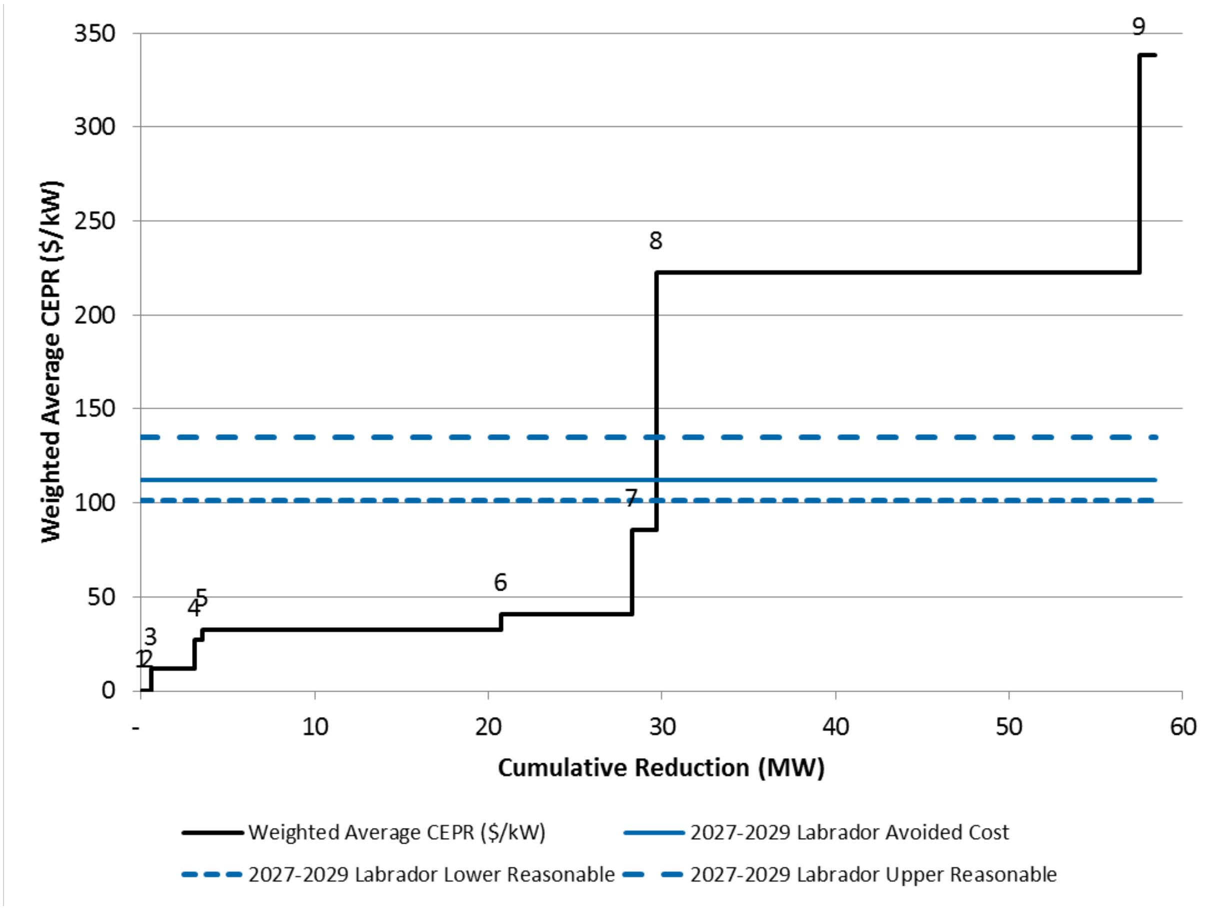
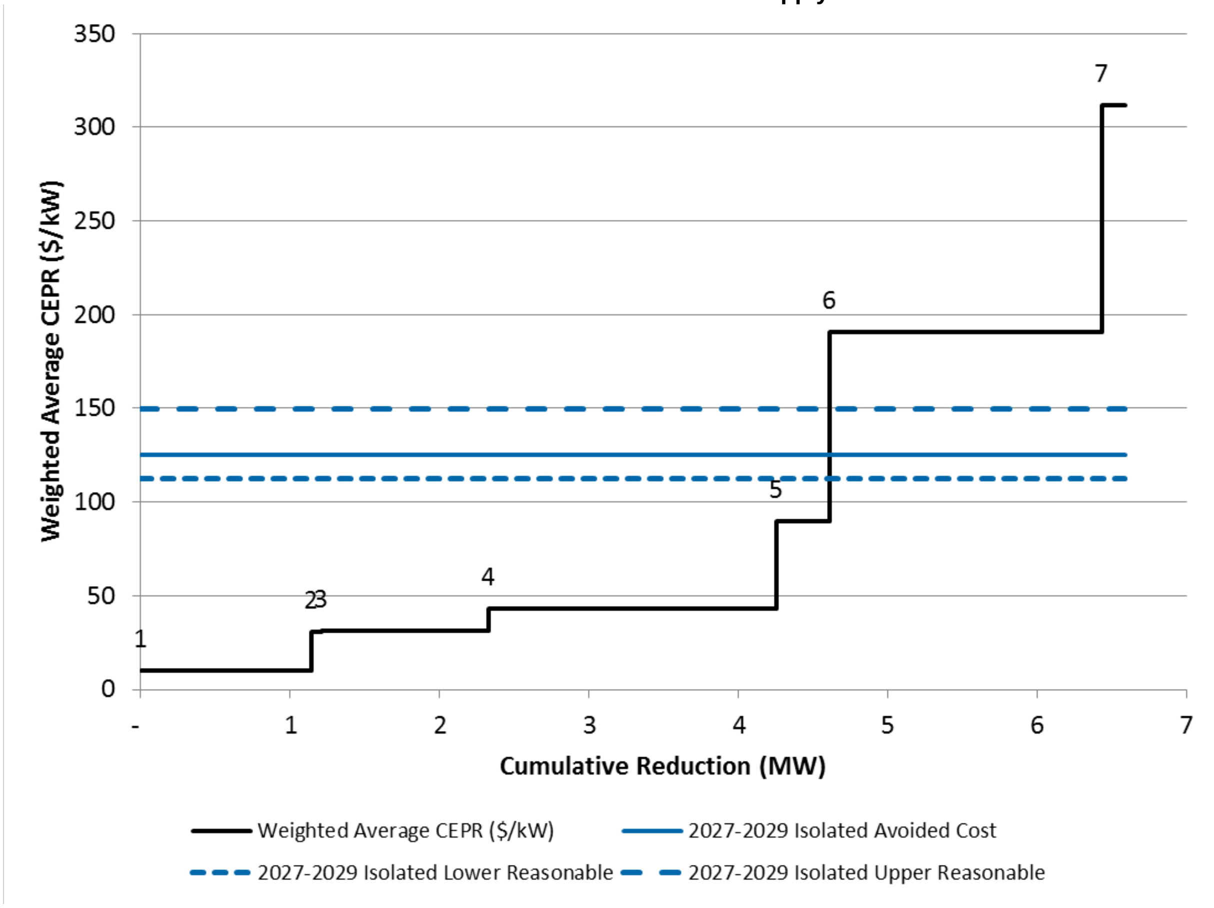


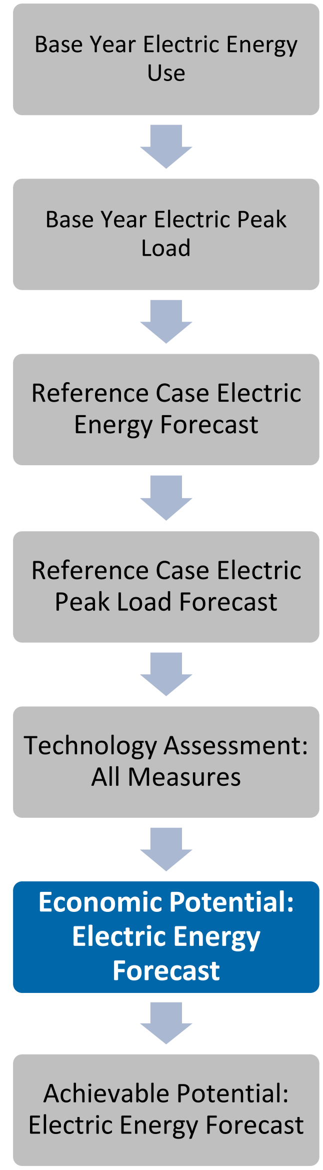
Exhibit 36 Isolated Measure Potential and CEPR

Ref #	Measure Name	Demand Reduction (MW)	Cumulative Reduction (MW)	CEPR ($/kW)
1	Dual Fuel Heat Cycling	1	1	$9.75
2	Heat Pump Cycling	0	1	$30.64
3	Electric Heat Cycling	1	2	$31.01
4	DHW Cycling	2	4	$42.92
5	3-Element DHW	0	5	$89.74
6	Thermal Storage (Baseboard)	2	6	$190.40
7	Thermal Storage (Central)	0	7	$311.83

Exhibit 37 Isolated Demand Reduction Supply Curve



8 Economic Potential: Electric Energy and Demand Forecast



8.1 Introduction

This section presents the Residential sector Economic Potential Forecast for electric energy and demand for the study period 2014 to 2029. The Economic Potential Electric Energy Forecast estimates the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold values for electricity in the three regions in NL. The model also estimates the peak demand implications of applying all the cost-effective efficiency measures. Starting from that point, the Economic Potential Peak Demand Forecast estimates the level of peak demand that would occur if all cost-effective demand reduction measures were also applied.

In this study, “cost effective” means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) or the cost of electricity peak reduction (CEPR) in the preceding section, is equal to or less than the economic threshold value for a given region. The CCE and CEPR used in this study are *measure CCE* and *measure CEPR* values, as distinct from *program CCE* and *program CEPR*. Measure CCE and CEPR values do not include the non-incentive costs of running a program, such as administration or promotion.[24] Technologies that are very close to the margin when the measure CCE or CEPR is compared to avoided costs may not make economic sense for the Utilities once program costs are added.

The discussion in this section covers the following:

- Avoided costs used for screening
- Major modelling tasks
- Technologies included in Economic Potential Forecast
- Presentation of energy efficiency results
- Interpretation of energy efficiency results
- Summary of peak load reductions from energy efficiency
- Presentation of load reduction results
- Interpretation of load reduction results
- Range of reasonableness.

8.2 Avoided Costs Used For Screening

The Utilities agreed on a set of economic threshold values for electricity supply to be used in this study. The values vary by region and milestone year as shown in Exhibit 38. Each of the values for the years after 2014 represents the average of the three years in the milestone period.

[24] Incentives do not change the CCE or CEPR calculation, because they change only who pays the cost of the measure, not the overall cost.

Exhibit 38 Avoided Costs of Added Electricity Supply

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.108	$0.037	$0.21
2017	$0.125	$0.039	$0.23
2020	$0.050	$0.045	$0.26
2023	$0.059	$0.053	$0.29
2026	$0.068	$0.061	$0.34
2029	$0.076	$0.068	$0.37

The Economic Potential Electric Energy Forecast then incorporates all the electric energy-efficient upgrades that the technology assessment found to have a CCE equal to or less than these thresholds.

The Utilities also agreed on a set of economic threshold values for new generation capacity to be used in this study. These values also vary by region and milestone year as shown in Exhibit 39. Again, each value for the years after 2014 represents an average of the three years in the milestone period. The cost of new capacity for the Isolated region was not available. For the purposes of the study, the higher of the two values for the other two regions was used in each milestone year.

Exhibit 39 Avoided Costs of New Electric Generation Capacity

Year	Avoided Cost per kW		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$50.911	$72.059	
2017	$65.116	$82.527	
2020	$101.821	$91.601	
2023	$115.126	$103.571	
2026	$124.930	$112.390	
2029	$124.907	$112.370	

The Economic Potential Peak Demand Forecast then incorporates all the demand reduction upgrades that the technology assessment found to have a CEPR equal to or less than these thresholds.

The Utilities also provided a range of reasonableness for all of these avoided costs. The lower range for new electricity supply is considered to be 10% below the costs per kWh shown in Exhibit 38 while the upper range is considered to be 30% above those values. The upper range for new electric generation capacity supply is considered to be 10% below the costs per kW shown in Exhibit 39 while the upper range is considered to be 20% above those values. The purpose for establishing the range of reasonableness is to show the sensitivity of the results to varying avoided cost scenarios and to improve the ability of planners to examine options that may become more cost effective over time.

Emerging end-use technology measures are becoming cheaper over time as these markets become more cost effective. This is apparent by examining a range of measures that have become very low cost (e.g., CFLs reduced by a factor of 5-10x since introduction; the same applies to more efficient motors, light sources and appliances). Including these apparently more costly measures in this study allows the review of these measures in the near future, as programs are effective in introducing more competitiveness within these markets. At the same time, new sources of supply are expected to come online during the study period, so it is important to explore the implications of lower avoided costs.

8.3 Major Modelling Tasks

By comparing the results of the Residential sector Economic Potential Electric Energy and Peak Demand Forecasts with the Reference Case, it is possible to determine the aggregate level of potential electricity savings and demand reductions within the Residential sector, as well as identify which specific building sub-sectors and end uses provide the most significant opportunities for savings.

To develop the Residential sector Economic Potential Electric Energy Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibit 23 were reviewed, using the 7% (real) discount rate.
- Technology upgrades that had a CCE equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CCE that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Electricity use within each of the building sub-sectors was modelled with the same energy models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.
- When more than one upgrade option was applied to a given end use, the first measure selected was the one that reduced the electrical load. For example, measures to reduce the overall space heating load (e.g., attic insulation and more efficient windows) were applied before a heat pump.

To develop the Residential sector Economic Potential Peak Demand Forecast, the following tasks were completed:

- The Economic Potential Electric Energy Forecast was used to generate the reductions in peak demand associated with efficiency improvements. These reductions were applied to the demand Reference Case to generate a Post-Efficiency Case to serve as the starting point for the demand reduction model. This was intended to avoid any double counting of demand reductions.
- The CEPR for each of the load reduction upgrades presented in Exhibit 24 were reviewed, using the 7% (real) discount rate.
- Technology upgrades that had a CEPR equal to, or less than, the threshold values for each region and milestone year were selected for inclusion in the Economic Potential scenario, either on a full-cost or incremental basis. It is assumed that technical upgrades having a full-cost CEPR that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an incremental basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Peak demand within each of the building sub-sectors was modelled with the same demand models that were used to generate the Reference Case. However, for this forecast, the remaining baseline technologies included in the Reference Case forecast were replaced with the most efficient technology upgrade option and associated performance efficiency that met the cost thresholds for each region and milestone period.

8.4 Technologies Included in Economic Potential Forecast

Exhibit 40 provides a listing of the efficiency technologies included in this forecast. Exhibit 41 provides a listing of the demand reduction technologies selected for included in this forecast. In each case, the exhibits show the following:

- End use affected
- Upgrade option(s) selected
- Dwelling types to which the upgrade options were applied
- Rate at which the upgrade options were introduced into the stock.

Some of the technologies listed in the exhibits below are the subject of current utility programs in the province of NL. The load forecast provided by the Utilities assumed a modest level of continued program activity and continued savings from efficiency improvements made under past programs, but no new program activity. The reference case for this project was constructed to be consistent with that forecast, in that the penetrations of the energy technologies below were not all assumed to remain static at their current levels. Reference case penetrations were assumed to increase, to account for natural adoption and the modest level of program activity assumed in the reference case.

In most cases, current programs are unlikely to capture all the economic potential for the technologies over the next 15 years. Therefore, none of the technologies have actually been removed from consideration in the study. Nonetheless, there are cases where the reference case penetration “catches up” to the economic penetration, and the economic potential diminishes, as can be seen later in this chapter in Exhibit 44. Note the potential for efficient clothes washers, for example. For this measure, economic potential rises in the first milestone and then levels off (because the avoided cost of electricity is expected to decrease in the Island Interconnected region, and the measure fails the economic screen for the middle two milestone periods of the study). During this period when the economic potential levels off, the continuing adoption assumed in the reference case catches up to the economic penetration, and the potential decreases.

Exhibit 40 Efficiency Technologies Included in Economic Potential Forecast

End Use Category	Upgrade Option	Applicability	Rate of Introduction
HVAC Equipment	Air-Source Heat Pump	Electrically heated SFD	At natural rate of replacement
	Cold Climate Heat Pump	Electrically heated SFD	At natural rate of replacement
	ECPM Fan Motors	Forced-air homes	At natural rate of replacement
	Electronic Thermostats	Baseboard heated homes	Immediate
	Mini-Splits	Baseboard heated homes	At natural rate of replacement/Immediate in some house types
	Prog. Thermostats	Baseboard heated homes	Immediate
	Prog. Thermostats (Central)	Centrally-heated homes	Immediate
Building Envelope	Air Sealing	Existing homes	Immediate
	Attic Insulation	Existing homes	Immediate
	Basement Insulation	Existing homes	Immediate
	Crawl Space Insulation	Existing homes	Immediate
	Door Systems	Existing homes	At natural rate of replacement/Immediate in some house types
	ESTAR Windows	Existing homes	At natural rate of replacement
	Sealing & Insul. - Old (pre-1980) homes	Older existing homes	Immediate
	Weather Stripping Maintenance	Existing homes	Immediate
New Construction	High-Perf. New Homes	New homes	As new homes are built
Appliances	Clothes Dryer Sensor	All	At natural rate of replacement
	Efficient Clothes Washers	All	At natural rate of replacement
	ESTAR Dehumidifiers	Homes with dehumidifiers	At natural rate of replacement
	ESTAR Dishwashers	All	At natural rate of replacement
	ESTAR Freezers	All	At natural rate of replacement
	Super Efficient Clothes Washers	All	At natural rate of replacement
	Super Efficient Freezers	All	At natural rate of replacement
DHW	DHW Pipe Insulation	Homes with electric DHW	Immediate
	DHW Tank Insulation	Homes with electric DHW	Immediate
	Faucet Aerator	Homes with electric DHW	Immediate

Exhibit 40 Continued: Efficiency Technologies Included in Economic Potential Forecast

End Use Category	Upgrade Option	Applicability	Rate of Introduction
	Faucets	Homes with electric DHW	Immediate
	Showerheads	Homes with electric DHW	Immediate
Lighting	LED Lamps	All	Immediate
	Motion Detectors - Outdoor	All homes with exterior lighting	Immediate
	T8 Fixtures	The few fluorescent strip fixtures in homes	At natural rate of replacement
	Timers - Outdoor	All homes with exterior lighting	Immediate
Electronics	ESTAR Computers	All	At natural rate of replacement
	ESTAR TVs	All	At natural rate of replacement
	Power Bars (PCs)	All	Immediate
	Power Bars (TVs)	All	Immediate
Other	Block Heater Timers	Labrador only	Immediate
	Car Warmer Timers	Labrador only	Immediate
	Hot Tub Covers	All homes with hot tubs	Immediate
Behaviour	AC Temperature	Homes with heat pump systems	Immediate
	Benchmarking	All	Immediate
	Close Blinds	All	Immediate
	Clothes Lines	All homes with outside areas	Immediate
	Daytime Setback	Electrically heated homes	Immediate
	DHW Temperature	Homes with electric DHW	Immediate
	Freezer Temperature	All	Immediate
	Min Hot Wash	All	Immediate
	Min Outdoor Lighting	All homes with exterior lighting	Immediate
	Overnight Setback	Electrically heated homes	Immediate
	PC Power Management	All	Immediate
	Refrigerator Retirement	Homes with a second refrigerator	Immediate
	Refrigerator Temperature	All	Immediate
	Turn Off Lights	All	Immediate
	Turn Off TVs	All	Immediate

Exhibit 40 Continued: Efficiency Technologies Included in Economic Potential Forecast

End Use Category	Upgrade Option	Applicability	Rate of Introduction
	Unplug Chargers	All	Immediate

Exhibit 41 Load Reduction Technologies Included in Economic Potential Forecast

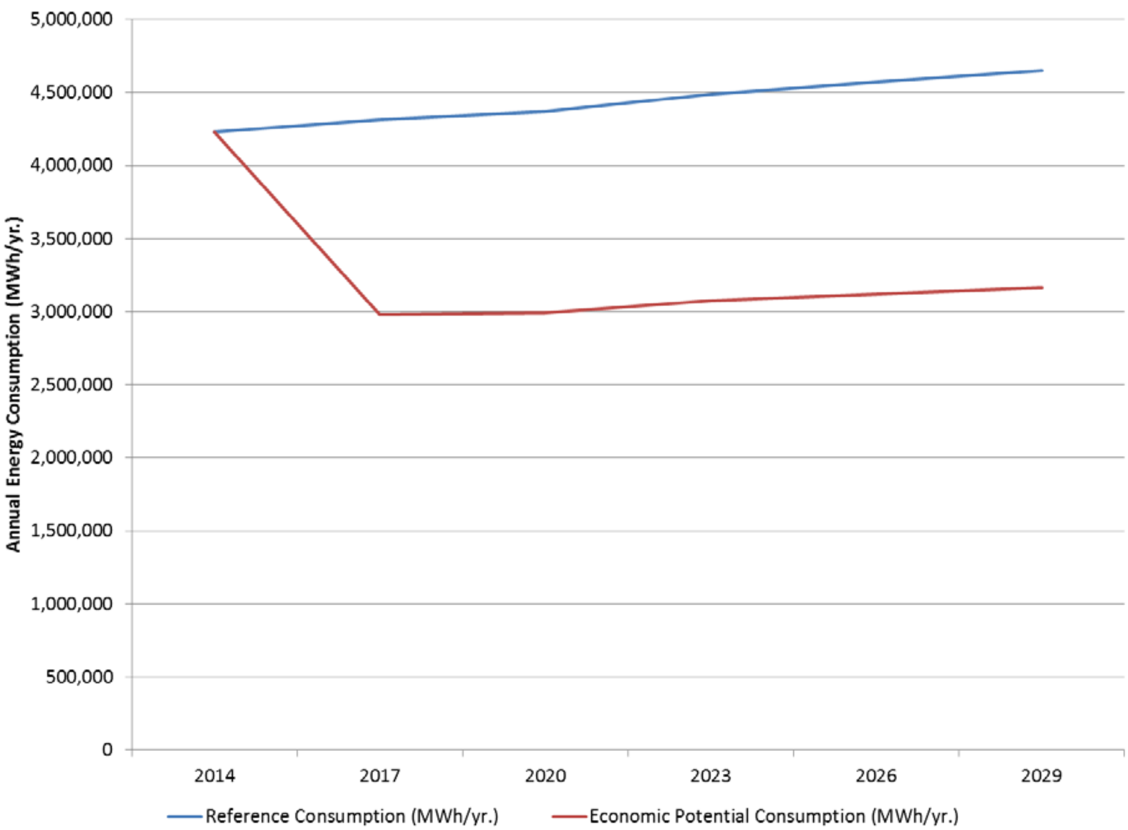
End Use Category	Upgrade Option	Applicability	Rate of Introduction
Space Heating	Electric Heat Cycling	Electrically heated SFD	Immediate
	Dual Fuel Heat Cycling	Electrically heated SFD	Immediate
	Heat Pump Cycling	Forced-air homes	Immediate
DHW	3-Element DHW	Homes with electric DHW	Immediate
	DHW Cycling	Homes with electric DHW	Immediate
Other	Car Warmer Demand	Labrador only	Immediate
	Block Heater Demand	Labrador only	Immediate

8.5 Summary of Electric Energy Savings

Exhibit 42 compares the Reference Case and Economic Potential Electric Energy Forecast levels of residential electricity consumption.[25] As illustrated, under the Reference Case residential electricity use would grow from the Base Year level of 4,227,000 MWh/yr. to approximately 4,652,000 MWh/yr. by 2029. This contrasts with the Economic Potential Forecast in which electricity use would decrease to approximately 3,168,000 MWh/yr. for the same period, a difference of approximately 1,485,000 MWh/yr., or about 32%.

The exhibit shows a large fraction of the economic potential savings occurring in the first milestone period. There are several reasons for this, including a large number of measures that pass on a full-cost basis, and avoided costs in the Island Interconnected region that are forecast to drop sharply after 2018. These factors are discussed in more detail in Section 8.5.2.

Exhibit 42 Reference Case versus Economic Potential Electric Energy Consumption in Residential Sector (MWh/yr.)



[25] All results are reported at the customer's point-of-use and do not include line losses.

8.5.1 Electric Energy Savings

Further detail on the total potential electric energy savings provided by the Economic Potential Forecast is provided in the following exhibits:[26]

- Exhibit 43 presents the results by end use, dwelling type and milestone year
- Exhibit 44 provides a further disaggregation of the savings by technology, and milestone year
- Exhibit 45 presents savings by major end use, milestone year and supply system
- Exhibit 46 presents savings by major end use, milestone year and dwelling type
- Exhibit 47 presents 2029 savings by major end use and vintage.

[26] MWh/yr. savings shown in the following exhibits are not incremental. For example, the space heating savings in 2029 are not in addition to the space heating savings from the previous milestone years. Rather, they are the difference between the Reference Case space heating consumption in 2029 and the space heating consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 43 Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year (MWh/yr.)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Clothes dryer	Television	Refrigerator	Computer and peripherals	Lighting	Ventilation	Hot tubs	Television peripherals
Single Family Dwellings	2017	719,970	124,932	136,281	45,088	54,194	30,906	23,980	10,061	21,620	5,000
	2020	764,890	124,234	138,542	48,284	54,990	30,305	19,427	11,713	15,672	5,225
	2023	777,449	124,978	141,863	51,808	55,743	33,202	17,329	14,431	15,356	5,470
	2026	785,146	129,407	146,570	54,844	56,095	39,924	16,043	22,319	15,004	5,652
	2029	791,294	129,666	149,632	57,742	56,302	40,407	15,270	28,747	14,816	5,826
Attached Houses	2017	34,251	23,839	14,986	7,283	10,101	4,641	3,624	1,120	1,937	861
	2020	35,436	23,961	15,886	7,988	10,319	4,839	2,989	1,135	1,279	924
	2023	34,323	24,329	16,963	8,770	10,536	5,716	2,681	1,294	1,144	991
	2026	33,195	25,679	18,636	9,368	10,662	7,023	2,526	1,491	1,048	1,036
	2029	39,675	25,616	19,373	9,886	10,757	7,200	2,417	3,394	980	1,074
Apartments	2017	7,233	13,315	4,460	4,438	484	2,249	1,399	191	-	673
	2020	6,680	13,666	4,316	4,795	495	2,984	1,094	177	-	711
	2023	5,504	14,214	4,473	5,194	507	4,843	936	176	-	753
	2026	4,413	14,592	4,584	5,528	514	6,428	833	175	-	784
	2029	4,122	14,918	4,684	5,843	520	6,549	761	173	-	816
Other, Vacant and Partial	2017	6,424	5,708	64	1,357	202	660	1,094	146	-	103
	2020	6,571	5,833	(94)	1,450	203	423	881	147	-	107
	2023	6,606	5,999	(89)	1,560	204	442	781	148	-	111
	2026	6,356	6,113	(81)	2,462	204	694	719	149	-	172
	2029	6,200	6,210	(86)	2,628	203	1,259	682	151	-	181
Grand Total	**2017**	767,878	167,794	155,791	58,167	64,981	38,456	30,097	11,519	23,557	6,637
	2020	813,578	167,693	158,649	62,517	66,007	38,551	24,390	13,172	16,951	6,966
	2023	823,882	169,520	163,210	67,333	66,990	44,203	21,727	16,049	16,500	7,326
	2026	829,111	175,792	169,709	72,202	67,475	54,070	20,122	24,134	16,052	7,644
	2029	841,290	176,409	173,603	76,099	67,782	55,415	19,129	32,464	15,796	7,897

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
4) MWh/yr. savings are not incremental. The space heating savings in 2029 are not in addition to the savings from the previous milestone years. Rather, they are the difference between the Reference Case space heating consumption in 2029 and the space heating consumption if all the measures included in the Economic Potential scenario are implemented.

Exhibit 43 Continued: Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year (MWh/yr.)

Housing Categories	Milestone Years	Dehumidifier	Freezer	Cooking	Other electronics	Clothes washer	Dishwasher	Block heaters & car warmers	Space cooling	Grand Total
Single Family Dwellings	2017	2,245	1,772	2,133	1,406	441	142	247	(147)	1,180,271
	2020	1,718	1,460	2,119	1,476	240	145	250	(150)	1,220,539
	2023	4,445	2,860	2,121	1,552	214	147	253	(158)	1,249,062
	2026	5,830	3,531	2,117	1,618	678	358	254	(163)	1,285,229
	2029	5,504	4,182	2,117	1,683	821	362	253	(168)	1,304,456
Attached Houses	2017	391	241	404	248	72	81	47	3	104,130
	2020	303	194	404	262	39	84	48	4	106,093
	2023	773	378	408	278	36	87	48	4	108,759
	2026	1,063	490	409	292	158	213	49	4	113,341
	2029	1,008	582	411	305	153	217	49	4	123,100
Apartments	2017	117	79	289	217	34	-	19	-	35,198
	2020	119	63	289	231	15	-	19	-	35,652
	2023	123	128	293	245	14	-	20	-	37,424
	2026	127	159	295	258	14	-	20	-	38,723
	2029	132	190	305	270	13	-	20	-	39,316
Other, Vacant and Partial	2017	-	98	141	132	18	-	7	-	16,152
	2020	-	79	139	139	10	-	6	-	15,893
	2023	-	152	138	146	9	-	6	-	16,213
	2026	-	190	137	152	9	-	6	-	17,284
	2029	-	225	148	158	9	-	7	-	17,974
Grand Total	**2017**	2,753	2,189	2,967	2,003	564	223	320	(144)	1,335,751
	2020	2,139	1,796	2,952	2,107	303	230	323	(147)	1,378,178
	2023	5,341	3,518	2,960	2,221	273	233	327	(154)	1,411,457
	2026	7,019	4,370	2,959	2,320	859	572	329	(159)	1,454,577
	2029	6,643	5,178	2,982	2,416	997	579	329	(164)	1,484,845

Notes:
1) The negative value for space cooling is based on the assumption that customers installing heat pumps will begin to use air conditioning that they did not use before.

Exhibit 44 Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Mini-Splits	279,764	295,901	313,433	326,181	337,636
Basement Insulation	161,041	184,435	184,608	184,860	192,464
Crawl Space Insulation	151,847	162,775	162,826	162,951	163,099
Clothes Lines	146,203	153,671	158,306	148,432	146,570
Sealing & Insul. - Old Homes	92,681	92,677	92,672	92,708	92,762
Min Hot Wash	64,866	65,825	66,618	65,743	65,530
Refrigerator Retirement	60,832	61,714	62,593	63,006	63,267
Power Bars (TVs)	46,187	49,582	53,332	57,213	60,004
Attic Insulation	42,738	42,728	42,729	47,319	47,371
Door Systems	50,353	46,395	41,280	36,758	32,751
Power Bars (PCs)	29,642	36,628	42,569	44,914	48,377
Overnight Setback	29,200	30,003	31,498	32,448	33,197
Showerheads	28,402	28,689	29,025	29,079	29,046
DHW Temperature	27,693	28,103	28,442	28,068	27,977
Faucets	22,613	23,506	24,471	25,205	25,866
Close Blinds	18,942	19,667	20,733	21,436	21,969
Daytime Setback	17,500	17,986	18,871	19,397	19,808
Air Sealing	18,379	18,378	18,377	18,385	18,396
Hot Tub Covers	21,746	15,647	15,231	14,818	14,581
ESTAR TVs	13,835	14,883	16,047	17,140	18,247
Efficient Clothes Washers	7,665	692	620	25,538	32,783
Weather Stripping Maintenance	13,250	12,907	12,942	12,880	12,813
LED Lamps	19,232	14,504	11,878	10,114	8,751
ECPM Fan Motors	2,730	4,162	7,034	15,335	23,846
Faucet Aerator	10,090	10,192	10,311	10,331	10,319
Benchmarking	8,221	7,758	7,759	7,746	7,833
DHW Tank Insulation	6,074	5,697	5,323	4,891	4,443
Motion Detectors - Outdoor	4,308	4,241	4,483	4,728	5,019
ESTAR Computers	7,663	584	165	7,632	5,419
Refrigerator Temperature	4,149	4,205	4,264	4,291	4,309

Exhibit 44 Continued: Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
DHW Pipe Insulation	4,672	4,385	4,097	3,765	3,421
Turn Off TVs	3,515	3,705	3,913	4,083	4,286
Timers - Outdoor	4,660	3,842	3,479	3,320	3,276
Electronic Thermostats	1,086	1,833	3,360	4,496	6,860
ESTAR Dehumidifiers	1,095	458	3,674	5,349	4,929
Super Efficient Clothes Washers	3,387	3,247	3,061	2,701	2,464
Clothes Dryer Sensor	2,263	2,380	2,454	2,323	2,305
Unplug Chargers	2,003	2,107	2,221	2,320	2,416
Prog. Thermostats	2,011	1,938	1,981	2,194	2,369
Min Outdoor Lighting	1,724	1,645	1,702	1,768	1,877
ESTAR Freezers	527	75	1,766	2,585	3,361
Freezer Temperature	1,620	1,636	1,626	1,619	1,611
PC Power Management	1,151	1,339	1,470	1,523	1,618
AC Temperature	447	460	476	487	496
High-Perf. New Homes	100	169	303	435	565
Air-to-Water Heat Pumps	-	268	310	353	393
Car Warmer Timers	223	230	233	237	240
ESTAR Windows	959	9	16	25	36
Air-Source Heat Pump	109	119	139	156	175
Block Heater Timers	-	-	-	334	339
Super Efficient Freezers	43	84	126	166	206
Turn Off Lights	153	127	115	111	110
Super Efficient Refrigerators	-	88	133	177	206
Cold Climate Heat Pump	52	55	61	65	70
T8 Fixtures	16	26	36	46	57
Super Windows	-	22	34	46	59
Professional Air Sealing	-	-	-	79	81
ESTAR Dishwashers	8	17	29	42	37
HRVs	-	-	20	31	43
Motion Detectors - Indoor	-	-	25	25	25

Exhibit 44 Continued: Economic Potential Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Annual Savings, 2017, (MWh/yr.)	Annual Savings, 2020, (MWh/yr.)	Annual Savings, 2023, (MWh/yr.)	Annual Savings, 2026, (MWh/yr.)	Annual Savings, 2029, (MWh/yr.)
Prog. Thermostats (Central)	4	3	3	2	1
HVAC Impact from Other Savings	(103,924)	(106,228)	(113,844)	(125,835)	(133,540)
Grand Total	1,335,751	1,378,178	1,411,457	1,454,577	1,484,845

Notes:

1) For some measures, such as Efficient Clothes Washers, the savings decrease after the first milestone and then rise again. This phenomenon emerges in the model because the assumed natural adoption of the measure is "catching up" to the economic potential adoption in those milestone years and is therefore eroding the savings potential. This is particularly likely for measures whose cost of conserved energy is below the avoided cost of electricity in the Island Interconnected region in 2017, but is higher than the avoided cost of electricity in the region after 2018. For these measures, adoption proceeds during the initial milestone periods, then stalls after the forecast avoided cost decreases, and then may later begin proceeding again after forecast avoided costs begin to rise.
2) The last measure in the table, HVAC Impact from Other Savings, accounts for the added load on the electric heating systems in dwellings where savings are occurring for many other end uses in the home. As discussed in Section 8.5.3, the savings for end uses such as lighting, appliances, and electronics are multiplied by a factor based on modeling of NL dwellings. The resulting heating penalty is added as a separate line item in this exhibit.

Exhibit 45 Economic Potential Savings by Major End Use, Year and Region (MWh/yr.)

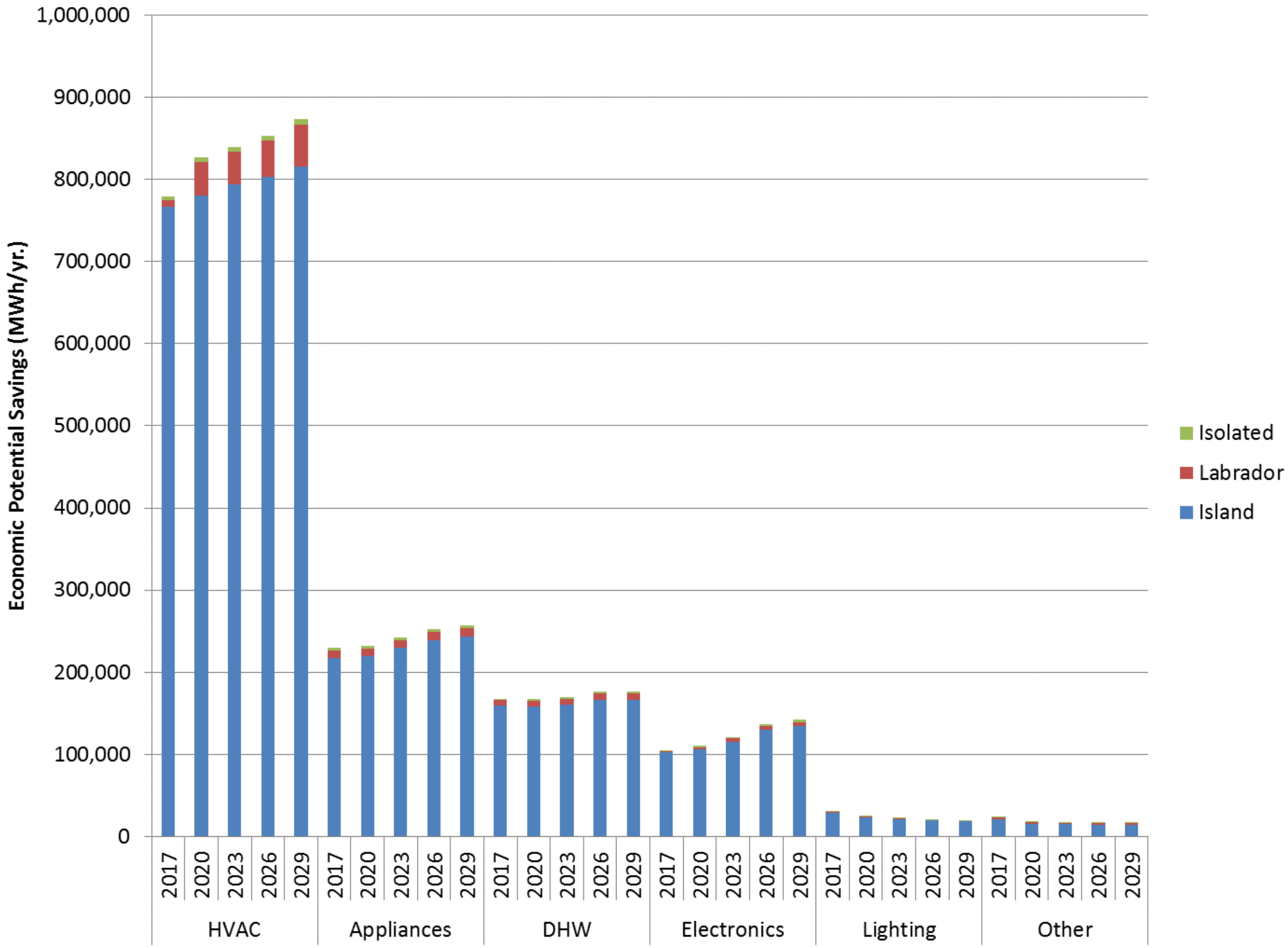


Exhibit 46 Economic Potential Savings by Major End Use, Year and Dwelling Type (MWh/yr.)

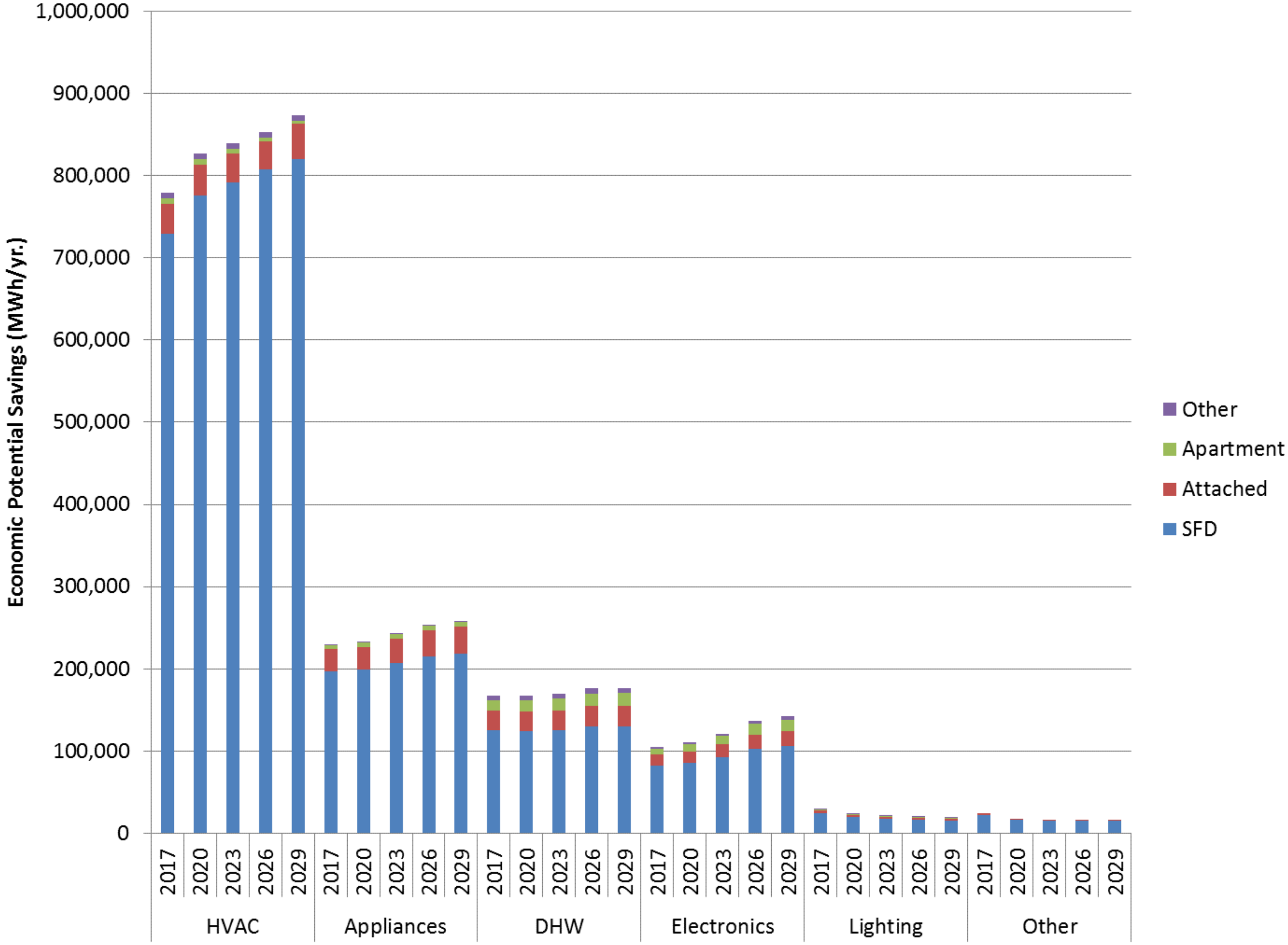
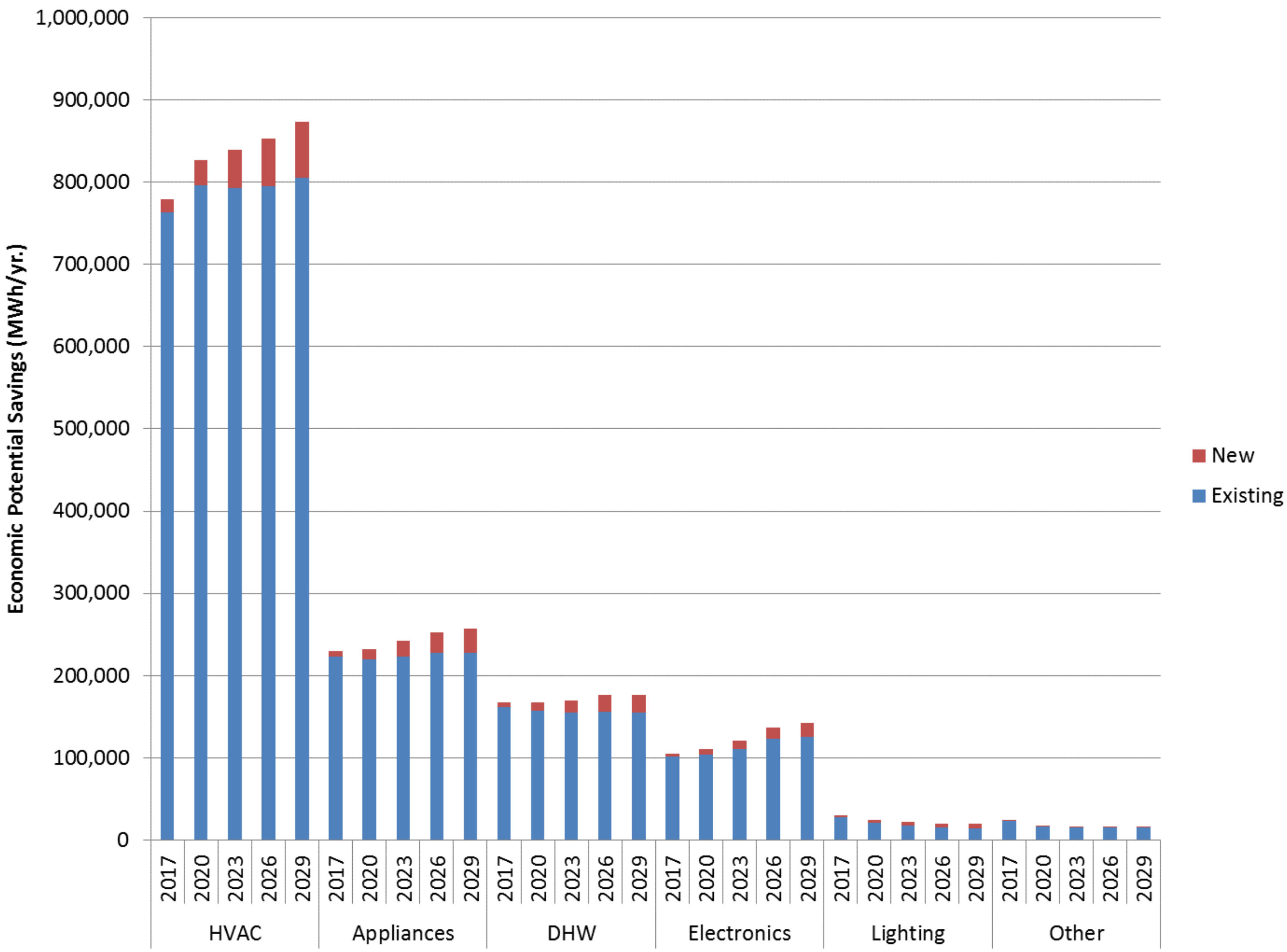


Exhibit 47 Economic Potential Savings by Major End Use, Year and Vintage (MWh/yr.)



8.5.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Electric Energy Savings by Milestone Year

The Economic Potential savings increase modestly from 1,336,000 MWh/yr. in 2017 to 1,485,000 MWh/yr. in 2029. Nearly 90% of the savings possible at the end of the study period are already economically viable within the first milestone period. There are three main reasons for this high percentage of savings that occur at the beginning of the study period:

- Many of the measures pass the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year. Many of the behavior measures offer significant savings, for example, and since they have negligible or no capital cost they can be implemented immediately for all eligible customers. The ductless mini-split heating systems, which offer very large savings, also pass on the basis of full cost and could therefore be implemented in the first milestone period for all eligible customers.
- The avoided costs in the Island Interconnected region are expected to fall significantly after the interconnection is made with Labrador. Consequently, many measures that pass in the first milestone period fail the economic screen later in the study, so that any further adoption of them is curtailed.
- While there are end uses where the opportunities for savings expand, such as space heating and electronics, there are other end uses where the opportunities contract, such as lighting. Lighting in the Reference Case includes the assumption that most of the market moves to lamps as efficient as LEDs by 2029.

Electric Energy Savings by Dwelling Type

Single detached houses account for over 88% of the potential savings; this reflects their larger market share and their generally higher level of electrical intensity per dwelling. Savings in attached dwellings account for 8% of the potential savings. Savings in apartments account for 3% of the potential savings. Savings in other residential buildings account for 1% of the potential savings.

By Region

The Island Interconnected region accounts for 95% of the potential savings. The Labrador Interconnected region accounts for 4% of the potential savings, and the Isolated region accounts for 1% of the potential savings.

By Existing Dwellings versus New Construction

Savings in existing dwellings account for almost all of the savings potential at the beginning of the study period, but as new homes are constructed, the savings potential associated with them occupies a progressively larger portion of the total. By 2029, savings from new homes account for 10% of the total potential.

Electric Energy Savings by End Use

Space heating and ventilation savings from upgrades to the building envelope and space heating systems account for approximately 58% of the total electricity savings in the Economic Potential Forecast. Of this, 23% is from ductless mini-split systems, 24% is from basement and crawlspace insulation, 10% is from other air sealing and insulation projects, and 3% is from efficient

> Space heating measures dominate the results, including both efficient equipment and building envelope improvements.

windows and doors. Other measures account for 2% or less of the savings. It should be noted that the reduction in internal heat loads resulting from measures that save electricity in other end uses will tend to increase heating energy consumption. This increase is subtracted from the overall potential savings, reducing it by approximately 9% overall by 2029.[27]

The measure with the largest potential, the ductless mini-split, is economically attractive relative to the avoided cost of electricity in the Island Interconnected region before the Island grid is connected to Labrador. After the link is complete, the avoided costs are expected to decrease to a level below the CCE for the ductless mini-split systems. In the economic potential model, the mini-split systems are assumed to be widely adopted in the first milestone period. In the context of real programs, where the measure may be deemed uneconomic after the first three years of the study period, the potential for this measure is likely much smaller.

Appliances account for approximately 17% of the total electricity savings in the Economic Potential Forecast. Of this, 4% is from retirement of second (and third) refrigerators and 2% is from ENERGY STAR® clothes washers and Tier3 clothes washers. Other appliance measures account for less than 1% of the savings. Within the appliance end use, the largest economic potential is a behavior measure: use of clothes lines accounts for 9% of the 18%.

DHW measures account for 12% of the total electricity savings in the Economic Potential Forecast. Of this, 4% is from low flow fixtures such as showerheads, faucets, and faucet aerators. The DHW savings associated with more efficient clothes washers account for approximately 1% of the 12%. Other measures account for 1% or less of the potential savings. Within the DHW end use, the largest economic potential is a behavior measure: minimization of hot water wash accounts for 4% of the 12%.

Electronic end uses account for about 8% of the total electricity savings at the beginning of the Economic Potential Forecast and rises to 10% by 2029. Of this, 4% is from power bars for televisions and their peripherals, 3% is from power bars for PCs and their peripherals, and 1% is from ENERGY STAR® televisions. Use of such power bars is likely to be superseded by technical changes in electronics products, reducing their standby losses. Nonetheless, the magnitude of the savings remains the same, although the technology to achieve it will change.

The lighting end uses, including indoor, outdoor and holiday lighting, account for about 2% of the total electricity savings at the beginning of the Economic Potential Forecast but fall to 1% by 2029. This is largely because of the expected natural adoption of LED lighting products or other products of similar efficiency.

The “other” category of end uses, which includes, spas, block heaters and car warmers, and small appliances and other, account for 2% of the electricity savings at the beginning of the Economic Potential Forecast but fall to 1% by 2029. Of this, the largest measure is improved hot tub covers. Block heater and car warmer timers offer savings in Labrador, but are not used in the rest of the province.

8.5.3 Caveats on Interpretation of Results

A systems approach was used to model the energy impacts of the efficiency upgrades presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible. More specifically, there are two particularly important considerations:

[27] This 9% reduction is the reason the percentage savings for individual measures add up to more than 58%.

- **More than one upgrade may affect a given end use.** For example, improved insulation reduces space heating electricity use, as does the installation of a heat pump. On its own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of "bundles of measures" that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a high-efficiency space heating system).

- **There are interactive effects among end uses.** For example, the electricity savings from more efficient appliances and lighting result in reduced waste heat. During the space heating season, appliance and lighting waste heat contributes to the building's internal heat gains, which lower the amount of heat that must be provided by the space heating system. The magnitude of the interactive effects can be significant. Based on selected building energy-use simulations using NRCan HOT2000 software, a 100 kWh savings in appliance or lighting electricity use results, on average, in an increased space heating load of up to 60 kWh in the Island Interconnected region (a 60% rate of interaction) and 70 kWh in the Labrador Interconnected region (a 70% rate of interaction). A 60% rate of interaction was used for the Isolated region.

> 70% is a higher rate of interaction between internal loads and space heating than seen in other studies. It is related mainly to the length of the heating season, rather than its severity.

  The model implements this interaction by multiplying the savings for the internal end uses in a dwelling by the factor for houses in that region. Exhibit 48 provides the interactive factors applied to space heating, by region and end use.[28] This becomes the additional heating load for the dwelling. This is in turn multiplied by the space heating electric share for the type of dwelling, because the non-electric heating sources are assumed to provide their share of the additional heating load.

  Exhibit 44 shows the total heating penalty caused by internal end use savings as a separate line item, just before the grand total. In other words, the heating penalty is not subtracted from the savings of individual measures, but is instead shown as a separate item in the exhibit. To attach the heating penalty to a specific measure, the savings can be reduced by the heating interaction penalty for the region and end use, as indicated in the exhibit. An interior lighting measure saving 100 kWh/yr. in the Island Interconnected region, for example, would actually save only (1 – 60%) x 100 = 40 kWh/yr. **in an electrically heated house.** In an oil-heated house, it would save the full 100 kWh/yr. and the heating penalty would instead affect the consumption of oil.

[28] In the residential model, interactive effects were applied to the total end use savings, rather than on a measure-by-measure basis. This is an approximation that provides good overall results. For most end uses, it is relatively clear whether energy waste occurs within or outside the heated part of the dwelling. For example, almost all televisions are used in the house, so savings from a television measure will interact with the space heating system. Most hot tubs are outside, and therefore savings from a hot tub measure will generally not interact with the space heating system. There is only one lighting end use in the residential model, so it includes both indoor and outdoor lighting. The majority of lighting is indoor, so the interactive factors have been applied to the end use. For individual lighting measures, the factor should be applied if the savings occur inside the dwelling and it should not be applied if they occur outside. DHW is the most complex end use to model. A considerable amount of the DHW heat goes down the drain after the immediate use, and there are also constant heat losses from the tank. Therefore, the interaction between DHW energy savings and the dwelling's heating system are very complex, and likely much weaker than for other end uses. This analysis has neglected the interaction between DHW savings and space heating.

Exhibit 48 Interactive Factors Applied to Space Heating, by End Use

End Use	Heating Interaction Factor Applied		
	Island Interconnected	Labrador Interconnected	Isolated
Space heating	N/A	N/A	N/A
Space cooling	N/A	N/A	N/A
Ventilation	60%	70%	60%
Domestic Hot Water (DHW)	0%	0%	0%
Cooking	60%	70%	60%
Refrigerator	60%	70%	60%
Freezer	60%	70%	60%
Dishwasher	60%	70%	60%
Clothes washer	60%	70%	60%
Clothes dryer	60%	70%	60%
Dehumidifier	0%	0%	0%
Lighting	60%	70%	60%
Computer and peripherals	60%	70%	60%
Television	60%	70%	60%
Television peripherals	60%	70%	60%
Other electronics	60%	70%	60%
Block heaters & car warmers	N/A	0%	N/A
Hot tubs	0%	0%	0%
Small appliance & other	60%	70%	60%

8.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 49 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Economic Potential Forecast. The reductions are shown by milestone year and region. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6. Exhibit 50 shows the same information graphically for the winter peak period.

Exhibit 49 and Exhibit 50 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct. For example, most of the heat pump measures are assumed not to produce any peak demand savings, because during the winter peak period the heat pumps and mini-splits are expected to revert to back-up electric resistance heating.[29] There will therefore be no net reduction in space heating peak demand for these measures. Accordingly, the demand reductions for the heat pump measures have been manually filtered out of the results presented in these exhibits.

Exhibit 51 shows the demand reductions associated with each electric energy savings measure contained in the Economic Potential Forecast for the milestone year 2029. The heat pump measures are omitted from the exhibit, as with the previous two exhibits. One notable line item in the exhibit is "HVAC Impact from Other Savings" - the impact on peak space heating load resulting from the savings for other end uses within the dwelling. This is to capture the fact that in an electrically-heated dwelling, savings of energy consuming devices within the home will not reduce the winter

[29] In fact, this is a conservative assumption for the Island Interconnected region. Although the demand peak occurs on the coldest winter days, in a climate such as that of St. John's the temperature is typically not very extreme on those peak days. Therefore, many heat pumps will continue to work in heat pump mode and not revert to electric resistance. In this study, we have retained the conservative assumption that they do not provide demand relief.

peak demand. On the coldest winter days, reducing the energy used by a lamp will simply make the electric baseboard beside it work harder. The non-heating end uses do produce some peak load reductions, for example, in homes that are heated by non-electric fuels, in outside light fixtures, or in heated water that drains out of the house while still warm. The impact of demand reductions for other end uses on the space heating demand can be seen graphically in Exhibit 50. As the demand impacts for many of the other end uses rise with time, the demand impacts for space heating actually decreases over time.

Electric peak load reductions related to capacity-only measures are presented separately in Section 8.7.

Exhibit 49 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year, Peak Period and Dwelling Type (MW)

Housing Categories	Milestone Years	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Single Family Dwellings	2017	212	3	2	218
	2020	210	12	2	224
	2023	210	13	2	225
	2026	214	14	3	231
	2029	216	14	3	233
Attached Houses	2017	18	1	-	19
	2020	17	2	-	19
	2023	17	2	-	19
	2026	18	2	-	20
	2029	18	4	-	22
Apartments	2017	8	0	-	8
	2020	8	0	-	8
	2023	8	0	-	8
	2026	8	0	-	8
	2029	8	0	-	8
Other, Vacant and Partial	2017	4	0	0	4
	2020	4	0	0	4
	2023	4	0	0	5
	2026	4	0	0	5
	2029	4	0	0	5
Grand Total	**2017**	242	5	2	249
	2020	239	15	2	256
	2023	239	15	3	256
	2026	244	17	3	263
	2029	246	19	3	268

Exhibit 50 Electric Peak Load Reductions from Economic Energy Savings Measures, by Milestone Year End Use and Dwelling Type, Winter Peak Period (MW)

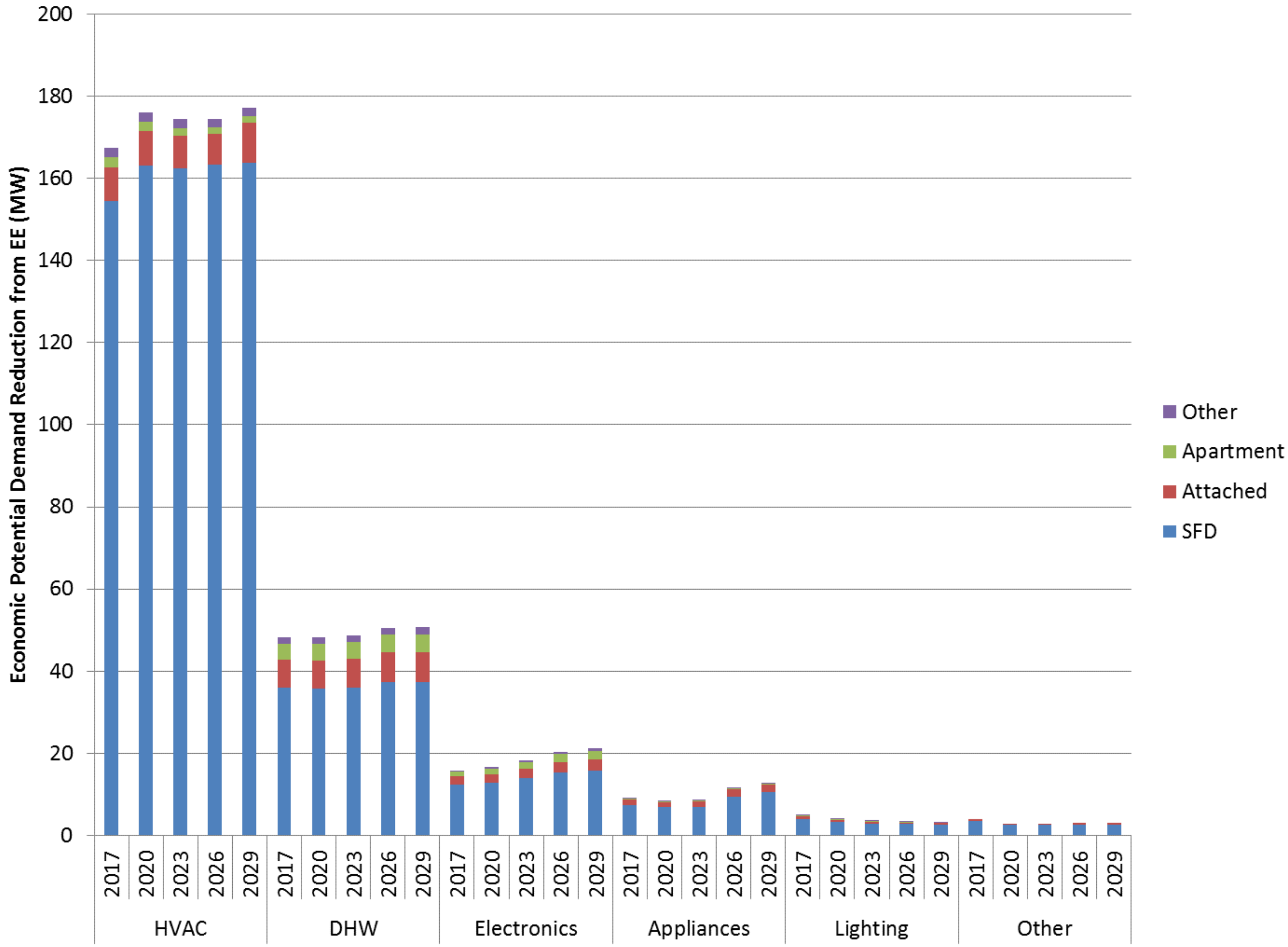


Exhibit 51 Electric Peak Load Reductions from Economic Energy Savings Measures, 2029 (MW)

Measure	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Basement Insulation	54	9	0	63
Crawl Space Insulation	51	3	0	54
Sealing & Insul. - Old Homes	31	-	0	31
Min Hot Wash	18	1	0	19
Attic Insulation	14	1	0	16
Overnight Setback	10	1	0	11
Door Systems	10	1	0	11
Power Bars (TVs)	9	0	0	10
Showerheads	8	0	0	8
DHW Temperature	8	0	0	8
ECPM Fan Motors	8	0	0	8
Faucets	7	0	0	7
Close Blinds	7	1	0	7
Daytime Setback	6	1	0	7
Efficient Clothes Washers	6	0	0	7
Refrigerator Retirement	6	0	0	6
Power Bars (PCs)	6	0	0	6
Air Sealing	6	-	0	6
Weather Stripping Maintenance	4	0	0	4
ESTAR TVs	3	-	0	3
Faucet Aerator	3	0	0	3
Electronic Thermostats	2	0	0	2
Hot Tub Covers	2	0	0	2
LED Lamps	1	0	0	1
DHW Tank Insulation	1	-	0	1
Benchmarking	1	0	0	1
DHW Pipe Insulation	1	0	0	1
Motion Detectors - Outdoor	1	0	0	1
Prog. Thermostats	1	0	0	1
Turn Off TVs	1	0	0	1
ESTAR Computers	1	0	0	1
Timers - Outdoor	1	-	0	1
Super Efficient Clothes Washers	0	-	0	1
Refrigerator Temperature	0	0	0	0
Clothes Dryer Sensor	0	0	0	0
ESTAR Freezers	0	0	0	0
Min Outdoor Lighting	0	0	0	0
Unplug Chargers	0	0	0	0
High-Perf. New Homes	-	-	0	0
Car Warmer Timers	-	0	-	0
PC Power Management	0	0	0	0
Freezer Temperature	0	0	0	0
Super Efficient Freezers	-	-	0	0
Turn Off Lights	0	0	0	0
ESTAR Windows	-	-	0	0
ESTAR Dishwashers	-	-	0	0
T8 Fixtures	0	0	0	0

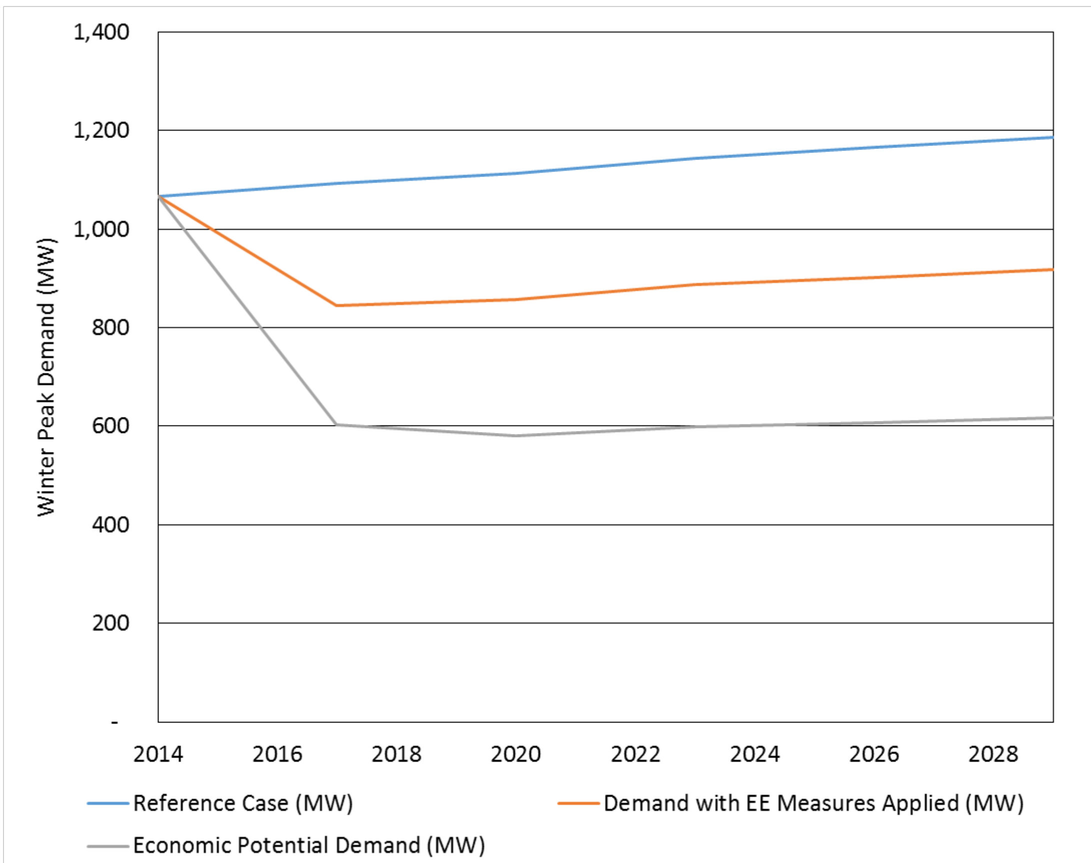
Exhibit 51 Continued: Electric Peak Load Reductions from Economic Energy Savings Measures, 2029 (MW)

Measure	Island Interconnected	Labrador Interconnected	Isolated	Grand Total
Prog. Thermostats (Central)	0	0	0	0
HVAC Impact from Other Savings	(42)	(2)	(0)	(45)
Grand Total	246	19	3	267

8.7 Summary of Peak Load Reduction

Exhibit 52 compares the Reference Case and Economic Potential Peak Demand Forecast levels of winter peak demand.[30] As illustrated, under the Reference Case residential peak demand would grow from the Base Year level of 1,067 MW to approximately 1,186 MW by 2029. This contrasts with the Economic Potential Forecast in which peak demand would decrease to approximately 647 MW for the same period, a difference of approximately 539 MW or about 45%. The middle line on the chart shows the peak demand that would result if all the energy efficiency measures were applied but none of the demand reduction measures. As illustrated in the exhibit, approximately 55% of the reduction comes from the impact of energy efficiency measures.

Exhibit 52 Reference Case Peak Demand versus Economic Potential Peak Demand in Residential Sector (MW)



[30] All results are reported at the customer's point-of-use and do not include line losses.

8.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Economic Potential Forecast is provided in the following exhibits:[31]

- Exhibit 53 presents the results by end use, dwelling type and milestone year
- Exhibit 54 provides a further disaggregation of the peak demand reduction by technology and milestone year
- Exhibit 55 presents peak demand reduction by major end use, milestone year and region
- Exhibit 56 presents peak demand reduction by major end use, milestone year and dwelling type
- Exhibit 57 presents 2029 peak demand reduction by major end use and vintage.

[31] MW reductions shown in the following exhibits are not incremental. For example, the space heating reductions in 2029 are not in addition to the space heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.

Exhibit 53 Total Economic Potential Peak Demand Reduction by End Use, Dwelling Type and Milestone Year (MW)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Block heaters & car warmers	Grand Total
Single Family Dwellings	2017	96	81	0	177
	2020	98	95	0	193
	2023	104	98	0	202
	2026	108	96	0	204
	2029	111	96	0	207
Attached Houses	2017	28	16	0	44
	2020	29	19	0	47
	2023	30	19	0	49
	2026	31	19	0	50
	2029	31	19	0	51
Apartments	2017	1	10	-	11
	2020	11	11	-	22
	2023	12	13	-	24
	2026	12	13	-	25
	2029	12	13	-	25
Other, Vacant and Partial	2017	10	0	-	10
	2020	12	2	-	14
	2023	12	2	-	14
	2026	14	2	-	17
	2029	15	2	-	17
Grand Total	**2017**	135	107	0	242
	2020	150	126	0	276
	2023	157	132	0	290
	2026	165	131	0	296
	2029	170	130	0	300

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value.
4) MW reductions are not incremental. The space heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.
5) The values in this exhibit do not include peak demand reductions from energy efficiency measures.

Exhibit 54 Economic Potential Peak Demand Reduction by Measure and Milestone Year (MW)

Measure	Peak Demand Reduction, 2017, (MW)	Peak Demand Reduction, 2020, (MW)	Peak Demand Reduction, 2023, (MW)	Peak Demand Reduction, 2026, (MW)	Peak Demand Reduction, 2029, (MW)
DHW Cycling	106	111	112	110	110
Electric Heat Cycling	92	105	110	116	119
Dual Fuel Heat Cycling	39	41	43	45	46
3-Element DHW	0	16	20	20	20
Heat Pump Cycling	4	4	4	4	4
Car Warmer Demand	0	0	0	0	0
Block Heater Demand	0	0	0	0	0
Grand Total	242	276	290	296	300

Exhibit 55 Economic Peak Load Reduction by Major End Use, Year and Region (MW)

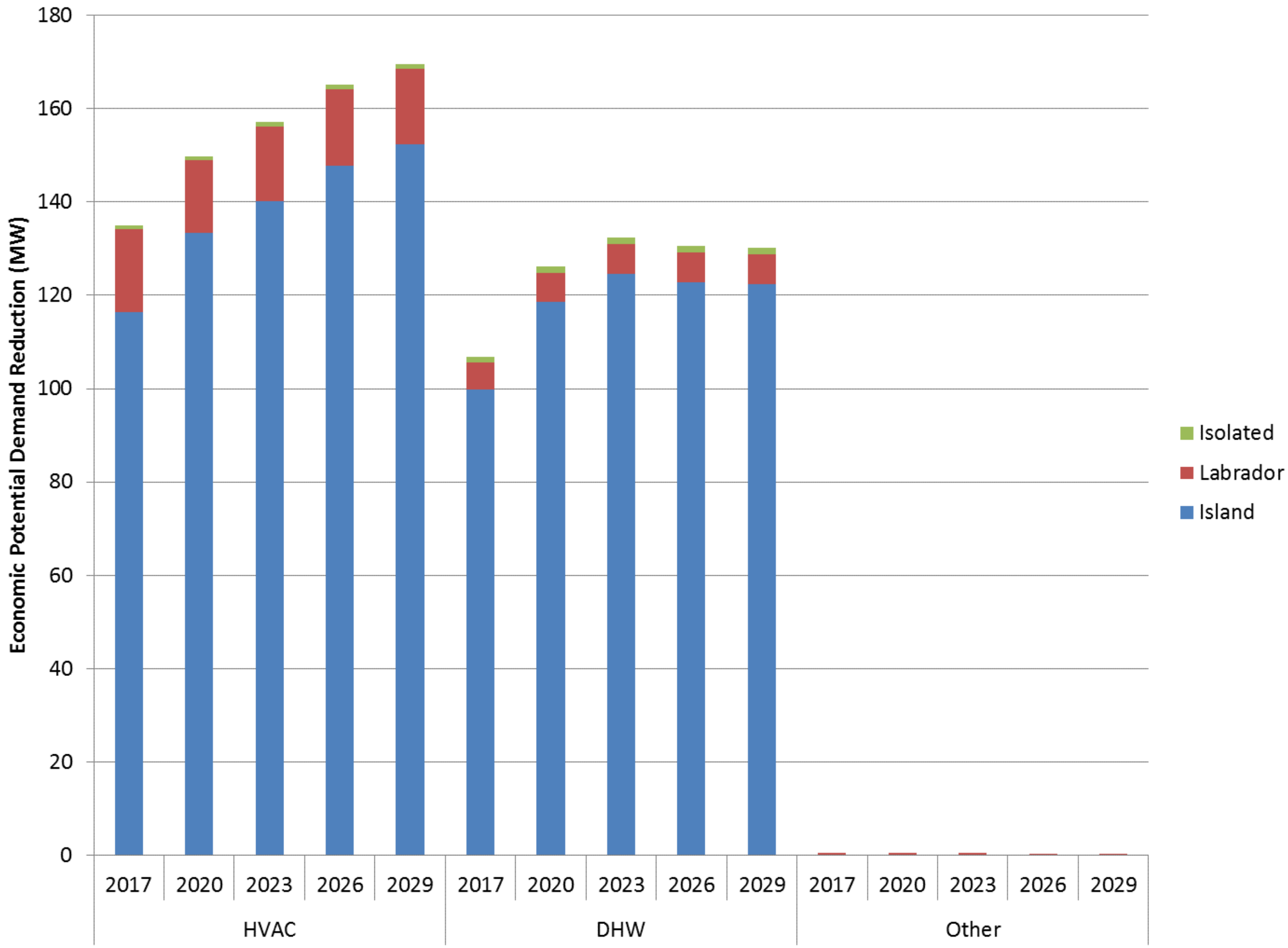


Exhibit 56 Economic Potential Peak Demand Reduction by Major End Use, Year and Dwelling Type (MW)

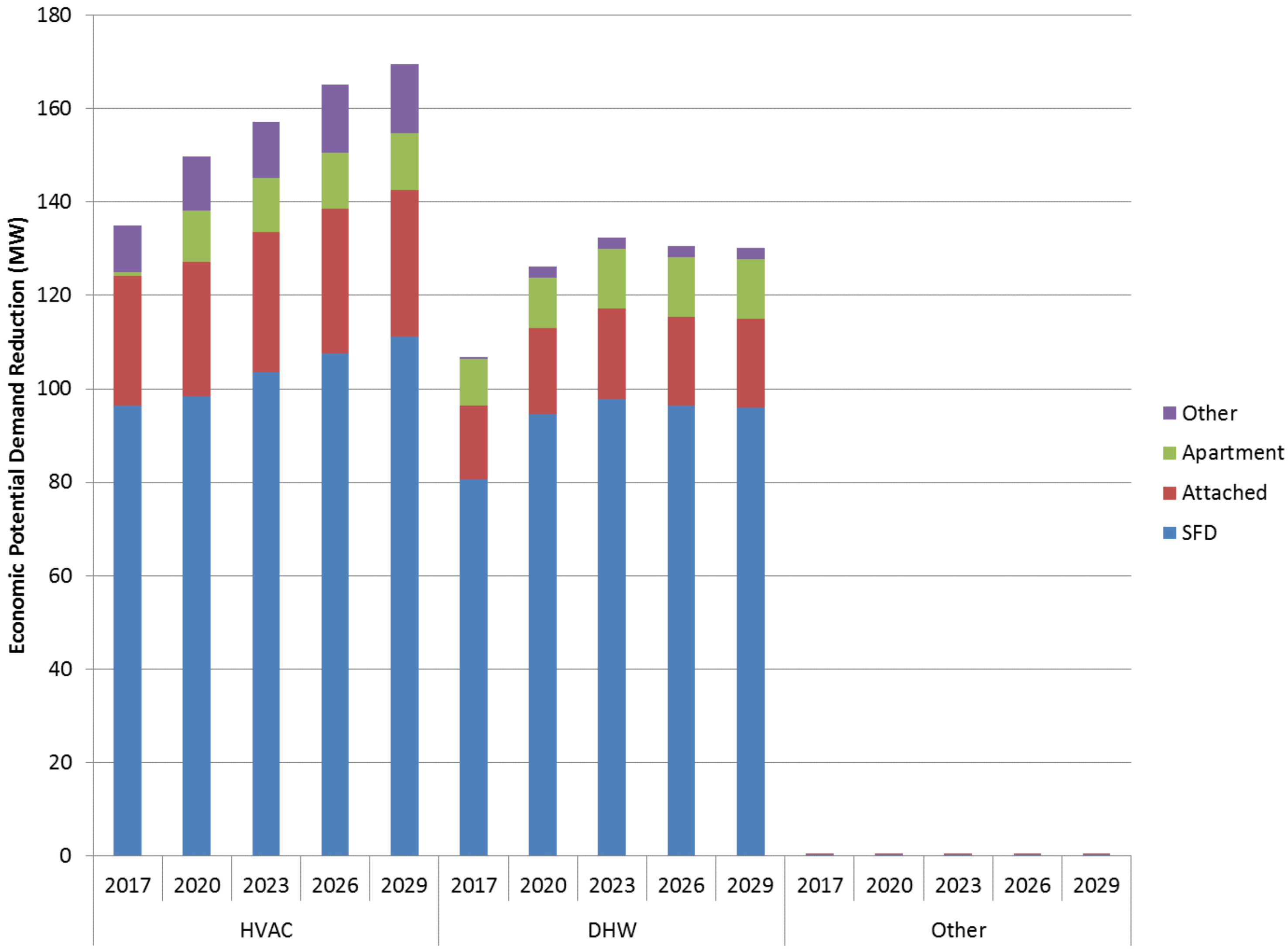
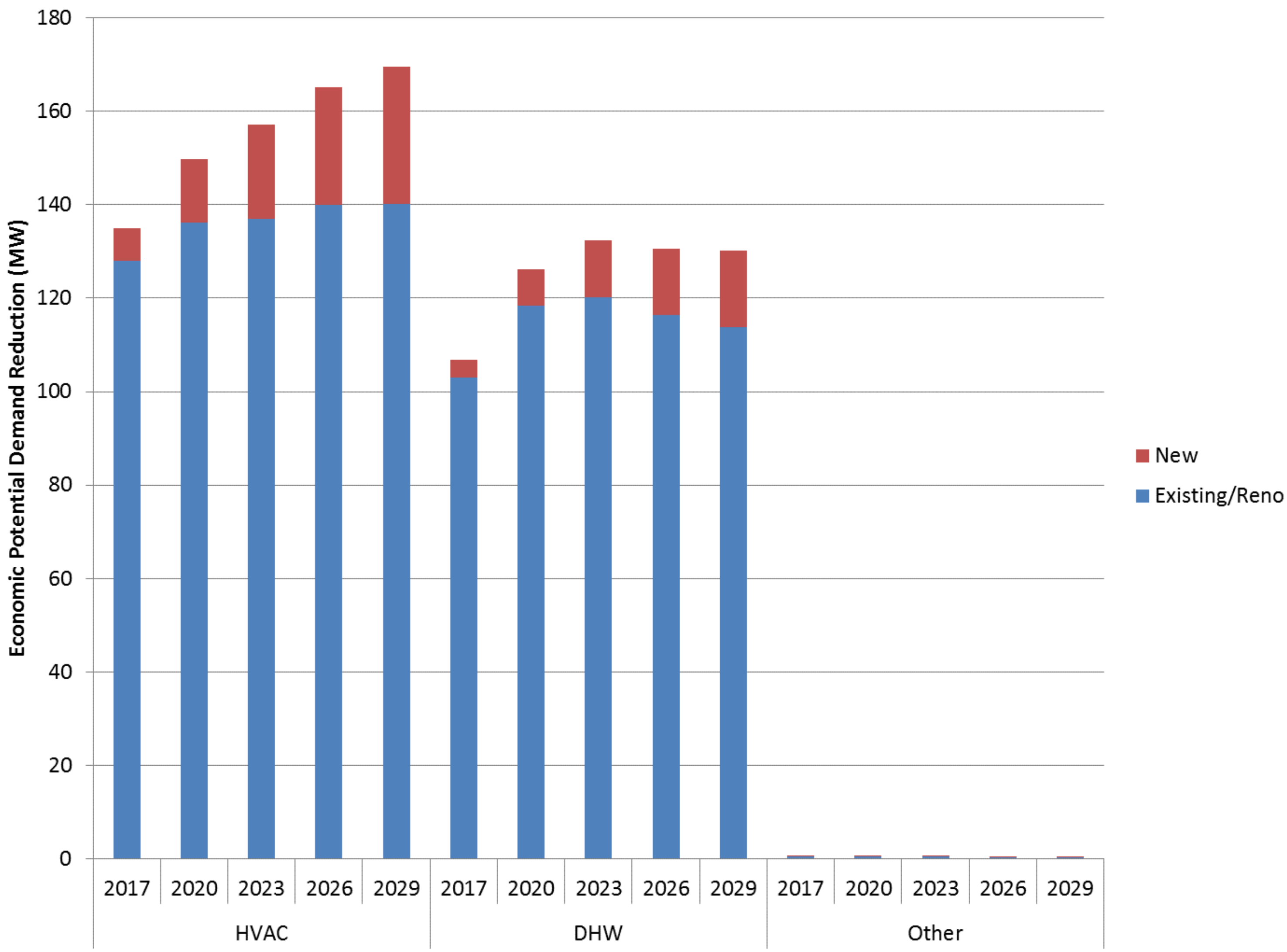


Exhibit 57 Economic Potential Peak Load Reduction by Major End Use, Year and Vintage (MW)



8.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Milestone Year

The Economic Potential peak load reductions increase modestly from 247 MW in 2017 to 300 MW in 2029. Approximately 82% of the peak reduction possible at the end of the study period is already economically viable within the first milestone period. Many of the measures pass the economic screen on the basis of their full cost, meaning that under the definition of economic potential they would be implemented in the first year.

Peak Demand Reduction by Dwelling Type

Single detached houses account for 69% of the potential peak load reductions; this reflects their larger market share and their generally higher level of electrical intensity per dwelling. Peak load reductions in attached dwellings account for 17% of the potential savings. Peak load reductions in apartments account for 8% of the potential savings. Peak load reductions in other residential buildings account for 6% of the potential savings.

Peak Demand Reduction By Region

The Island Interconnected region accounts for 91% of the potential peak load reductions. The Labrador Interconnected region accounts for 8% of the potential peak load reductions, and the Isolated region accounts for 1% of the potential peak load reductions.

Peak Demand Reduction By Existing Dwellings versus New Construction

Peak load reductions in existing dwellings account for almost all of the reduction potential at the beginning of the study period, but as new homes are constructed, the load reduction potential associated with them occupies a progressively larger portion of the total. By 2029, peak load reductions from new homes account for 15% of the total potential.

Peak Demand Reduction by End Use

Space heating load reductions account for approximately 55% of the total load reductions in the Economic Potential Forecast, not include load reductions from energy efficiency measures. Of this, 40% is from electric heat cycling, 15% is from heat cycling in dwellings with a second heating fuel option, and 1% is from cycling heat pumps.

DHW measures account for 45% of the total load reductions in the Economic Potential Forecast, not include load reductions from energy efficiency measures. Of this, 37% is from DHW cycling and 7% is from three-element DHW tanks.

Timers for car warmers and block heaters offer a very small portion of the total load reduction opportunity for the province overall, but contribute 2% to the overall potential for the Labrador Interconnected region.

8.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Economic Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

Exhibit 58 shows that the results are sensitive to this range of avoided costs. By 2029, the exhibit shows the following changes in potential:

- The lower range of reasonableness produces energy savings that are 6% lower in the Island Interconnected region, 10% lower in the Labrador Interconnected region, and almost unchanged in the Isolated region.
- The lower range of reasonableness produces peak demand reductions that are 6% lower in the Island Interconnected region, 4% lower in the Labrador Interconnected region, and 1% lower in the Isolated region.
- The upper range of reasonableness produces energy savings that are 8% higher in the Island Interconnected region, 71% in the Labrador Interconnected region, and almost unchanged in the Isolated region.
- The upper range of reasonableness produces peak demand reductions that are 1% higher in the Island Interconnected region, almost unchanged in the Labrador Interconnected region[32], and almost unchanged in the Isolated region.

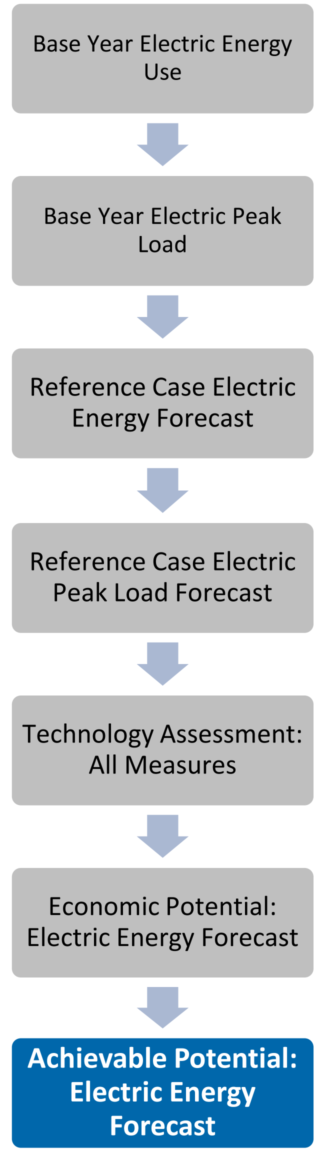
The dramatic change in energy savings potential in the Labrador region with higher avoided costs is mainly because the cost of conserved energy for the ductless mini-splits lies between the base scenario avoided costs and the upper range of avoided costs for most of the milestone years.

[32] The resulting reduction in Labrador space heating in the model caused the demand model to show a 10% reduction in potential for space heat cycling. In fact, however, mini-split systems would be operating in electric resistance mode during the winter peak period, so no such reduction in potential would actually occur

Exhibit 58 Sensitivity of the Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	1,218,122	430	1,295,153	458	1,328,438	478
	2020	1,225,380	463	1,302,489	491	1,341,847	499
	2023	1,252,862	474	1,333,728	504	1,383,832	515
	2026	1,279,722	481	1,370,235	515	1,455,577	521
	2029	1,310,677	490	1,391,573	521	1,498,845	525
Labrador Interconnected	2017	24,837	28	27,825	29	62,068	36
	2020	28,068	30	62,225	37	66,932	38
	2023	63,051	38	63,464	38	92,675	39
	2026	64,176	38	69,178	39	105,725	39
	2029	69,765	40	77,310	42	132,343	38
Isolated	2017	12,713	4	12,774	4	13,107	4
	2020	13,119	5	13,464	5	13,580	5
	2023	14,239	5	14,266	5	14,357	5
	2026	15,113	5	15,164	5	15,220	5
	2029	15,918	5	15,962	5	16,025	5

9 Achievable Potential: Electric Energy Forecast



9.1 Introduction

This section presents the Residential sector Achievable Potential for the study period (2014 to 2029). The Achievable Potential is defined as the proportion of the energy-efficiency opportunities identified in the Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to the estimation of Achievable Potential
- Achievable Potential Workshop results
- Summary of potential electric energy savings
- Electric peak load reductions for energy efficiency measures
- Summary of peak load reductions
- Sensitivity of the results to changes in avoided cost
- Description of the application of net-to-gross ratios.

9.2 Description of Achievable Potential

Achievable Potential recognizes that, in many instances, it is difficult to induce all customers to purchase and install all the energy-efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

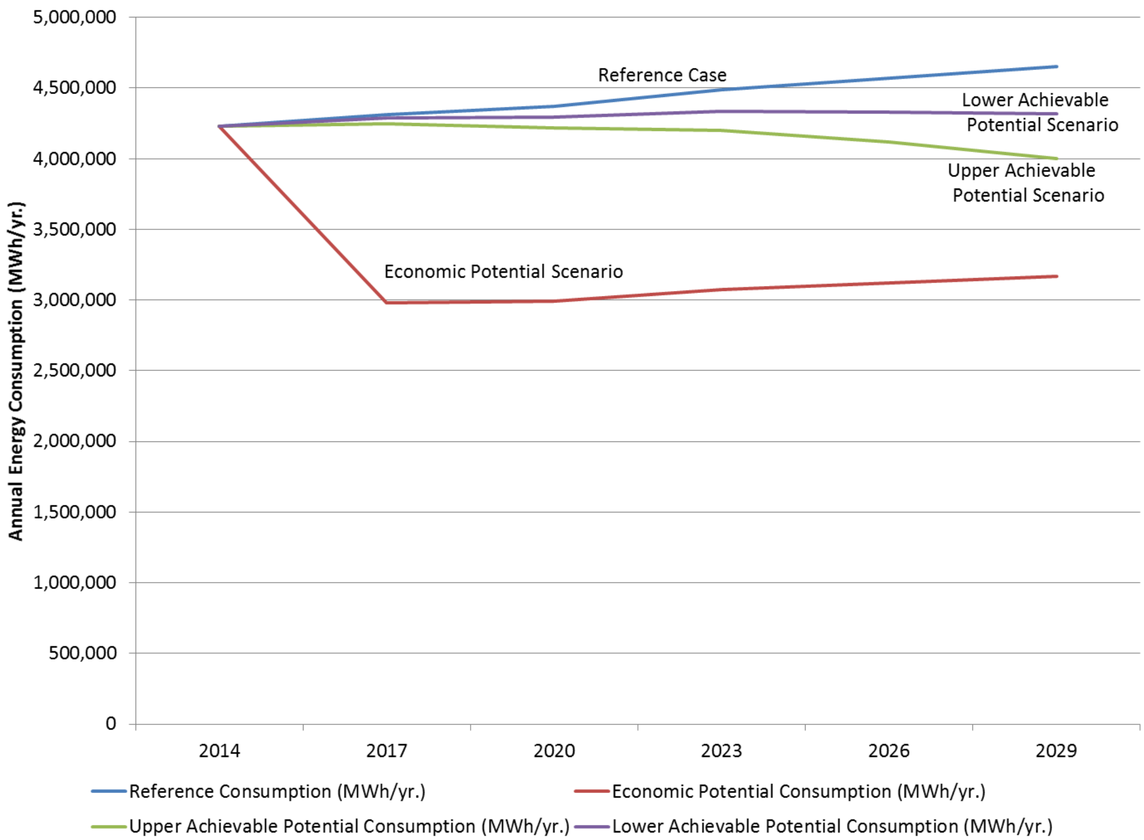
- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability.

The rate at which customers accept and purchase energy-efficiency products will be influenced by the level of financial incentives, information and other measures put in place by the Utilities, various levels of government, and the private sector to remove barriers such as those noted above.

Exhibit 59 presents the levels of electricity consumption that are estimated in the Achievable Potential scenario. As illustrated, the Achievable Potential scenarios are banded by the two forecasts presented in previous sections: the Economic Potential Forecast and the Reference Case.

As illustrated in Exhibit 59 electric energy savings under the Achievable Potential scenario are less than in the Economic Potential Forecast. In this CDM study, the primary factor that contributes to the outcome shown in Exhibit 59 is the rate of market penetration. In the Economic Potential Forecast, efficient new technologies are assumed to fully penetrate the market as soon as it is economically attractive to do so. However, the Achievable Potential recognizes that under real world conditions, the rate at which customers are likely to implement new technologies will be influenced by additional practical considerations and will, therefore, occur more slowly than under the assumptions employed in the Economic Potential Forecast.

Exhibit 59 Annual Electricity Consumption—Energy-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Residential Sector (GWh/yr.)



As also illustrated in Exhibit 59 the Achievable Potential results are presented as a band of possibilities, rather than a single line. This is because any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty. Consequently, two Achievable Potential scenarios are presented: lower and upper.

The lower Achievable Potential assumes NL market conditions that are similar to those contained in the Reference Case. That is, the customers' awareness of energy-efficiency options and their motivation levels remain similar to those in the recent past, technology improvements continue at historical levels, and new energy performance standards continue as per current known schedules. It also assumes that the ability of the NL utilities to influence customers' decisions towards increased investments in energy-efficiency options remains roughly in line with previous CDM experience.

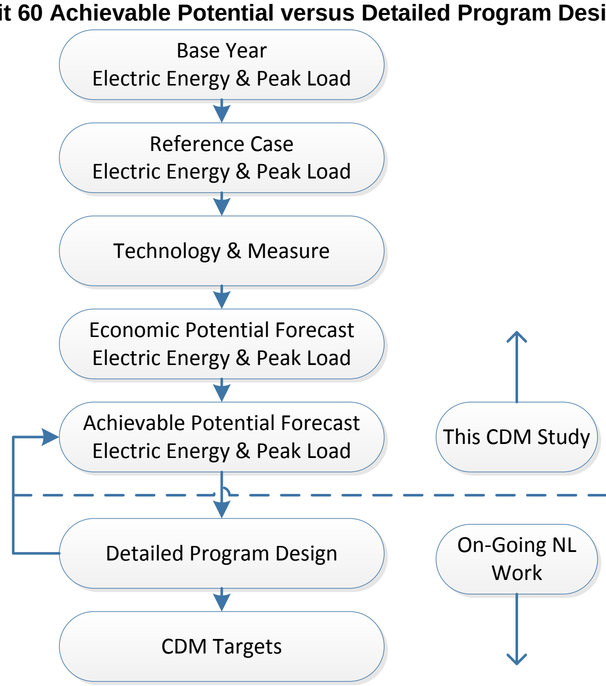
The upper Achievable Potential assumes NL market conditions that aggressively support investment in energy efficiency. For example, this scenario assumes that real electricity prices increase over the study period. It also assumes that federal and provincial government actions to mitigate climate change result in increased levels of complementary energy-efficiency initiatives. The upper Achievable Potential typically does not reach economic potential levels; this recognizes that some portion of the market is typically constrained by barriers that cannot realistically be affected by CDM programs within the study period.

9.2.1 Achievable Potential versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.

Exhibit 60 illustrates the relationship between Achievable Potential and the more detailed program design.

Exhibit 60 Achievable Potential versus Detailed Program Design



This study examined more than 80 technologies applicable to residential electric end uses. Although considerable effort has been made to obtain up-to-date information on each technology and to tailor it to the local market in NL, this is not a substitute for the type of detailed groundwork needed to prepare a utility program. For each of the technologies selected for further investigation, it will be important to obtain further information on the technical viability and durability of the products in the NL climate, on the costs in the NL marketplace, and on real savings under local conditions. If the viability of the technology is confirmed, an assessment of the market barriers is required, leading to the development of program strategies to overcome these barriers.

9.3 Approach to the Estimation of Achievable Potential

Achievable Potential was estimated in a five-step approach.

- Priority opportunities were selected
- Opportunity profiles were created
- Opportunity worksheets were prepared
- A full-day workshop was held
- Workshop results were aggregated and applied to the remaining opportunities.

Further discussion is provided below.

Step 1 Select Priority Opportunities

The first step in developing the Achievable Potential estimates required selection of the energy-saving opportunities identified in the Economic Potential Forecasts to be discussed during the Achievable workshop. Several criteria determined selection, including:

- The priority measures should represent a substantial fraction of the overall economic potential
- The priority measures should represent several different energy end uses
- The priority measures should have a variety of different likely patterns of market adoption, so the discussions will be widely varied.

A summary of the selected energy-efficiency actions, along with the approximate percentage that it represents in the Economic Potential Forecast, is provided in Exhibit 61.

Exhibit 61 Residential Sector Actions – Energy Efficiency

Measure #	Measure	End Use	Percentage of 2029 Economic Potential	
			Consumption Savings	Demand Savings
R1	Basement Insulation	Space Heating, Ventilation	13%	0%
R2	Mini-Split Heat Pumps	Space Heating	22%	0%
R3	High-Perf. New Homes	HVAC, Lighting, DHW	0%	0%
R4*	Cycling (DHW, Electric, Heat Pump, Dual Fuel)	DHW/Space Heating*	0%	91%
R5*	Electric Thermal Storage (Baseboard/Central)	Space Heating*	0%	0%
R6	Air Sealing (Professional/Homeowner)	Space Heating, Ventilation	1%	0%
R7	Low-Flow Faucets, Ultra Low-Flow Showerheads, Faucet Aerators	DHW	4%	0%
R8	Behavioral (Refrigerator Retirement, Minimize Hot Wash, Clothes Lines)	Refrigerator/DHW/Clothes Dryers	18%	0%
R9	Efficient & Super Efficient Clothes Washers	DWH, Clothes Washers, Clothes Dryers	2%	0%
Grand Total			**62%**	**91%**

* Demand (kW) measures

Step 2 Create Opportunity Assessment Profiles

The next step involved the development of brief profiles for each of the opportunities noted above in Exhibit 61, in the form of PowerPoint slides. The slides are presented in Appendix G.

The purpose of the opportunity profiles was to provide a high-level logic framework that would serve as a guide for participant discussions in the Achievable workshop (see Step 4 below). The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project. As illustrated in Appendix G, each opportunity profile addresses the following areas:

- **Technology Description** – provides a summary statement of the broad goal and rationale for the action.
- **Target Dwelling Type and Typical Application —** highlights the dwelling types and applications offering the most significant opportunities, and which provide a good starting point for discussion of the technology.
- **Financial and Economic Indicators —** provides estimates of average simple payback, cost of conserved electricity (CCE) and basis of assessment (full-cost versus incremental).
- **Eligible Participants —** provides an estimate of the number of dwellings or appliances that could be affected during the study period if the entire Economic Potential were to be captured.
- **Economic Potential versus Time —** shows the pattern of the changing size of the opportunity over the study period, for existing and new dwellings. Some opportunities grow steadily through the study period, as more and more appliances reach the age when they would be replaced. Other opportunities are economic to capture immediately, and after that the growth over time is limited to opportunities in new dwellings being built. Still other opportunities decline with time as they are eroded by natural conservation activities.

Step 3 Prepare Opportunity Worksheets

A draft assessment worksheet was also prepared for each opportunity profile in advance of the Achievable workshop. The assessment worksheets complemented the information contained in the opportunity profiles by providing quantitative data on the potential electric energy savings for each opportunity as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

The worksheets, including the results recorded during the workshop discussions, are provided in Appendix H. As illustrated in Appendix H, each opportunity assessment worksheet addresses the following areas:

- **Approximate Cost of Conserved Electricity (CCE) —** shows the approximate levelized cost of saving each kWh of electricity saved by the measure. For the purposes of the workshop, this information provided participants with an indication of the scope for using financial incentives to influence customer participation rates. In the case of demand measures, the Cost of Electricity Peak Reduction (CEPR), per kW, replaced the levelized cost of saving a kWh of electricity.
- **Customer Payback —** shows the simple payback from the customer's perspective for the package of energy-efficiency measures included in the opportunity. This information provided an indication of the level of attractiveness that the opportunity would present to customers. This provided an important reference point for the workshop participants when considering potential participation rates. When combined with the preceding CCE or CEPR information, participants were able to roughly estimate the level of financial incentives that could be employed to increase the opportunity's attractiveness to customers without making it economically unattractive to the Newfoundland utilities.
- **Economic Potential in Terms of Applicable Participants (e.g., number of dwellings) —** shows the total number of potential participants in terms of either dwellings or appliances (as appropriate) that could theoretically take part in the opportunity. Numbers shown are from the eligible populations used in the Economic Potential Forecasts.

- **Participation Rates (%) —** these fields were filled in during the workshops (described below in the following step), based on input from the participants. They show the percentage of economic savings that workshop participants concluded could be achievable in the last milestone period (usually 2029, but may be earlier for measures that peak earlier).
- **Achievable Potential in Terms of Applicable Participants (e.g., number of dwellings) —** these fields were calculated by the spreadsheet based on the participation rates provided by the participants.
- **Participation Rates Relative to the Discussion Scenario —** these fields were filled in during the workshops to provide guidance to the consulting team on how participation might differ in other regions or dwelling types, or for related or similar technologies.
- **Other Parameters —** these fields were filled in during the workshop to capture highlights of the discussion.

Step 4 Conduct Achievable Workshop

The most critical step in developing the estimates of Achievable Potential was a one-day Achievable Potential workshop that was held on April 21, 2015. Workshop participants consisted of core members of the consultant team, CDM program and technical personnel from the Utilities, industry representatives, and representatives of other stakeholders. Together, the participating personnel brought many years of experience to the workshop related to the technologies and markets.

The purpose of this workshop was to:

- Promote discussion regarding the technical and market constraints confronting the identified energy-efficiency opportunities
- Identify potential strategies for addressing the identified constraints, including potential partners and delivery channels
- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

Following a brief consultant presentation that summarized the residential sector study results to date, the workshop provided a structured assessment of each of the selected opportunities. Opportunity assessment consisted of a facilitated discussion of the key elements affecting successful promotion and implementation of the CDM opportunity. More specifically:

- What are the major constraints/challenges constraining customer adoption of the identified energy-efficiency opportunities?
  - How big is the “won't” portion of the market for this opportunity?
- Preferred strategies and potential partners for addressing identified constraints (high level only)
  - Key criteria that determine customers' willingness to proceed
  - Key potential channel partners
  - Optimum intervention strategies e.g., push, pull, combination
  - How sensitive is this opportunity to incentive levels?

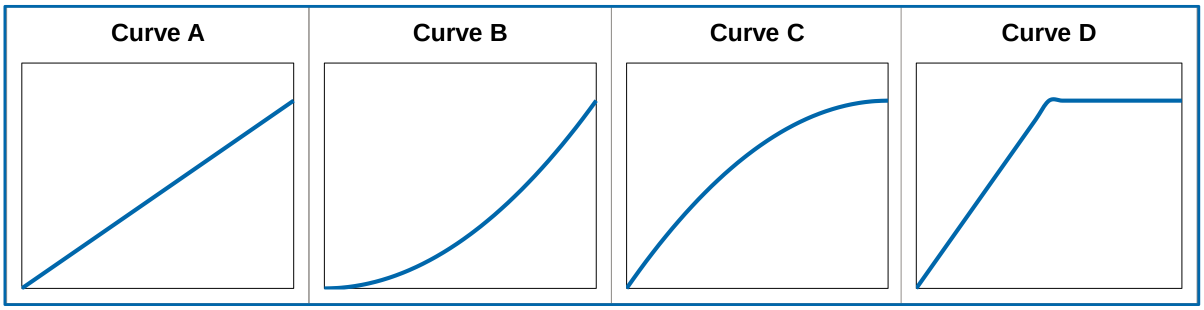
Following discussion of market constraints and potential intervention strategies, the participants' views on potential participation rates were recorded. The process involved the following steps:

- The participation rate for the upper Achievable scenario in 2029 was estimated.
- The shape of the adoption curve was selected for the upper Achievable scenario. Rather than seek consensus on the specific values to be employed in each of the intervening years,

workshop participants selected one of four curve shapes that best matched their view of the appropriate "ramp-up" rate for each opportunity (see Exhibit 62 below).

- The process was then repeated for the lower Achievable scenario.
- Once participation rates had been established for the specific technology, sub-sector and service region selected for the opportunity discussion, workshop participants provided the consultants with guidelines for extrapolating the discussion results to the other sub-sectors and service regions included in the opportunity, but not discussed in detail during the workshop. Where time permitted, participants also discussed how the adoption of similar, related technologies might differ from the technology being discussed.

Exhibit 62 Participation Rate "Ramp Up" Curves



Curve A represents a steady increase in the expected participation rate over the study period

Curve B represents a relatively slow participation rate during the first half of the study period followed by a rapid growth in participation during the second half of the 15-year study period

Curve C represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the study period

Curve D represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first half of the study period.

Step 5 Aggregate and Extend Opportunity Results

The final step involved aggregating the results of the individual opportunities to provide a view of the potential Achievable in both the Residential and Commercial sectors.

9.4 Achievable Workshop Results

The following sub-sections present a summary of the workshop discussions for each of the residential opportunities listed in Exhibit 61 above. The adoption rates and curves selected by the participant are summarized in Section 9.4.10. Included for each opportunity are:

- Participation estimates (for 2029) made by workshop participants, with comments, where needed, about values assumed in the calculations (presented in Section 9.5)
- Where needed, additional participation estimates made after the workshop for the purposes of the calculations (presented in Section 9.5)
- Selected highlights that attempt to capture key discussion themes related to the opportunity.

Appendix H provides copies of the assessment worksheets used during the workshop.

9.4.1 Basement Insulation

Achievable workshop participants provided 2029 participation rate estimates of 35% for the upper Achievable Potential scenario and 5-10% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in the upper Achievable Potential scenario would be B, while in the lower Achievable Potential scenario it would most likely be A.

Barriers that tend to lower adoption included the cost of insulation and basement finishing, low awareness of savings potential from basement insulation, as well as difficulties with the practicalities and logistics of implementing a large insulation project. NL has many do-it-yourselfers, who tend to postpone a project of this size. On the other hand, an aging population requires access to contractors, which can be limited outside of the Avalon Peninsula. Concerns were raised about insulation projects being completed incorrectly, installation in homes without ventilation systems, which could exacerbate moisture problems, and completed projects not being properly inspected. Additionally, the disruption caused by undertaking a large basement project could negatively affect participation, particularly for elderly occupants.

Potential strategies for addressing the market barriers include working with home inspectors during home purchases to explain where the best potential is and encourage basement insulation projects when the basement is empty during owner changeovers. Any techniques the utility could use to educate homeowners (and renters) and minimize the effort and disruption of the project would increase adoption. Energy audits could be paid for by the utility, and utilities could consider managing a list of contractors to complete the work. The cost savings due to improved insulation should be highlighted, and a split incentive for renters and landowners should be considered to increase adoption in rental units.

The initial discussion focused on existing single detached homes on the Island. Participants believed participation would be somewhat lower in attached homes and apartments, as well as all dwellings in Labrador and isolated regions due to reduced availability of contractors and materials. Participants also discussed some of the other insulation measures briefly. Improvements of crawl space insulation was thought likely to proceed similarly to basement insulation; wall insulation was deemed to be more difficult to implement and would be adopted less frequently; and attic insulation was thought likely to be adopted more often than basement insulation.

9.4.2 Ductless Mini-Split Heat Pumps

Achievable workshop participants provided 2029 participation rate estimates of 60% for the upper Achievable Potential scenario and 30% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both Achievable Potential scenarios would be B, and that mini-split heat pumps will be important in the reference case within 15 years.

Barriers that tend to lower adoption included the high cost, unit aesthetics, limited availability of qualified installers and the related variation in user satisfaction with the technology. The cost of materials and installation were estimated to be higher than those provided by the utility; participants estimated costs of around $6,000 - $8,000 total for multiple units, installed. Participants noted the technology must be selected and installed appropriately to ensure customer satisfaction. For example, low quality units may not perform well at low temperatures, improper heat loss calculations can lead to incorrect unit sizing, and homes with multiple heat sources should have the effects of these sources included in the overall heating design approach.

Potential strategies for addressing the market barriers include offering financing to mitigate high up-front costs and insisting on licensed installation to ensure the technology is applied appropriately. Proper installation can help to ensure users have and share positive experiences with the technology. These testimonials, paired with educating customers on product benefits to comfort and the additional function of air conditioning, can increase measure adoption and overcome reluctance to adopt a new technology.

The initial discussion focused on existing single detached homes on the Island grid. Participants believed participation would be somewhat lower in apartments and somewhat higher in new homes. In Labrador and isolated communities, participation would be lower because of the difficulty of finding materials and qualified installers in these communities. Participants also discussed some of the other heat pump measures briefly. Adoption of air-source, cold climate and air-to-water heat pumps were thought likely to proceed somewhat more slowly than adoption of mini-split heat pumps since all require additional materials, such as ducting or a radiant distribution system.

9.4.3 High-Performance New Homes

Achievable workshop participants provided 2029 participation rate estimates of 80% for the upper Achievable Potential scenario and 65% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve in both the upper and lower Achievable Potential scenarios would be A.

Barriers that tend to lower adoption included implementation cost, knowledge on the part of consumers and lack of builder experience in building and selling homes beyond the building code requirements. Home owners tend to not stay in the same home long enough to justify the initial costs of high-performing homes unless the home resale value is accordingly higher. Therefore, it is imperative to promote the value of the home rating system in terms of energy cost savings and improved comfort so subsequent buyers also understand the value of the improvements. Government labelling of high-performing homes could also offer useful differentiation; home certification could be subsidized and included in the program. Informing customers about the benefits could encourage homebuilders to create high-performance homes to meet the demand.

For program planning, the participants suggested increasing the performance requirements from an EnerGuide rating of 80 to 83, based on workshop participant understanding of the Nova Scotia ENERGY STAR® qualified New Home Construction program.[33] To achieve an EnerGuide rating of 80, participants typically see homes with rigid wall insulation, improved basement and attic insulation levels over code requirements and an HRV. To achieve a higher rating, in the mid-80s, homes generally need to also have a heat pump installed. Additionally, it was noted that rural new construction is typically not built to code, so overall energy savings could be greater if high-performance homes were implemented successfully in those jurisdictions.

There was some discussion in the workshop session about the percentage energy savings used to evaluate this measure. In the model, a base case energy performance of EnerGuide 76 was assumed for average newly constructed homes, based on data in the Residential End Use Survey and information on typical construction practices provided by client staff. Based on the discussions in the workshop, there is some uncertainty about whether average new homes in NL would be rated that high. If an EnerGuide rating closer to 70 is more accurate, the savings for this measure would be larger.

The initial discussion focused on existing single detached homes in the Island grid. Participants believed participation would be the same for attached homes and lower in Labrador and Isolated communities. Participants also discussed some of the other measures in the new construction

[33] The Efficiency Nova Scotia New Home Construction program considers homes that meet ENERGY STAR® high efficiency requirements and those that have an EnerGuide rating of 85 or higher, R2000 certification or Passive House certification.

categories. Both net-zero homes and LEED apartments were expected to be adopted at a rate lower than that of high-performance new homes.

9.4.4 Heat Cycling

Achievable workshop participants provided 2029 participation rate estimates of 2% for the upper Achievable Potential scenario and no participation for the lower Achievable Potential scenario. Participants thought the most likely adoption curve would be A.

Barriers that tend to lower adoption included customer comfort, loss of temperature control and the necessity for high value incentives. Unless a home has a secondary heating fuel available, adoption rates would be nominal based on comfort alone. Additionally, workshop participants warned that some customers might participate in a heat cycling program for the incentive but install portable heaters to meet their heating requirements, undermining any peak demand savings to the utility. Since the measure is invasive and there are no time-of-use rate charges to customers, a large incentive would be required to encourage participation—an incentive likely larger than its value to the utility, particularly when the cost of cycling equipment and its installation are included.

The initial discussion focused on existing single detached homes in the Island grid. Participants believed participation would be essentially the same across dwelling types and regions. Participants also discussed some of the other cycling measures. Heat cycling in homes with a secondary heating fuel available was expected to be adopted at a much higher rate. DHW cycling was also expected to have much higher adoption rates since the effects would likely go unnoticed by participants with hot water storage tanks. Newfoundland Power has run a pilot program on DHW cycling and was able to provide crucial insight, after the workshop, on likely uptake of a full-scale program targeting that technology.

9.4.5 Electric Thermal Storage

Achievable workshop participants provided 2029 participation rate estimates of 1% for the upper Achievable Potential scenario and no participation for the lower Achievable Potential scenario.

Barriers that tend to lower adoption included the lack of financial incentive for customers to install the unit and aesthetics. Newfoundland does not currently use customer time-of-use rates, so there is no incentive for a customer to shift their peak electrical load. Unless the utility is willing to pay for the whole project cost, there is no reason a customer would implement this measure. The utilities would need to implement time-of-use rates, and upgrade current meters accordingly, in order for this measure to be considered by the customer.

The initial discussion focused on electric thermal storage units with baseboard heaters in existing single detached homes on the Island grid. Participants believed participation would be the same across dwelling types and regions. Participation in a program for a central electric thermal storage unit were estimated to be lower.

9.4.6 Air Sealing

The workshop principally considered homeowner air sealing projects over professionally completed work due to the difference in pricing. Achievable workshop participants provided 2029 participation rate estimates of 65% for the upper Achievable Potential scenario, which assumes a bundling of energy efficiency projects with a home energy audit, and 20% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve both scenarios would be A.

Barriers that tend to lower adoption included the lack of homeowner knowledge of leakage areas or awareness of the importance of sealing, as well as the lack of confidence or physical ability to properly complete the project. Without education, the project could be completed incorrectly: sealing would be limited to the “usual suspect” areas, sealing could exacerbate the problem if done incorrectly or the home could be made too tight, which could cause other issues in a home without an HRV. Additionally, homeowners could risk personal injury if they are not physically able to complete the project safely.

Strategies to encourage adoption of homeowner air sealing would include education and demonstrations since cost is not a main barrier. Instructional videos could be made available online, and prepackaged kits with an instructional video to show installation could improve results. Additionally, a home energy audit could be conducted including a blower door test to pinpoint leakage areas. An energy audit approach could be effective at education and would work best with a bundle of envelope measures to justify its cost.

The initial discussion focused on existing single detached homes on the Island grid. Participants believed participation would be somewhat lower in attached homes and apartments. Participation in Labrador was believed to be the same, but lower in the Isolated region where most homes are not electrically heated. Participants also discussed some of the other sealing measures. Weather-stripping maintenance was thought to have similar adoption rates, whereas professional air sealing and a combined air sealing and attic insulation in old (pre-1980) homes measure would have lower participation due to their higher cost.

9.4.7 Low-Flow Water Fixtures

Achievable workshop participants provided 2029 participation rate estimates of 20% for the upper Achievable Potential scenario and 5% for the lower Achievable Potential scenario. Participants thought the most likely adoption curve both scenarios would be A.

Barriers that tend to lower adoption included a poor perception of low-flow showerheads and a lack of appreciation for the effect water fixtures have on DHW usage. Low-flow showerheads have historically been perceived to deliver a poor quality shower; improvements to the technology have not completely removed that perception, which could partially explain why 1.25 gpm showerheads are rarely available in the province. Participants also pointed out that low-flow can mean different thresholds for different certifications and consumers cannot always differentiate. The low-flow showerhead measure will never capture those who want rainwater showerheads or those who remove flow restrictors. For faucets, most models already have aerators. In general, customers think that water fixtures most affect water usage, a resource not metered in Newfoundland, and neglect the cost of heating the water.

Strategies to encourage adoption of low-flow water fixtures include educating customers on the cost savings associated with heating less water, distinguishing truly water-saving fixtures from imitations, potentially creating a low-flow kit and directly installing the products.

The initial discussion focused on ultra low-flow showerheads in existing single detached homes on the Island grid. Participants believed participation would be somewhat lower in attached homes and apartments. Participants thought adoption would be the same for homes on the Labrador grid and lower in isolated communities. Washroom faucets would likely have lower adoption due to the higher cost of replacing the full fixture, and kitchen faucet aerators would have higher adoption than showerheads.

9.4.8 Behavioral Measures

Achievable workshop participants first focused on the potential for using clothes lines instead of clothes dryers and then expanded the conversation to refrigerator retirement and minimizing hot water clothes washes. For clothes lines, participants provided 2029 participation rate estimates of 10% for the upper Achievable Potential scenario and no participation above the reference case for the lower Achievable Potential scenario. For refrigerator retirement, participants provided 2029 participation rate estimates of 60% for the upper Achievable Potential scenario and 30% for the lower Achievable Potential scenario. Participation rates for minimizing hot water washing would fall between those rates provided for clothes lines and refrigerator retirement. For all measures, participants thought the most likely adoption curve would be A.

Barriers that tend to lower adoption of clothes lines include subdivision covenants disallowing them and weather constraints. Increasing clothes line use is limited to the number of days when weather is appropriate for outdoor clothes drying, unless a covered space outdoors is available. Using a drying rack inside essentially uses electric heat to dry the clothes and can cause indoor air quality issues, so there is little incentive to encourage this behavioral change. Participants largely perceive that those who can and would already do use clothes lines, and that there is little room for improvement. An education campaign could moderately increase participation.

Barriers to minimizing hot clothes washing include a concern for germs or dust mites and a perception that Newfoundland water is too cold, so a moderate amount of hot water is added even for the cold water wash. Participants agreed that customers generally tend to use hot water to wash bed sheets, but rarely for clothes. Education could capture those who use hot or warm wash for clothing.

Barriers that tend to lower retirement of a second refrigerator include the difficulty of physically removing the refrigerator and properly disposing of it, as well as an ingrained “shed culture” that can include a second refrigerator if the shed has access to electricity. Strategies to encourage removal may include working with retailers to educate consumers about the program and coordinating with service districts to offer free refrigerator removal and disposal. To overcome the “shed” refrigerator phenomenon, the younger generation raised in a recycling culture could be leveraged to encourage older generations to remove extra refrigerators. The cost to operate them is rarely the key factor in removal decisions.

The initial discussion focused on existing single detached homes on the Island grid. Participants noted that the adoption rate for attached homes and apartments would likely be lower since there are fewer opportunities for clothes lines, second refrigerators and, in the case of apartments, individual clothes washer units. Homes in Labrador would have a similar adoption rate, whereas those in isolated communities would have higher rates of adoption due to higher sensitivity to electricity costs.

9.4.9 High Efficiency Clothes Washers

Achievable workshop participants provided 2029 participation rate estimates of 20% for the upper Achievable Potential scenario and 10% for the lower Achievable Potential Scenario. Participants thought the most likely adoption curve both scenarios would be A.

Barriers that tend to lower adoption include a high first cost, lack of engaged retailers and low awareness of the electricity cost of a wash of clothes. The current program relies heavily on retailers effectively educating customers on which models qualify for an incentive, since the program does not reference a standard, such as ENERGY STAR® or CEE. At the same time, the existing program offers an incentive exclusively to customers, not to the retailers. Indeed, working with retailers was noted as the most critical program support action for increased adoption of this measure.

Strategies to encourage adoption of high efficiency clothes washers could include incentives to retailers, a program based on a clear standard instead of “qualifying models” and education programs aimed at consumers to increase awareness of the electricity cost of clothes washers (including drying). It was noted that clothes washers are one of the products with the largest uptake in the current Newfoundland TakeCharge program. It should also be noted that the current program does use a clear standard for clothes washers, but the standard is not referenced in marketing materials, because in the past it has caused confusion and rebate rejection among customers. The qualifying model approach was found to be superior.

The initial discussion focused on existing single detached homes on the Island grid. Participants expected adoption to be higher in new homes, but lower in attached homes and apartments. Lower participation rates were expected in Labrador and Isolated regions due to decreased product accessibility.

Participants discussed some of the other high efficiency appliance measures. Adoption rates of ENERGY STAR® refrigerators and freezers were expected to be lower, whereas ENERGY STAR® dishwashers were expected to have higher adoption rates than high efficiency clothes washers.

9.4.10 Aggregate Results

Exhibit 63 summarizes the participant rate and “ramp up” curve assumptions discussed above.

Exhibit 63 Summary of Achievable Potential Participation Rates and Curves

Technology	Lower Achievable Potential		Upper Achievable Potential	
	2029 Participation Factor	Adoption Curve	2029 Participation Factor	Adoption Curve
R1: Basement Insulation	25%	Curve A	35%	Curve B
R2: Mini-Split Heat Pumps	30%	Curve B	60%	Curve B
R3: High-Perf. New Homes	52%	Curve A	64%	Curve A
R4: Cycling (DHW, Electric, Heat Pump, Dual Fuel)	5%	Curve A	10%	Curve A
R5: Electric Thermal Storage (Baseboard/Central)	0%	N/A	0%	N/A
R6: Air Sealing (Professional/Homeowner)	20%	Curve A	65%	Curve A
R7: Low-Flow Faucets, Ultra Low-Flow Showerheads, Faucet Aerators	5%	Curve A	20%	Curve A
R8: Behavioral (Refrigerator Retirement, Minimize Hot Wash, Clothes Lines)	0% (Clothes Lines) 15% (Hot Wash) 30% (Fridge)	Curve A	10% (Clothes Lines) 35% (Hot Wash) 60% (Fridge)	Curve A
R9: Efficient & Super Efficient Clothes Washers	20% (Efficient) 10% (Super)	Curve A	40% (Efficient) 20% (Super)	Curve A

As noted earlier, it was not possible to fully address all opportunities in the one-day workshop. Consequently, the workshop focused on opportunities selected based on the criteria described in Step 1. Estimated participation rates for the remaining opportunities were extrapolated from the workshop results shown above and an aggregate set of results was prepared that included all of the eligible technologies.

The results shown in the attached appendices and in the following summary section incorporate the results of all these inputs.

9.5 Summary of Potential Electric Energy Savings

This section presents a summary of the electric energy savings for the upper and lower achievable potential scenarios. The summary is organized and presented in the following sub-sections:

- Overview and selected highlights
- Electric energy savings – Upper Achievable scenario
- Electric energy savings – Lower Achievable scenario.

9.5.1 Overview and Selected Highlights

Exhibit 64 presents an overview of the results for the total Newfoundland service territory by milestone year, for three scenarios: Economic Potential, upper Achievable Potential and lower Achievable Potential.

Exhibit 64 Electricity Savings by Milestone Year for Three Scenarios (GWh/yr.)

Year	Economic Potential		Upper Achievable		Lower Achievable	
	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case	Potential Savings (GWh/yr.)	% Savings Relative to Reference Case
2017	1,336	31%	63	1.5%	28	0.6%
2020	1,378	32%	157	3.6%	78	1.8%
2023	1,411	31%	286	6.4%	151	3.4%
2026	1,455	32%	456	10%	244	5.3%
2029	1,485	32%	650	14%	336	7.2%

Selected Highlights – Potential Electric Energy Savings

Selected highlights of the potential electric energy savings for the upper and lower achievable potential scenarios shown in Exhibit 64 are summarized below. Further detail is provided in the following sub-sections and in the accompanying appendices.

Savings by Milestone Year

Savings in both Achievable scenarios are reached somewhat more steadily throughout the period than in the Economic Potential scenario. In the upper Achievable Potential scenario, 24% of the 2029 savings would be achieved by 2020, rising to 44% in 2023 and 70% by 2026. In the lower Achievable Potential scenario, 8% of the 2029 savings would be achieved by 2020, rising to 45% in

2023 and 72% by 2026. Although there are some measures in both scenarios that can be implemented early in the study period, the majority are expected to follow an adoption curve that starts slowly and builds up towards 2029.

Savings by Dwelling Type

Single-family dwellings account for approximately 93% of each of the upper and lower Achievable Potential savings; this reflects their larger market share and their generally higher level of energy intensity per dwelling. In fact, the subset of single-family dwellings predominantly heated by electricity account for 85% of the 2029 upper Achievable Potential and 88% of the 2029 lower Achievable Potential. This reflects the new construction expected during the study period and the substantial amount of electric heat these new dwellings are expected to include.

Savings by Region

The Island Interconnected region accounts are expected to comprise 95% of potential savings in 2029. The Labrador Interconnected region accounts provide 4%, and the Isolated region provides 1% of the potential savings in 2029.

Savings by End Use

Space heating savings account for 71% of the upper Achievable Potential savings in 2029 and 78% of the lower Achievable Potential savings. The most significant measures that save space heating include ductless mini-split heat pumps, basement and crawl space insulation, attic sealing and insulation of old (pre-1980) homes, attic insulation and door systems.

Space heating accounts for a very large percentage of the potential, but the space heating savings potential is also a very large percentage of the reference case space heating consumption. Between 12% and 20% of space heating could potentially be saved, respectively, in the lower and upper Achievable Potential scenarios. The potential in electrically-heated dwellings, as a percentage of their reference case consumption, is just over two times as large as it is in dwellings without electric heat.

Domestic hot water savings account for 7% of 2029 upper Achievable Potential savings and 5% of lower Achievable Potential savings. The measure that saves the most domestic hot water is the behavioral measure to minimize the use of hot water when washing clothes.

Refrigerators account for approximately 6% of 2029 savings, televisions and their peripherals account for approximately 3-4%, and clothes dryers account for 2-4%. The reduction in refrigerator electricity comes principally from retiring second (and third) refrigerators, as well as a small portion is attributed to increasing refrigerator temperature set points to the recommended storage temperature. The savings in televisions and their peripherals are expected to come primarily from the use of smart power bars that reduce standby losses. Clothes lines dominate the savings for clothes dryers in the upper Achievable Potential, whereas the dryer savings from efficient clothes washers dominate lower Achievable Potential savings. (Efficient clothes washers save a great deal of dryer energy because of their faster spin speeds.)

The remaining end uses are all under 3% in both scenarios. There are savings available in 14 other end uses. Together they account for approximately 8% of upper Achievable Potential savings in 2029 and approximately 6% of lower Achievable Potential savings in 2029.

Savings by Measure

The most significant savings in the Achievable Potential come from the following measures:

- Ductless mini-split heat pumps, which account for 39% of the upper Achievable Potential savings in 2029 and 40% of the lower Achievable Potential savings in 2029
- Basement insulation, which accounts for nearly 10% of the upper Achievable Potential savings in 2029 and 14% of the lower Achievable Potential savings in 2029
- Crawl space insulation, which accounts for 8.5% of the upper Achievable Potential savings in 2029 and nearly 12% of the lower Achievable Potential savings in 2029
- Attic sealing and insulation of old (pre-1980) homes, which accounts for 7.4% of the upper Achievable Potential savings in 2029 and 4.4% of the lower Achievable Potential savings in 2029
- Refrigerator retirement, which accounts for 5.7% of the upper Achievable Potential savings in 2029 and 5.5% of the lower Achievable Potential savings in 2029
- Attic insulation, which accounts for 3.1% of the upper Achievable Potential savings in 2029 and 4.3% of the lower Achievable Potential savings in 2029
- Minimize hot water clothes wash, which accounts for 3.8% of the upper Achievable Potential savings in 2029 and 3.2% of the lower Achievable Potential savings in 2029.

There are numerous other smaller measures that contribute to the overall Achievable Potential results.

9.5.2 Electric Energy Savings – Upper Achievable Scenario

The following exhibits present the potential electricity savings[34] under the upper Achievable Potential scenario. The results shown are relative to the Reference Case. The results are broken down as follows:

- Exhibit 65 presents the results by region and by milestone year
- Exhibit 66 presents the results for the total NL service territory by dwelling type and milestone year
- Exhibit 67 presents the results for the total NL service territory by end use and milestone year
- Exhibit 68 presents the results for the total NL service territory by technology and milestone year.

Exhibit 65 Upper Achievable Electricity Savings by Region (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Island Interconnected	60,930	150,463	274,926	437,615	621,508	15%	96%
Labrador Interconnected	1,481	4,645	8,407	14,114	22,015	6%	3%
Isolated (Diesel)	723	1,638	2,832	4,363	6,187	14%	1%
Grand Total	63,135	156,746	286,164	456,092	649,710	14%	100%

[34] Note: A value of “0” in the following exhibits means a relatively small number, not an absolute value of zero.

Exhibit 66 Upper Achievable Electricity Savings by Dwelling Type and Milestone Year (MWh/yr.)

Dwelling Type	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Apartment, electric space heat	1,649	3,347	5,290	7,329	9,303	3%	1%
Apartment, non-electric space heat	72	116	202	278	329	2%	0%
Attached, electric space heat	3,791	8,049	13,295	20,351	28,796	5%	4%
Attached, non-electric space heat	442	825	1,255	1,706	2,309	6%	0%
Other and non-dwellings	423	866	1,443	2,291	3,196	3%	0%
Single-family detached, electric space heat	46,779	124,913	236,531	385,503	553,925	20%	85%
Single-family detached, non-electric space heat	9,658	18,019	27,225	37,363	50,241	7%	8%
Vacant and partial	321	612	922	1,271	1,611	2%	0%
Grand Total	63,135	156,746	286,164	456,092	649,710	14%	100%

Note: Any difference in totals is due to rounding.

Exhibit 67 Upper Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Space heating	29,570	92,975	188,075	311,525	464,149	20%	71%
Domestic Hot Water (DHW)	8,569	16,993	25,827	36,754	46,039	8%	7%
Refrigerator	7,474	15,137	22,980	30,780	38,554	18%	6%
Clothes dryer	3,833	7,050	10,810	19,633	26,239	11%	4%
Television	4,410	8,388	13,007	18,130	23,475	12%	4%
Computer and peripherals	2,782	5,162	8,627	14,422	17,978	7%	3%
Lighting	3,481	5,504	7,146	8,549	9,799	8%	2%
Ventilation	616	1,518	2,999	6,929	11,828	14%	2%
Hot tubs	1,248	1,829	2,722	3,575	4,443	6%	1%
Television peripherals	450	936	1,466	2,024	2,600	3%	0%
Dehumidifier	166	269	869	1,321	1,467	2%	0%
Cooking	197	391	588	784	987	1%	0%
Freezer	130	230	526	757	1,014	1%	0%
Other electronics	132	278	440	613	797	2%	0%
Clothes washer	37	33	44	251	358	4%	0%
Dishwasher	21	43	65	87	109	1%	0%
Block heaters & car warmers	9	18	28	93	119	8%	0%
Space cooling	10	(8)	(56)	(135)	(245)	-12%	0%
Grand Total	63,135	156,746	286,164	456,092	649,710	14%	100%

Notes: DHW savings include savings from reduced DHW consumption by efficient clothes washers and dishwashers. Space cooling has negative savings in some milestone years because the adoption of mini-splits and other heat pumps is assumed to introduce some new cooling consumption for customers who did not have air conditioning before.
Any difference in totals is due to rounding.

Exhibit 68 Upper Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

Measure	Year					Adoption Curve	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
Refrigerator Retirement	7,093	14,387	21,882	29,363	36,850	A	0	0	0
Min Hot Wash	4,957	9,961	15,028	19,871	24,626	A	0	0	0
Overnight Setback	3,277	6,559	9,698	12,372	14,451	A	0	0	0
Weather Stripping Maintenance	2,568	4,982	7,135	8,921	10,270	A	0	0	0
Close Blinds	2,048	4,121	6,130	7,869	9,257	A	0	0	0
Daytime Setback	1,963	3,928	5,806	7,402	8,641	A	0	0	0
DHW Temperature	605	1,215	1,833	2,424	3,004	A	0	0	0
Turn Off TVs	353	733	1,144	1,570	2,015	A	0	0	0
Clothes Dryer Sensor	356	736	1,143	1,523	1,919	A	0	0	0
Refrigerator Temperature	381	744	1,088	1,401	1,685	A	0	0	0
Unplug Chargers	132	278	440	613	797	A	0	0	0
Min Outdoor Lighting	140	265	405	548	710	A	0	0	0
PC Power Management	99	223	366	516	680	B	0	0	0
Freezer Temperature	110	222	335	448	560	A	0	0	0
Turn Off Lights	12	19	26	33	40	A	0	0	0
AC Temperature	24	50	81	116	157	A	0	N/A	N/A
Clothes Lines	3,000	6,151	9,467	12,504	15,625	A	0.5	0.5	0.5
Faucet Aerator	492	1,021	1,589	2,160	2,735	A/B	0.8	0.7	0.8
Showerheads	1,109	2,298	3,579	4,863	6,160	A	1.2	1.1	1.2
DHW Pipe Insulation	228	439	632	787	907	A/B	1.4	1.3	1.4
Prog. Thermostats (Central)	0	0	0	0	0	A	1.9	1.5	2.6
T8 Fixtures	1	2	3	5	7	B	2.4	2.4	2.4
Benchmarking	590	1,094	1,646	2,193	2,757	A/B	2.5	2.3	3.1
Hot Tub Covers	1,094	1,610	2,404	3,167	3,947	A	3.1	3.1	3.1
Door Systems	829	3,020	6,040	9,548	13,269	A	3.1	3.8	3.5
Crawl Space Insulation	2,084	8,827	19,866	35,342	55,268	A	3.6	4.2	4.1
LED Lamps	2,935	4,453	5,504	6,274	6,809	A	3.6	3.6	3.6
ECPM Fan Motors	214	538	1,278	4,341	8,236	A	4.6	6.1	14.5
Motion Detectors - Outdoor	209	454	771	1,122	1,521	A	4.8	3.8	4.1
Electronic Thermostats	85	288	765	1,294	2,080	A	5.2	4.9	10.3
ESTAR Dehumidifiers	53	42	520	848	863	A	5.6	5.6	5.6
ESTAR Freezers	18	5	183	296	434	A	5.8	5.8	5.8

Exhibit 68 Continued: Upper Achievable Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Year					Adoption Curve	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
Power Bars (TVs)	3,357	7,124	11,395	16,149	21,034	A	5.8	3.0	6.1
Basement Insulation	2,244	10,025	22,573	40,177	64,501	A	6.0	4.7	5.4
Faucets	720	1,511	2,385	3,282	4,210	A	6.3	1.0	7.2
Efficient Clothes Washers	580	89	118	8,106	12,151	A	6.4	6.2	18.0
ESTAR Computers	582	76	22	2,354	2,080	A	6.6	6.6	6.6
Attic Insulation	731	2,924	6,578	12,724	19,901	A	7.3	5.8	7.3
Power Bars (PCs)	2,101	4,863	8,239	11,552	15,218	A	7.6	3.9	8.4
Mini-Splits	10,149	40,865	93,543	165,980	256,364	A	8.0	N/A	8.7
Prog. Thermostats	173	319	451	576	668	A	8.0	5.2	13.4
ESTAR TVs	1,059	1,278	1,642	2,036	2,513	A	8.0	N/A	8.0
Super Efficient Clothes Washers	134	154	177	195	217	A	9.6	N/A	20.2
DHW Tank Insulation	243	467	672	837	964	A	10.3	N/A	10.9
Timers - Outdoor	184	310	432	558	699	A/B	11.0	N/A	11.0
Air Sealing	2,387	4,774	7,161	9,552	11,947	A	12.4	N/A	15.0
Sealing & Insul. - Old Homes	9,749	19,462	29,138	38,797	48,435	A	12.5	N/A	15.7
Car Warmer Timers	9	18	28	39	49	A	N/A	0.9	N/A
Block Heater Timers	-	-	-	54	69	B	N/A	5.9	N/A
Cold Climate Heat Pump	1	5	12	22	34	A	N/A	N/A	12.5
Super Efficient Freezers	1	4	8	13	20	A/B	N/A	N/A	14.5
ESTAR Dishwashers	0	1	3	5	5	A	N/A	N/A	14.5
Air-Source Heat Pump	3	11	28	55	92	A	N/A	N/A	17.0
ESTAR Windows	17	0	1	3	7	A	N/A	N/A	17.0
High-Perf. New Homes	13	43	116	223	362	A	N/A	N/A	17.7
Super Efficient Refrigerators	-	6	10	15	20	B	N/A	N/A	23.5
Air-to-Water Heat Pumps	-	24	62	120	202	A	N/A	N/A	24.2
Super Windows	-	1	3	4	6	A	N/A	N/A	25.5
Motion Detectors - Indoor	-	-	3	3	4	A	N/A	N/A	26.4
HRVs	-	-	3	6	9	A	N/A	N/A	28.4
Professional Air Sealing	-	-	-	27	34	A	N/A	N/A	33.2
HVAC Impact from Other Savings	(8,362)	(16,274)	(25,425)	(37,103)	(48,384)				
Grand Total	63,135	156,746	286,164	456,092	649,710				

Note: Curves A and B in this exhibit are as presented in Exhibit 62.
In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

Exhibit 68 provides results at a sufficient level of detail that some modeling issues require explanation:

- Some measures show an initially high potential, which then drops off in the second milestone period and begins to increase again towards the end of the study period. This is primarily caused by two details in the model. First, the avoided cost values for the Island Interconnected region, as shown in Exhibit 38, are projected to decrease dramatically after 2018 and then eventually rise again. This causes the adoption of some measures to halt temporarily in the middle of the study. For many measures, there is also an assumed rate of natural adoption in the reference case. For these measures, the reference case adoption may "catch up" to the adoption in the achievable potential scenario, reducing the potential shown by the model.
- In some cases, the potential shown in this exhibit is lower than for the same measure in Exhibit 72. This occurs for measures that are late in the "cascade" of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much higher savings in the Upper Achievable than in the Lower Achievable scenarios, leaving less energy to be saved by later measures in the sequence.
- The CCE values in Exhibit 68 do not always match those presented elsewhere in the report. The CCE values presented in these exhibits are calculated weighted averages, based on the particular mixture of dwelling types and regions in which the measure is applied in this scenario. For most measures, the CCE varies by dwelling type and region, because of varying savings and costs. If the mixture of dwellings in the Upper Achievable scenario is different from the mixture in the Lower Achievable scenario, the weighted average CCE will be somewhat different. In general, the CCE values in this chapter will be lower than those presented in Chapter 7, because the economic screening removes the most expensive applications of most measures.
- The last measure in the table, HVAC Impact from Other Savings, accounts for the added load on the electric heating systems in dwellings where savings are occurring for many other end uses in the home. As discussed in Section 8.5.3, the savings for end uses such as lighting, appliances, and electronics are multiplied by a factor based on modeling of NL dwellings. The resulting heating penalty is added as a separate line item in this exhibit.

9.5.3 Electric Energy Savings – Lower Achievable Scenario

The following exhibits present the potential electricity savings[35] under the lower Achievable Potential scenario. The results shown are relative to the Reference Case. The results are broken down as follows:

- Exhibit 69 presents the results by supply system, by region and milestone year
- Exhibit 70 presents the results for the total NL by dwelling type and milestone year
- Exhibit 71 presents the results for the total NL by end use and milestone year
- Exhibit 72 presents the results for the total NL by technology and milestone year.

Exhibit 69 Lower Achievable Electricity Savings by Region (MWh/yr.)

Region	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Island Interconnected	26,944	74,101	144,481	231,445	317,592	7%	95%
Labrador Interconnected	553	2,780	5,500	10,122	15,393	4%	5%
Isolated (Diesel)	300	717	1,297	2,074	3,035	7%	1%
Grand Total	27,797	77,598	151,279	243,641	336,020	7%	100%

[35] A value of "0" in the following exhibits means a relatively small number, not an absolute value of zero.

Exhibit 70 Lower Achievable Electricity Savings by Dwelling Type and Milestone Year (MWh/yr.)

Dwelling Type	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Apartment, electric space heat	645	1,334	2,150	2,975	3,684	1%	1%
Apartment, non-electric space heat	29	44	78	109	129	1%	0%
Attached, electric space heat	1,665	3,877	6,816	10,428	14,529	3%	4%
Attached, non-electric space heat	175	321	491	674	939	2%	0%
Other and non-dwellings	201	460	831	1,291	1,653	2%	0%
Single-family detached, electric space heat	21,228	64,452	130,135	213,198	294,438	10%	88%
Single-family detached, non-electric space heat	3,727	6,867	10,411	14,453	19,994	3%	6%
Vacant and partial	128	242	367	512	654	1%	0%
Grand Total	27,797	77,598	151,279	243,641	336,020	7%	100%

Note: Any difference in totals is due to rounding.

Exhibit 71 Lower Achievable Electricity Savings by End Use and Milestone Year (MWh/yr.)

End Use	2017	2020	2023	2026	2029	2029 Savings Relative to Ref Case	Percentage of Total 2029 Savings
Space heating	14,749	53,110	113,485	186,256	262,011	11%	78%
Refrigerator	3,713	7,528	11,440	15,340	19,236	9%	6%
Domestic Hot Water (DHW)	2,939	5,779	8,792	12,931	16,280	3%	5%
Television	1,973	3,706	5,734	7,989	10,357	5%	3%
Computer and peripherals	1,236	2,220	3,702	6,380	7,892	3%	2%
Lighting	1,632	2,544	3,250	3,828	4,316	3%	1%
Ventilation	300	829	1,725	3,822	6,236	7%	2%
Clothes dryer	417	449	672	3,575	5,329	2%	2%
Hot tubs	340	498	740	972	1,208	2%	0%
Television peripherals	193	401	629	870	1,118	1%	0%
Dehumidifier	75	119	410	628	693	1%	0%
Cooking	84	168	252	336	423	0%	0%
Freezer	57	99	239	347	468	0%	0%
Other electronics	57	119	189	263	342	1%	0%
Clothes washer	18	15	19	123	176	2%	0%
Dishwasher	9	19	28	37	47	0%	0%
Block heaters & car warmers	2	5	7	23	30	2%	0%
Space cooling	3	(8)	(36)	(80)	(141)	-7%	0%
Grand Total	27,797	77,598	151,279	243,641	336,020	7%	100%

Note: DHW savings include savings from reduced DHW consumption by efficient clothes washers and dishwashers. Space cooling has negative savings in some milestone years because the adoption of mini-splits and other heat pumps is assumed to introduce some new cooling consumption for customers who did not have air conditioning before.
Any difference in totals is due to rounding.

Exhibit 72 Lower Achievable Electricity Savings by Technology and Milestone Year (MWh/yr.)

Measure	Year					Adoption Curve	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
Refrigerator Retirement	3,546	7,193	10,941	14,682	18,425	A	0	0	0
Min Hot Wash	2,133	4,303	6,519	8,676	10,807	A	0	0	0
Overnight Setback	1,415	2,869	4,324	5,691	6,992	A	0	0	0
Close Blinds	884	1,801	2,728	3,607	4,451	A	0	0	0
Daytime Setback	848	1,718	2,588	3,405	4,182	A	0	0	0
Weather Stripping Maintenance	795	1,561	2,274	2,923	3,524	A	0	0	0
Clothes Dryer Sensor	178	368	572	771	978	A	0	0	0
Turn Off TVs	154	323	510	711	924	A	0	0	0
Refrigerator Temperature	166	331	495	651	801	A	0	0	0
Unplug Chargers	57	119	189	263	342	A	0	0	0
Min Outdoor Lighting	61	117	181	250	328	A	0	0	0
PC Power Management	43	95	157	222	292	A	0	0	0
Freezer Temperature	47	95	144	192	240	A	0	0	0
Turn Off Lights	5	8	11	14	18	A	0	0	0
AC Temperature	10	21	33	47	62	A	0	N/A	N/A
Faucet Aerator	123	255	397	540	684	A	0.8	0.7	0.8
Showerheads	277	575	895	1,216	1,540	A	1.2	1.1	1.2
DHW Pipe Insulation	57	110	158	197	227	A	1.4	1.3	1.4
Prog. Thermostats (Central)	0	0	0	0	0	A	1.9	1.5	2.6
T8 Fixtures	0	0	1	1	2	A	2.4	2.4	2.4
Benchmarking	253	471	710	949	1,196	A	2.4	2.3	3.1
Hot Tub Covers	273	402	601	792	987	A	3.1	3.1	3.1
Door Systems	828	3,017	6,034	8,592	9,649	A/B	3.1	3.8	3.5
Crawl Space Insulation	2,082	8,819	19,847	31,747	40,038	A/B	3.6	4.2	4.1
LED Lamps	1,467	2,226	2,752	3,137	3,405	A	3.6	3.6	3.6
ECPM Fan Motors	107	269	639	2,194	4,207	A	4.6	6.1	14.5
Motion Detectors - Outdoor	52	113	193	280	380	A	4.8	3.8	4.1
Electronic Thermostats	21	74	201	354	600	A	5.2	4.9	10.2
ESTAR Dehumidifiers	27	21	260	424	432	A	5.6	5.6	5.6
ESTAR Freezers	9	2	92	148	217	A	5.8	5.8	5.8
Power Bars (TVs)	1,443	3,064	4,905	6,957	9,071	A	5.8	3.0	6.1
Basement Insulation	2,241	10,011	22,542	36,293	47,561	A/B	6.0	4.7	5.4

Exhibit 72 Continued: Lower Achievable Electricity Savings by Measure and Milestone Year (MWh/yr.)

Measure	Year					Adoption Curve	Weighted Average CCE (¢/kWh)		
	2017	2020	2023	2026	2029		Island	Labrador	Isolated
Faucets	180	378	596	821	1,053	A	6.3	1.0	7.2
Efficient Clothes Washers	290	44	59	4,053	6,075	A	6.4	6.2	18.0
ESTAR Computers	291	38	11	1,177	1,040	A	6.6	6.6	6.6
Attic Insulation	730	2,920	6,570	11,461	14,503	A/B	7.3	5.8	7.3
Power Bars (PCs)	902	2,086	3,534	4,980	6,559	A	7.6	3.9	8.4
Mini-Splits	5,105	20,676	47,591	85,454	135,335	B	8.0	N/A	8.7
Prog. Thermostats	44	82	119	157	193	A	8.0	5.2	13.3
ESTAR TVs	530	639	821	1,018	1,257	A	8.0	N/A	8.0
Super Efficient Clothes Washers	67	77	89	99	112	A	9.6	N/A	20.2
DHW Tank Insulation	61	117	168	209	241	A	10.3	N/A	10.9
Timers - Outdoor	46	78	108	140	175	A	11.0	N/A	11.0
Air Sealing	735	1,469	2,203	2,939	3,676	A	12.4	N/A	15.0
Sealing & Insul. - Old Homes	3,004	6,003	8,999	11,998	14,997	A	12.5	N/A	15.7
Car Warmer Timers	2	5	7	10	12	A	N/A	0.9	N/A
Block Heater Timers	-	-	-	14	17	A	N/A	5.9	N/A
Cold Climate Heat Pump	1	3	6	11	18	B	N/A	N/A	12.6
Super Efficient Freezers	1	2	4	7	10	A	N/A	N/A	14.5
ESTAR Dishwashers	0	1	1	2	2	A	N/A	N/A	14.5
Air-Source Heat Pump	1	6	14	28	48	B	N/A	N/A	16.9
ESTAR Windows	17	0	1	2	5	A/B	N/A	N/A	17.0
High-Perf. New Homes	10	35	95	181	294	A	N/A	N/A	17.7
Super Efficient Refrigerators	-	3	5	8	10	A	N/A	N/A	23.5
Air-to-Water Heat Pumps	-	12	31	62	105	B	N/A	N/A	24.2
Super Windows	-	1	1	2	3	A	N/A	N/A	25.5
Motion Detectors - Indoor	-	-	1	1	1	A	N/A	N/A	26.4
HRVs	-	-	2	3	5	A	N/A	N/A	28.4
Professional Air Sealing	-	-	-	8	10	A	N/A	N/A	33.2
HVAC Impact from Other Savings	(3,825)	(7,431)	(11,651)	(17,129)	(22,297)				
Grand Total	27,797	77,598	151,279	243,641	336,020				

Note: Curves A and B in this exhibit are as presented in Exhibit 62.
In the exhibit, a zero indicates a value that rounds off to zero (i.e., less than 0.5). A dash indicates a value that is actually zero.

As with Exhibit 68, Exhibit 72 provides results at a sufficient level of detail that some modeling issues require explanation:

- As explained following Exhibit 68, some measures show an initially high potential, which then drops off in the second milestone period and begins to increase again towards the end of the study period. As described before, this is primarily caused by the changing avoided cost values for the Island Interconnected region through the study period, and by the reference case adoption rates "catching up" to the adoption rates in the achievable potential scenario.
- In some cases, the potential shown in this exhibit is higher than for the same measure in Exhibit 68. This occurs for measures that are late in the "cascade" of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much lower savings in the Lower Achievable than in the Upper Achievable scenarios, leaving more energy to be saved by later measures in the sequence.
- The CCE values in Exhibit 72 do not always match those presented earlier in the report. As discussed earlier that is because the CCE values presented in these exhibits are calculated weighted averages, based on the particular mixture of dwelling types and regions in which the measure is applied in this scenario.
- The last measure in the table, HVAC Impact from Other Savings, accounts for the added load on the electric heating systems in dwellings where savings are occurring for many other end uses in the home. As discussed in Section 8.5.3, the savings for end uses such as lighting, appliances, and electronics are multiplied by a factor based on modeling of NL dwellings. The resulting heating penalty is added as a separate line item in this exhibit.

9.6 Electric Peak Load Reductions from Energy Efficiency

Exhibit 73 presents a summary of the peak load reductions that would occur as a result of the electric energy savings contained in the Achievable Potential Forecast. The reductions are shown by milestone year, region and dwelling type for both lower and upper achievable potential savings. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case presented previously in Sections 4 and 6. Exhibit 74 and Exhibit 75 show the lower and upper Achievable Potential savings by region, dwelling type and principal end use for each milestone year.

Exhibit 73, Exhibit 74 and Exhibit 75 only approximate the potential demand impacts associated with the energy-efficiency measures because they are based on the assumption that the measures do not change the load shape of the end uses they affect. This is not always correct. For example, most of the heat pump measures will not produce any peak demand savings, because during the winter peak period the heat pumps and mini-splits will revert to back-up electric resistance heating.[36] Therefore, there will be no net reduction in space heating peak demand for these measures. Accordingly, the demand reductions for the heat pump measures have been manually filtered out of the results presented in these exhibits.

Exhibit 76 shows the demand reductions associated with each electric energy savings measure contained in the Achievable Potential Forecast for the milestone year 2029. The heat pump measures are omitted from the exhibit, as with the previous two exhibits. One notable line item in the exhibit is "HVAC Impact from Other Savings" - the impact on peak space heating load resulting from the savings for other end uses within the dwelling. This is to capture the fact that in an electrically-

[36] In fact, this is a conservative assumption for the Island Interconnected region. Although the demand peak occurs on the coldest winter days, in a climate such as that of St. John's the temperature is typically not very extreme on those peak days. Therefore, many heat pumps will continue to work in heat pump mode and not revert to electric resistance. In this study, we have retained the conservative assumption that they do not provide demand relief.

heated dwelling, savings of energy consuming devices within the home will not reduce the winter peak demand. The impact of demand reductions for other end uses on the space heating demand can be seen graphically in Exhibit 74. As the demand impacts for many of the other end uses rise with time, the demand impacts for space heating actually decreases over time.

Electric peak load reductions related to capacity-only measures are presented separately in Section 9.7.

Exhibit 73 Electric Peak Load Reductions from Upper and Lower Achievable Potential Energy Savings Measures by Milestone Year, Region and Dwelling Type (MW)

Housing Categories	Milestone Years	Island Interconnected		Isolated		Labrador Interconnected		Grand Total	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Single Family Dwellings	2017	4.8	10.4	0.1	0.1	0.1	0.2	4.9	10.8
	2020	12.9	23.9	0.1	0.3	0.6	0.8	13.7	25.1
	2023	24.5	40.9	0.2	0.5	1.3	1.6	26.0	43.0
	2026	37.2	62.2	0.4	0.7	2.4	3.0	40.0	65.9
	2029	46.4	85.6	0.5	1.0	3.4	4.5	50.3	91.0
Attached Houses	2017	0.3	0.7	-	-	0.0	0.1	0.3	0.7
	2020	0.8	1.5	-	-	0.1	0.2	0.9	1.7
	2023	1.5	2.6	-	-	0.1	0.3	1.6	2.8
	2026	2.3	4.0	-	-	0.2	0.4	2.5	4.4
	2029	2.9	5.5	-	-	0.7	1.0	3.6	6.6
Apartments	2017	0.2	0.4	-	-	0.0	0.0	0.2	0.4
	2020	0.3	0.8	-	-	0.0	0.0	0.3	0.8
	2023	0.5	1.3	-	-	0.0	0.0	0.5	1.3
	2026	0.7	1.7	-	-	0.0	0.0	0.7	1.8
	2029	0.9	2.2	-	-	0.0	0.1	0.9	2.2
Other, Vacant and Partial	2017	0.08	0.17	0.00	0.00	0.00	0.01	0.1	0.2
	2020	0.18	0.37	0.00	0.01	0.01	0.02	0.2	0.4
	2023	0.32	0.60	0.01	0.01	0.01	0.03	0.3	0.6
	2026	0.47	0.88	0.01	0.02	0.01	0.04	0.5	0.9
	2029	0.59	1.19	0.02	0.03	0.02	0.05	0.6	1.3
Grand Total	**2017**	5.3	11.6	0.1	0.1	0.1	0.3	5.5	12.1
	2020	14.2	26.6	0.1	0.3	0.7	1.1	15.1	28.0
	2023	26.9	45.3	0.2	0.5	1.4	2.0	28.5	47.7
	2026	40.7	68.8	0.4	0.7	2.7	3.5	43.7	73.0
	2029	50.8	94.5	0.5	1.0	4.1	5.6	55.4	101.1

Exhibit 74 Electric Peak Load Reductions from Upper Achievable Potential Energy Savings Measures, by Milestone Year End Use and Dwelling Type, Winter Peak Period (MW)

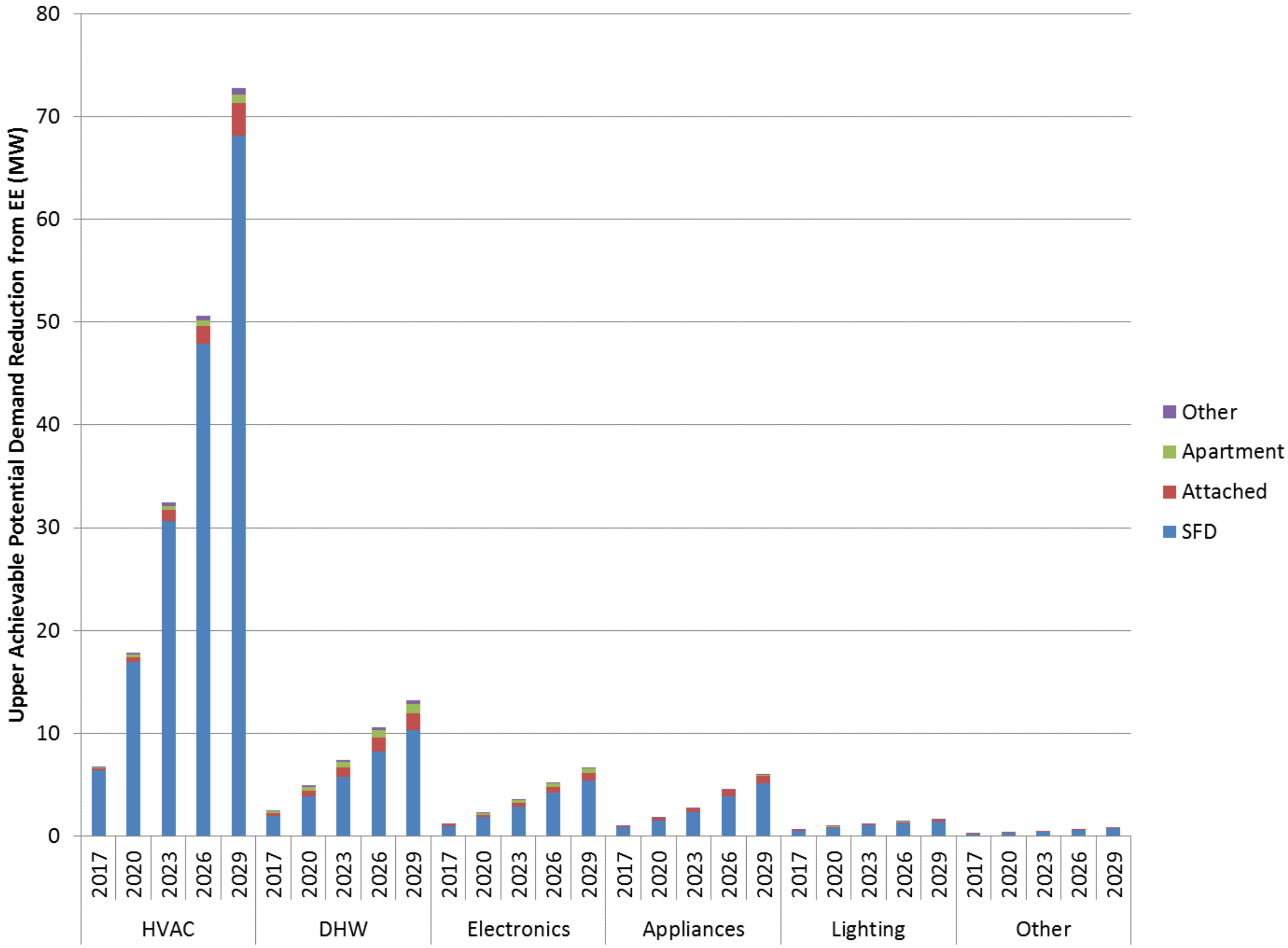


Exhibit 75 Electric Peak Load Reductions from Lower Achievable Potential Energy Savings Measures, by Milestone Year End Use and Dwelling Type, Winter Peak Period (MW)

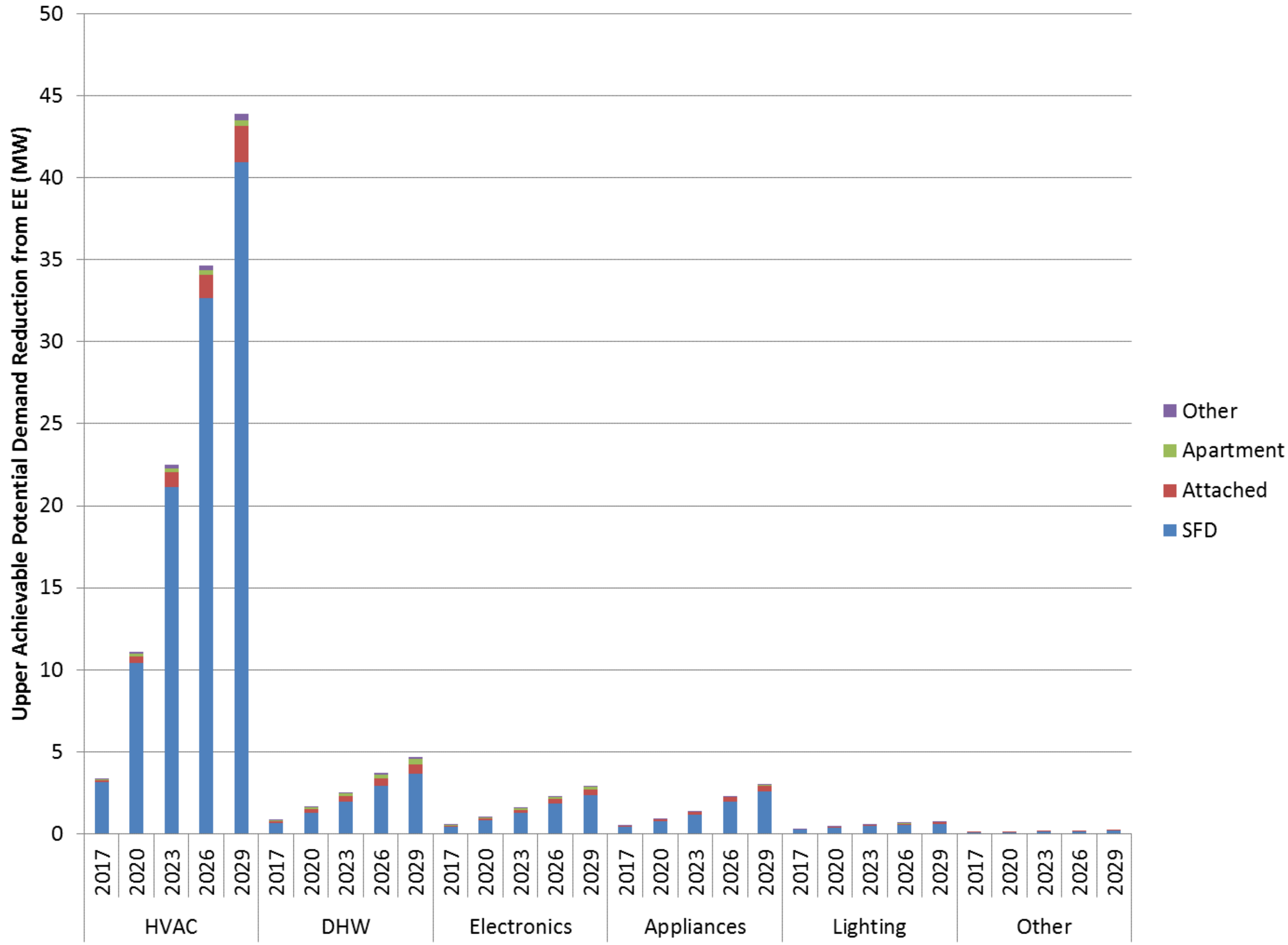


Exhibit 76 Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW)

Measure	Island Interconnected		Labrador Interconnected		Isolated		Grand Total	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Basement Insulation	13.4	18.7	2.1	2.4	0.1	0.1	15.6	21.2
Crawl Space Insulation	12.5	17.5	0.8	0.9	0.1	0.1	13.3	18.4
Sealing & Insul. - Old Homes	5.0	16.2	-	-	0.0	0.1	5.0	16.3
Min Hot Wash	2.9	6.7	0.1	0.3	0.0	0.1	3.1	7.1
Attic Insulation	4.4	6.1	0.4	0.5	0.0	0.0	4.8	6.6
Overnight Setback	2.2	4.4	0.2	0.4	0.0	0.0	2.3	4.8
Door Systems	3.0	4.2	0.2	0.3	0.0	0.0	3.2	4.4
Air Sealing	1.2	4.0	-	-	0.0	0.0	1.2	4.0
Refrigerator Retirement	1.7	3.5	0.1	0.2	0.0	0.1	1.8	3.7
Power Bars (TVs)	1.4	3.3	0.0	0.1	0.0	0.0	1.5	3.4
Weather Stripping Maintenance	1.1	3.1	0.1	0.3	0.0	0.0	1.2	3.4
Close Blinds	1.4	2.9	0.1	0.2	0.0	0.0	1.5	3.1
Daytime Setback	1.3	2.6	0.1	0.2	0.0	0.0	1.4	2.9
ECPM Fan Motors	1.4	2.7	0.0	0.0	0.0	0.1	1.4	2.8
Efficient Clothes Washers	1.2	2.3	0.0	0.1	0.0	0.0	1.2	2.4
Power Bars (PCs)	0.8	1.9	0.0	0.0	0.0	0.0	0.8	2.0
Showerheads	0.4	1.7	0.0	0.1	0.0	0.0	0.4	1.8
Faucets	0.3	1.2	0.0	0.0	0.0	0.0	0.3	1.2
LED Lamps	0.5	1.1	0.0	0.0	0.0	0.0	0.6	1.1
DHW Temperature	-	0.8	-	0.0	-	0.0	-	0.9
Faucet Aerator	0.2	0.7	0.0	0.0	0.0	0.0	0.2	0.8
Electronic Thermostats	0.2	0.6	0.0	0.1	0.0	0.0	0.2	0.7
Hot Tub Covers	0.1	0.6	0.0	0.0	0.0	0.0	0.2	0.6
ESTAR TVs	0.2	0.4	-	-	0.0	0.0	0.2	0.4
Benchmarking	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4
Turn Off TVs	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.3
Clothes Dryer Sensor	0.2	0.3	0.0	0.0	0.0	0.0	0.2	0.3
DHW Tank Insulation	0.1	0.3	-	-	0.0	0.0	0.1	0.3
ESTAR Computers	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
DHW Pipe Insulation	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.3
Motion Detectors - Outdoor	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.3
Prog. Thermostats	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
Refrigerator Temperature	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
High-Perf. New Homes	-	-	-	-	0.1	0.1	0.1	0.1
Min Outdoor Lighting	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Timers - Outdoor	0.0	0.1	-	-	0.0	0.0	0.0	0.1
Unplug Chargers	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
PC Power Management	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Freezer Temperature	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Super Efficient Clothes Washers	0.0	0.0	-	-	0.0	0.0	0.0	0.0
ESTAR Freezers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Car Warmer Timers	-	-	0.0	0.0	-	-	0.0	0.0
Turn Off Lights	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESTAR Windows	-	-	-	-	0.0	0.0	0.0	0.0
Super Efficient Freezers	-	-	-	-	0.0	0.0	0.0	0.0

Exhibit 76 Continued: Electric Peak Load Reductions from Achievable Potential Energy Savings Measures, 2029 (MW)

Measure	Island Interconnected		Labrador Interconnected		Isolated		Grand Total	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
ESTAR Dishwashers	-	-	-	-	0.0	0.0	0.0	0.0
T8 Fixtures	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prog. Thermostats (Central)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC Impact from Other Savings	(7.1)	(15.4)	(0.3)	(0.7)	(0.0)	(0.1)	(7.5)	(16.2)
Grand Total	50.8	94.5	4.1	5.5	0.5	1.0	55.4	101.0

As with Exhibit 68, Exhibit 76 provides results at a sufficient level of detail that some modeling issues require explanation:

- As explained following Exhibit 68, some measures show an initially high potential, which then drops off in the second milestone period and begins to increase again towards the end of the study period. As described before, this is primarily caused by the changing avoided cost values for the Island Interconnected region through the study period, and by the reference case adoption rates "catching up" to the adoption rates in the achievable potential scenario.
- In some cases, the potential shown for Lower Achievable is higher than for the same measure in Upper Achievable. This occurs for measures that are late in the "cascade" of measures that apply to a specific end use. It is caused when other measures earlier in the sequence of measures applied by the model have much lower savings in the Lower Achievable than in the Upper Achievable scenarios, leaving more energy to be saved by later measures in the sequence.
- The last measure in the table, HVAC Impact from Other Savings, accounts for the added load on the electric heating systems in dwellings where savings are occurring for many other end uses in the home. As discussed in Section 8.5.3, the savings for end uses such as lighting, appliances, and electronics are multiplied by a factor based on modeling of NL dwellings. The resulting heating penalty is added as a separate line item in this exhibit.

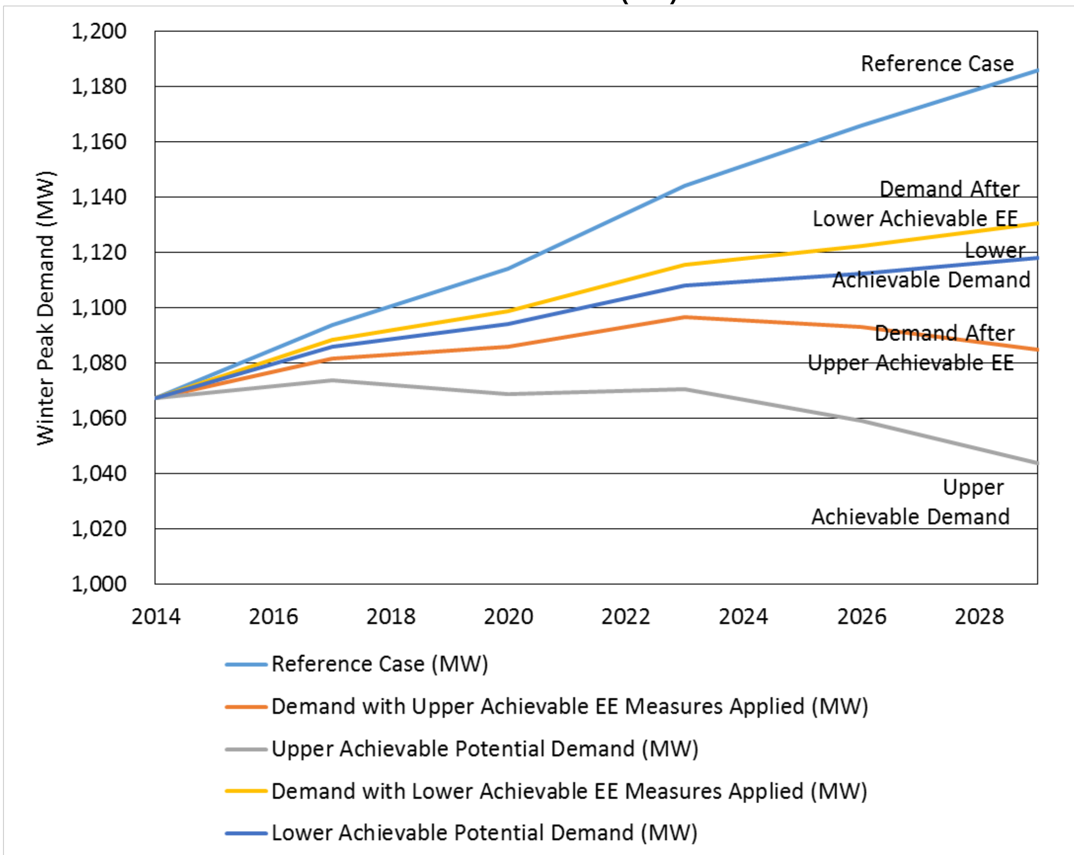
9.7 Summary of Peak Load Reductions

This section presents a summary of the electric peak load reductions that would result from the application of peak demand efficient measures. Exhibit 77 compares the Reference Case, Lower Achievable Potential and Upper Achievable Potential Peak Demand Forecast levels of winter peak demand.[37]

As illustrated, under the Reference Case residential peak demand would grow from the Base Year level of 1,067 MW to approximately 1,186 MW by 2029. This contrasts with the Lower Achievable Potential Forecast in which peak demand would decrease to approximately 1,118 MW for the same period, a difference of approximately 68 MW or about 6%. The Upper Achievable Potential forecasts peak demand at 1,044 MW, a difference of approximately 142 MW or 12%. The other two lines on the chart show the peak demand that would result if all the energy efficiency measures were applied but none of the demand reduction measures in each of the Lower and Upper Achievable Potential scenarios. As illustrated in the exhibit, approximately 72% of the reduction comes from the impact of energy efficiency measures in the Upper Achievable Potential scenario, and approximately 81% of the reduction comes from the impact of energy efficiency measures in the Lower Achievable Potential scenario.

[37] All results are reported at the customer's point-of-use and do not include line losses.

Exhibit 77 Peak Demand of Reference Case, Lower Achievable Potential and Upper Achievable Potential in Residential Sector (MW)



9.7.1 Peak Demand Reduction

Further detail on the total potential peak demand reduction provided by the Upper and Lower Achievable Potential Forecast is provided in the following exhibits:[38]

- Exhibit 78 presents the results by end use, dwelling type and milestone year
- Exhibit 79 provides a further disaggregation of the peak demand reduction by technology and milestone year
- Exhibit 80 and Exhibit 81 present peak demand reduction by major end use, milestone year and region
- Exhibit 82 and Exhibit 83 present peak demand reduction by major end use, milestone year and dwelling type
- Exhibit 84 and Exhibit 85 present 2029 peak demand reduction by major end use and vintage.

[38] MW reductions shown in the following exhibits are not incremental. For example, the space heating reductions in 2029 are not in addition to the space heating reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Lower or Upper Achievable Potential scenario are implemented.

Exhibit 78 Total Lower and Upper Achievable Potential Peak Demand Reduction by End Use, Dwelling Type and Milestone Year (MW)

Housing Categories	Milestone Years	Domestic Hot Water (DHW)		Space heating		Block heaters & car warmers		Grand Total	
		Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.	Lower Ach.	Upper Ach.
Single Family Dwellings	2017	1.16	4.58	0.45	1.44	0.00	0.01	1.61	6.02
	2020	2.69	9.79	0.91	2.85	0.01	0.01	3.60	12.65
	2023	4.11	14.65	1.36	4.16	0.01	0.02	5.48	18.83
	2026	5.48	19.26	1.77	5.23	0.01	0.03	7.26	24.52
	2029	6.80	23.60	2.15	5.99	0.02	0.03	8.97	29.62
Attached Houses	2017	0.23	0.89	0.08	0.26	0.00	0.00	0.31	1.16
	2020	0.52	1.92	0.17	0.54	0.00	0.01	0.70	2.47
	2023	0.81	2.91	0.27	0.83	0.01	0.01	1.08	3.75
	2026	1.09	3.86	0.35	1.08	0.01	0.02	1.45	4.96
	2029	1.36	4.77	0.44	1.29	0.01	0.02	1.81	6.08
Apartments	2017	0.14	0.54	0.00	0.01	0.00	0.00	0.14	0.55
	2020	0.29	1.15	0.01	0.10	0.00	0.00	0.30	1.25
	2023	0.52	1.89	0.01	0.16	0.00	0.00	0.53	2.05
	2026	0.70	2.49	0.02	0.22	0.00	0.00	0.72	2.72
	2029	0.87	3.09	0.02	0.28	0.00	0.00	0.89	3.37
Other, Vacant and Partial	2017	0.01	0.02	0.11	0.23	0.00	0.00	0.12	0.25
	2020	0.07	0.26	0.23	0.48	0.00	0.00	0.30	0.73
	2023	0.10	0.38	0.35	0.73	0.00	0.00	0.45	1.11
	2026	0.13	0.50	0.48	1.02	0.00	0.00	0.61	1.52
	2029	0.16	0.62	0.60	1.27	0.00	0.00	0.76	1.90
Grand Total	**2017**	1.53	6.03	0.65	1.93	0.01	0.01	2.18	7.98
	2020	3.57	13.11	1.32	3.97	0.01	0.02	4.90	17.10
	2023	5.54	19.83	1.99	5.88	0.02	0.03	7.54	25.74
	2026	7.40	26.12	2.62	7.55	0.02	0.04	10.04	33.71
	2029	9.19	32.08	3.21	8.84	0.03	0.05	12.43	40.97

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) In the above exhibit a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) MW reductions are not incremental. The space heating reductions in 2029 are not in addition to the reductions from the previous milestone years. Rather, they are the difference between the Reference Case space heating peak demand in 2029 and the space heating peak demand if all the measures included in the Economic Potential scenario are implemented.
5) The values in this exhibit do not include peak demand reductions from energy efficiency measures.
6) Demand-specific measure savings will fluctuate based on the demand savings from conservation measures. The demand reference case to which demand-specific measures are applied already factors in the corresponding Upper or Lower Achievable demand savings from conservation measures. So the more peak demand reductions are generated through conservation measures, the less peak demand remains for demand-specific measures to reduce.

Exhibit 79 Lower and Upper Achievable Potential Peak Demand Reduction by Measure and Milestone Year (MW)

Measure	Lower Achievable Potential Peak Demand Reduction (MW)					Upper Achievable Potential Peak Demand Reduction (MW)				
	2017	2020	2023	2026	2029	2017	2020	2023	2026	2029
DHW Cycling	1.52	3.13	4.72	6.26	7.77	6.02	12.25	18.27	23.96	29.41
Dual Fuel Heat Cycling	0.65	1.32	1.99	2.62	3.21	1.29	2.59	3.84	4.90	5.74
Electric Heat Cycling	0.00	0.00	0.00	0.00	0.00	0.61	1.32	1.96	2.54	2.98
3-Element DHW	0.01	0.44	0.82	1.13	1.42	0.01	0.86	1.57	2.16	2.67
Heat Pump Cycling	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.08	0.10	0.12
Car Warmer Demand	0.00	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.04
Block Heater Demand	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.02
Grand Total	2.18	4.90	7.54	10.04	12.43	7.98	17.10	25.74	33.71	40.97

Exhibit 80 Lower Achievable Potential Peak Load Reduction by Major End Use, Year and Region (MW)

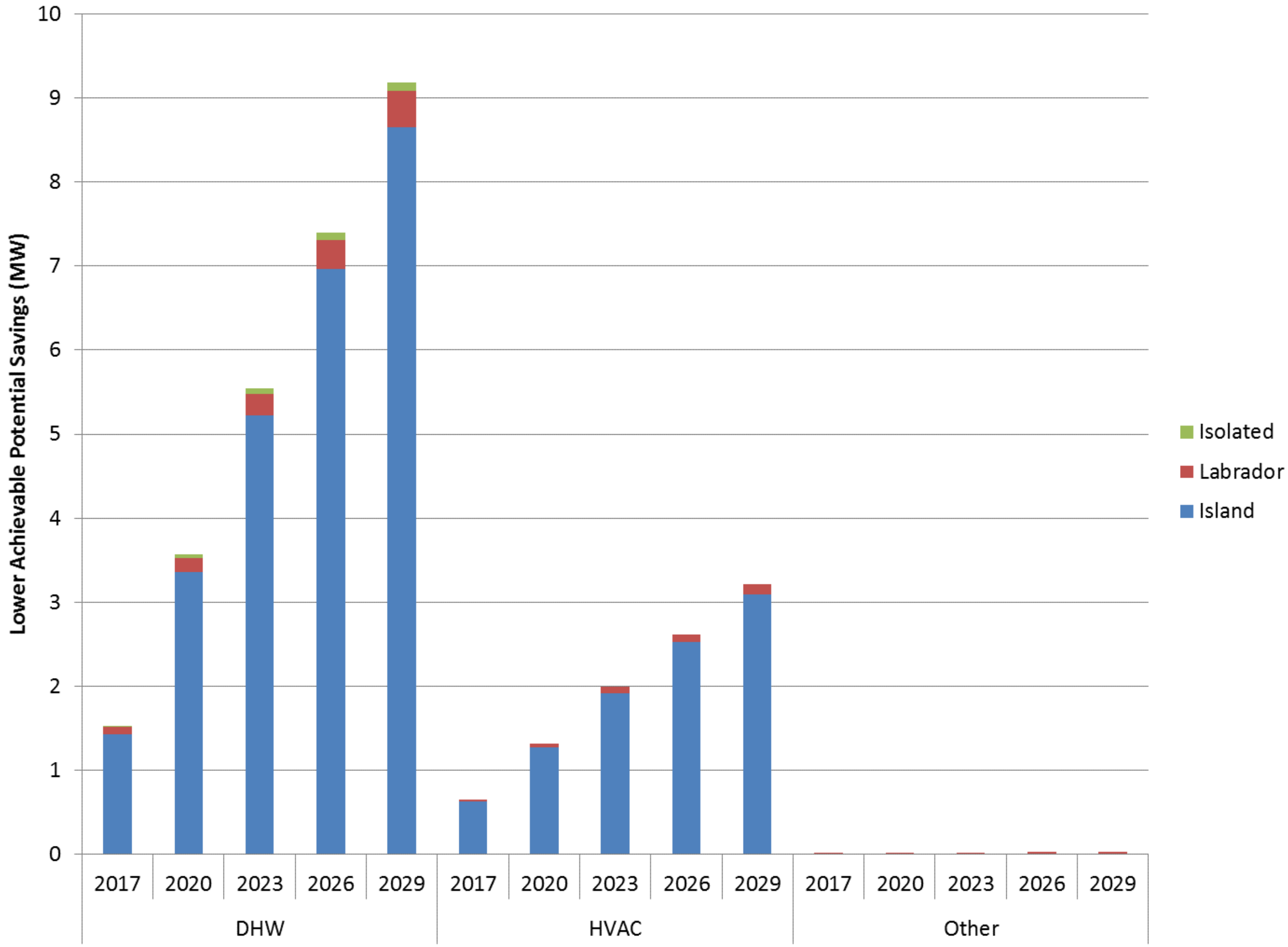


Exhibit 81 Upper Achievable Potential Peak Load Reduction by Major End Use, Year and Region (MW)

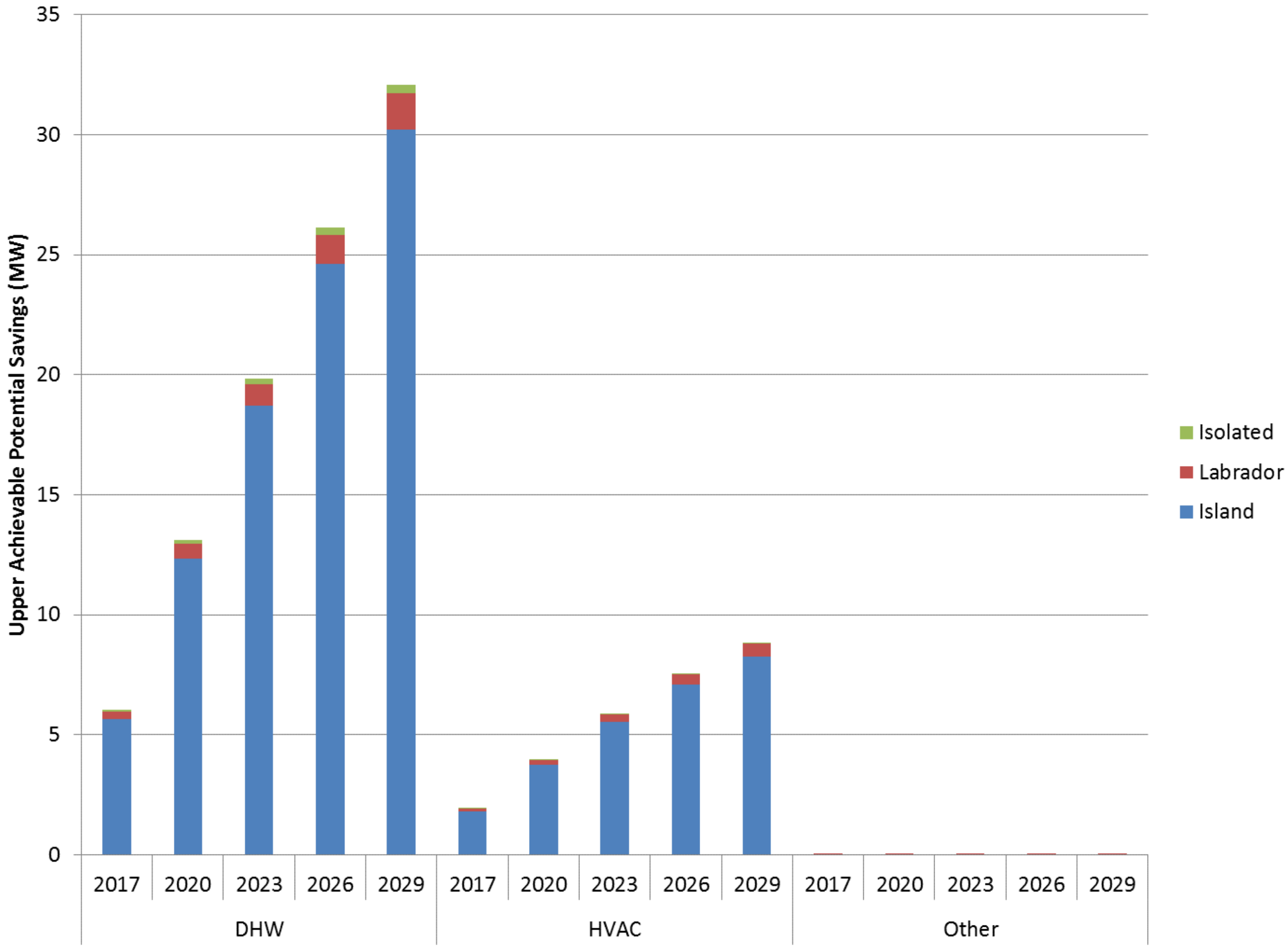


Exhibit 82 Lower Achievable Potential Peak Demand Reduction by Major End Use, Year and Dwelling Type (MW)

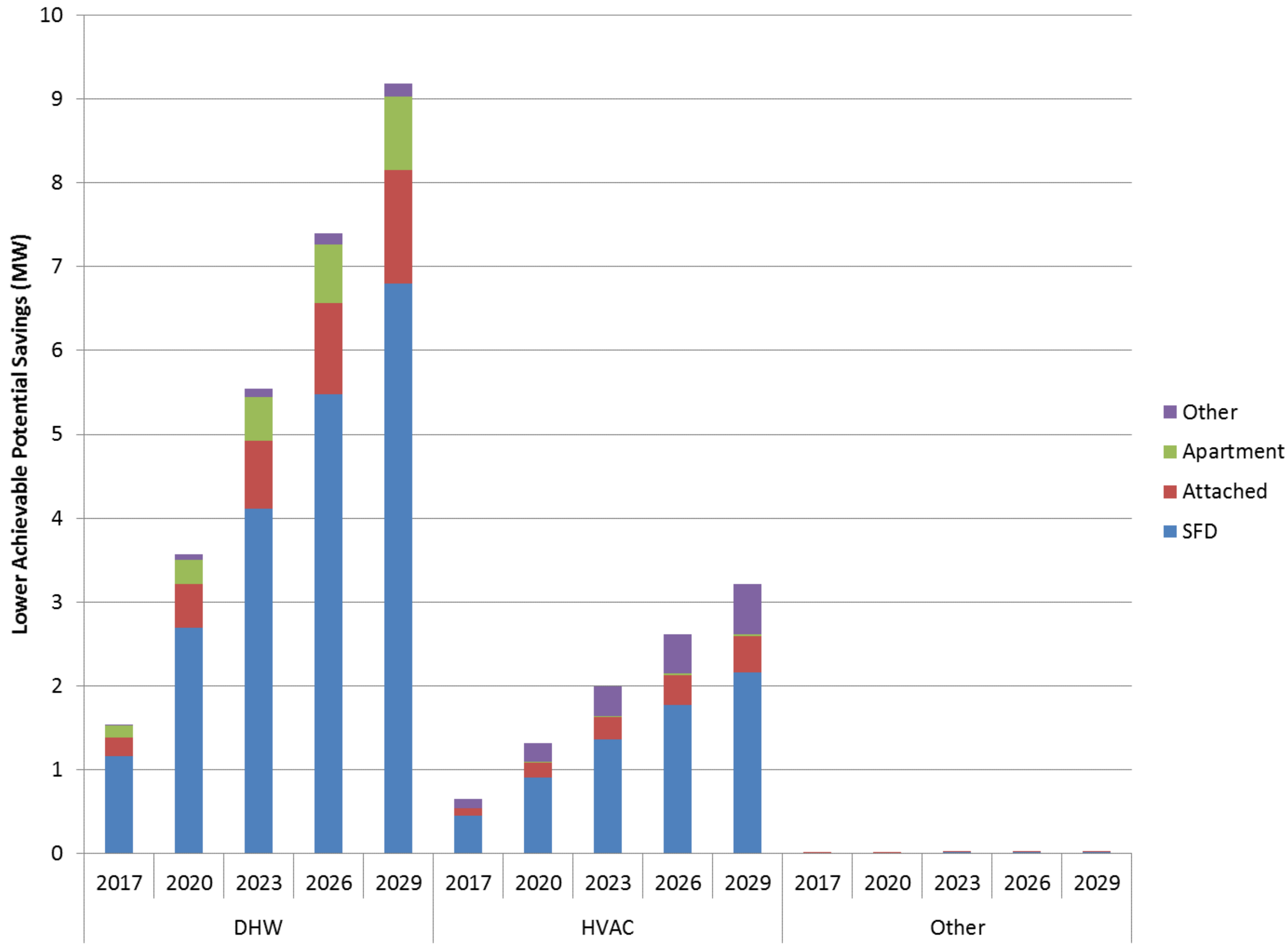


Exhibit 83 Upper Achievable Potential Peak Demand Reduction by Major End Use, Year and Dwelling Type (MW)

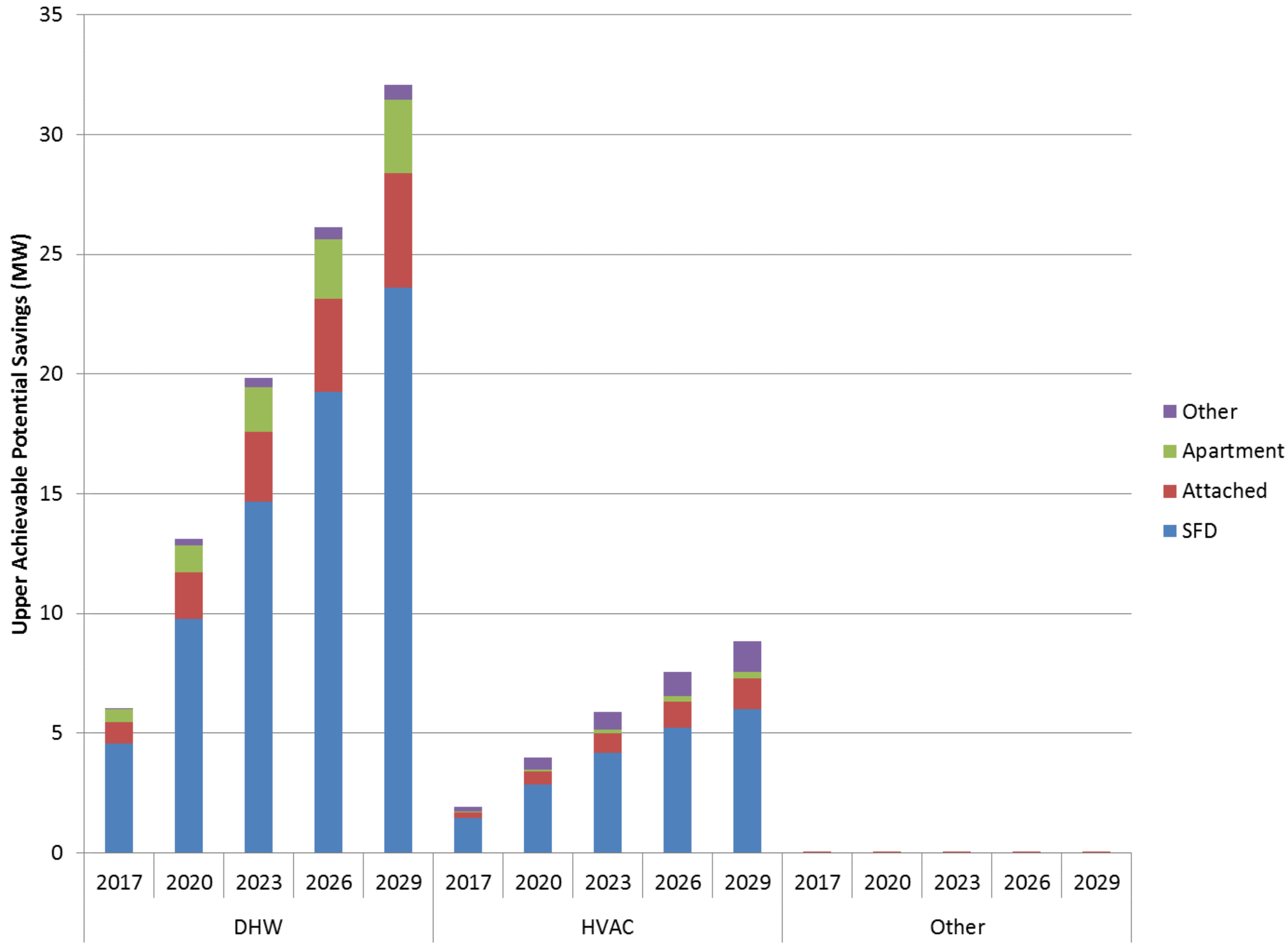


Exhibit 84 Lower Achievable Potential Peak Load Reduction by Major End Use, Year and Vintage (MW)

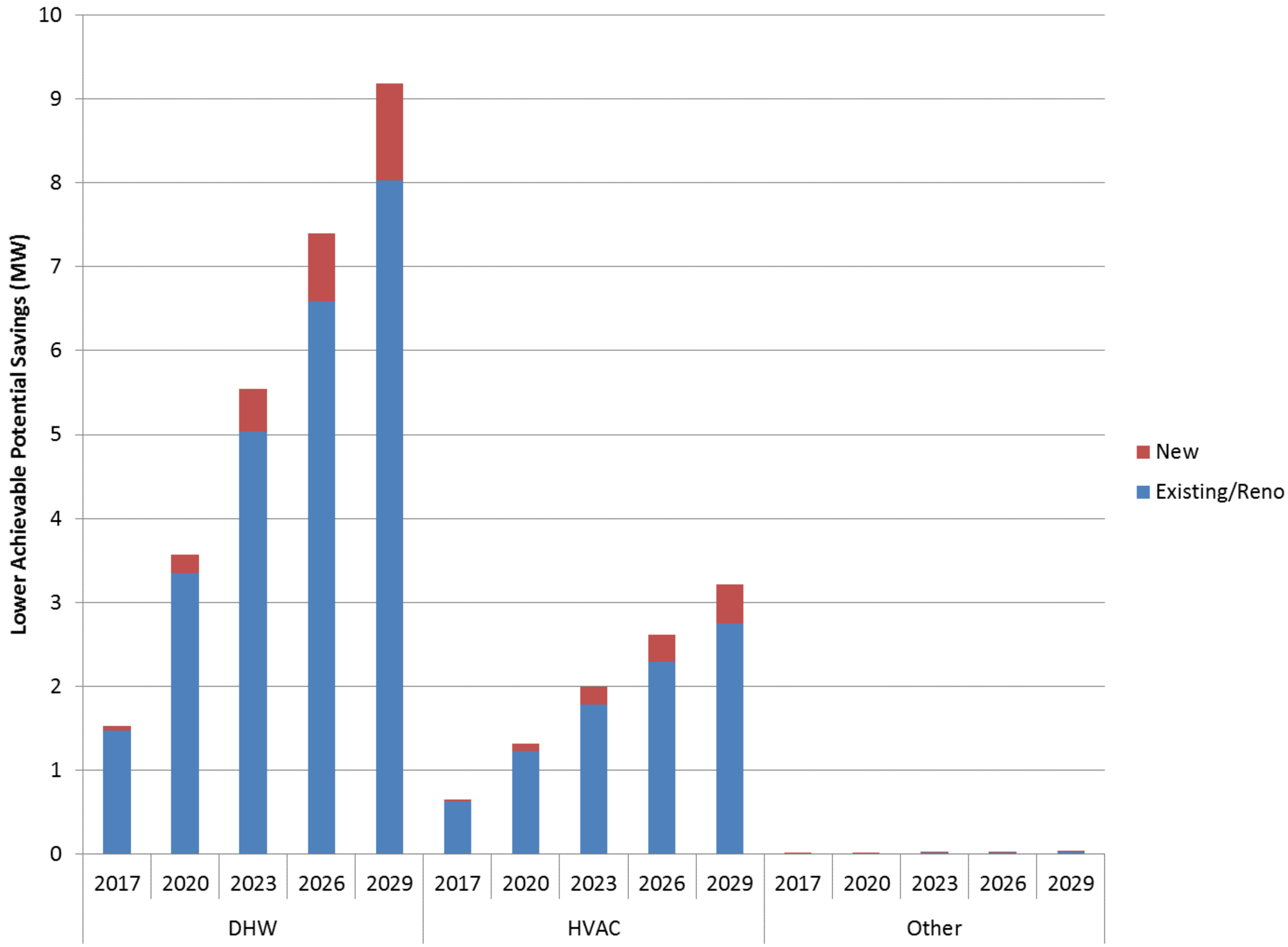
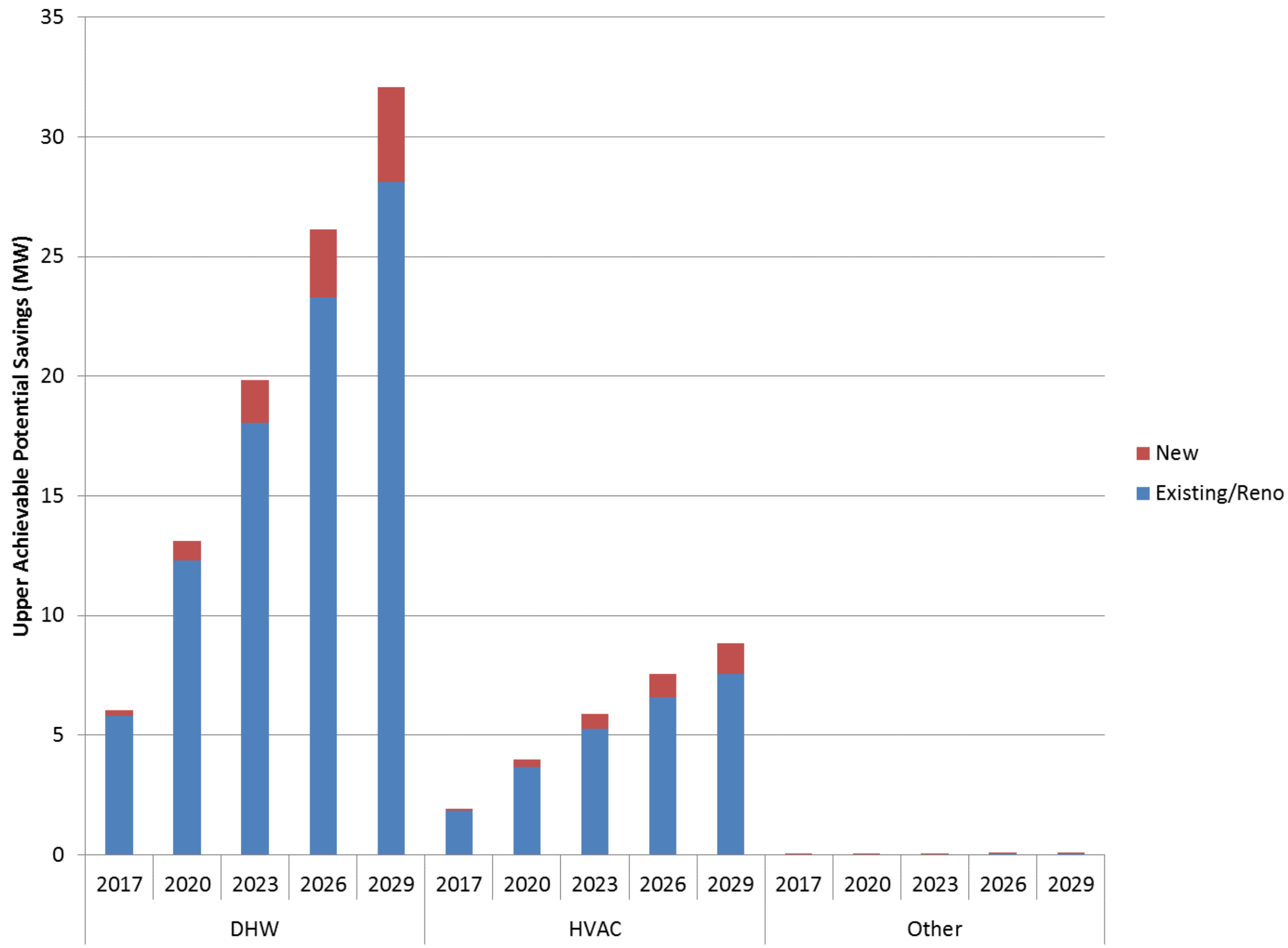


Exhibit 85 Upper Achievable Potential Peak Load Reduction by Major End Use, Year and Vintage (MW)



9.7.2 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below:

Peak Demand Reduction by Milestone Year

The Lower Achievable Potential peak load reductions increase from 2.2 MW in 2017 to 12.4 MW in 2029. The Upper Achievable Potential peak load reductions increase from 8.0 MW in 2017 to 41.0 MW in 2029.

Peak Demand Reduction by Dwelling Type

Single detached houses account for 73% of the potential peak load reductions; this reflects their larger market share and their generally higher level of electrical intensity per dwelling. Peak load reductions in attached dwellings account for 14% of the potential savings; apartments account for 8% of the potential savings; and other residential buildings account for 5% of the potential savings.

Peak Demand Reduction by Region

The Island Interconnected region accounts for 95% of the potential peak load reductions. The Labrador Interconnected region accounts for 5% of the potential peak load reductions, and the Isolated region accounts for 1% of the potential peak load reductions.

Peak Demand Reduction by Existing Dwellings versus New Construction

Peak load reductions in existing dwellings account for almost all of the reduction potential at the beginning of the study period; as new homes are constructed, the load reduction potential associated with them occupies a progressively larger portion of the total. By 2029, peak load reductions from new homes account for just over 10% of the total potential.

Peak Demand Reduction by End Use

DHW measures account for approximately 76% of the total load reductions in the Upper Achievable Potential Forecast in 2017, not including load reductions from energy efficiency measures; this rises to 78% of the total by 2029. DHW measures account for approximately 71% of the total load reductions in the Lower Achievable Potential Forecast in 2017, not including load reductions from energy efficiency measures; this rises to 74% of the total by 2029. Of the 78% of 2029 reductions that come from DHW in the Upper Achievable Potential, 72% is from DHW cycling. Of the 74% of 2029 reductions that come from DHW in the Lower Achievable Potential, 62% is from DHW cycling.

Space heating load reductions account for approximately 24% of the total load reductions in the Upper Achievable Potential Forecast in 2017, not including load reductions from energy efficiency measures; this decreases to 22% of the total by 2029. Space heating load reductions account for approximately 29% of the total load reductions in the Lower Achievable Potential Forecast in 2017, not including load reductions from energy efficiency measures; this decreases to 26% of the total by 2029. Of the 22% of 2029 reductions that come from space heating in the Upper Achievable Potential, 14% is from heat cycling in dwellings with a second heating fuel and 7% is from heat cycling in dwellings without a second heating fuel. Of the 26% of 2029 reductions that come from space heating in the Lower Achievable Potential, all of it is considered to come from heat cycling in dwellings with a second heating fuel. In the Lower Achievable Potential, there was assumed to be no uptake of heat cycling in homes with no other fuel.

Timers for car warmers and block heaters offer a very small portion of the total load reduction opportunity for the province overall, but contribute between 2% and 5% to the overall potential for the Labrador Interconnected region.

9.8 Sensitivity of the Results to Changes in Avoided Cost

The avoided costs used in the Achievable Potential model are varied by region and by milestone year. As with any forecast, the projected avoided costs are subject to uncertainty. Accordingly, the model has been re-run with avoided costs varied within a reasonable range. The lower end of this range is considered to be 10% below the current projection, for both energy cost and demand cost. The upper end of the range is considered to be 30% above the current projections for energy cost and 20% above the current projections for demand cost.

Exhibit 86 shows that the lower Achievable Potential results are sensitive to this range of avoided costs. By 2029, the exhibits show the following changes in achievable potential:

- The lower range of reasonableness produces lower Achievable Potential energy savings that are 6% lower in the Island Interconnected region, 10% lower in the Labrador Interconnected region, and almost unchanged in the Isolated region.
- The lower range of reasonableness produces lower Achievable Potential peak demand reductions that are 11% lower in the Island Interconnected region, 10% lower in the Labrador Interconnected region, and 1% lower in the Isolated region.
- The upper range of reasonableness produces lower Achievable Potential energy savings that are 6% higher in the Island Interconnected region and almost unchanged in the other two regions.
- The upper range of reasonableness produces lower Achievable Potential peak demand reductions that are almost unchanged in all regions.

Exhibit 86 Sensitivity of the Lower Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	23,162	6	26,944	7	26,944	7
	2020	66,493	16	74,101	19	74,807	19
	2023	132,805	30	144,481	34	147,821	35
	2026	212,007	44	231,445	50	242,256	51
	2029	298,048	56	317,592	63	336,663	63
Labrador Interconnected	2017	494	0	553	0	956	0
	2020	1,182	0	2,780	1	3,042	1
	2023	5,487	2	5,500	2	6,764	2
	2026	9,049	3	10,122	3	11,280	3
	2029	13,778	4	15,393	5	15,389	5
Isolated	2017	297	0	300	0	297	0
	2020	701	0	717	0	701	0
	2023	1,292	0	1,297	0	1,292	0
	2026	2,060	0	2,074	0	2,060	0
	2029	3,020	1	3,035	1	3,020	1

Exhibit 87 shows that the upper Achievable Potential results are sensitive to this range of avoided costs. By 2029, the exhibits show the following changes in achievable potential:

- The lower range of reasonableness produces upper Achievable Potential energy savings that are 8% lower in the Island Interconnected region, 9% lower in the Labrador Interconnected region, and almost unchanged in the Isolated region.
- The lower range of reasonableness produces upper Achievable Potential peak demand reductions that are 6% lower in the Island Interconnected region and almost unchanged in the other two regions.
- The upper range of reasonableness produces upper Achievable Potential energy savings that are 6% higher in the Island Interconnected region and almost unchanged in the other two regions.
- The upper range of reasonableness produces upper Achievable Potential peak demand reductions that are that are almost unchanged in all regions.

Exhibit 87 Sensitivity of the Upper Achievable Potential Energy Savings and Peak Demand Reduction to Avoided Cost

Region	Year	Lower Range of Reasonableness		Base Scenario		Upper Range of Reasonableness	
		Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)	Energy Savings (MWh/yr.)	Peak Demand Reduction (MW)
Island Interconnected	2017	48,956	15	60,930	19	60,930	19
	2020	126,956	35	150,463	43	151,863	43
	2023	240,557	57	274,926	70	281,437	71
	2026	386,399	83	437,615	101	458,583	101
	2029	569,163	112	621,508	133	658,182	133
Labrador Interconnected	2017	1,398	1	1,481	1	1,892	1
	2020	3,054	1	4,645	2	4,934	2
	2023	8,346	3	8,407	3	9,790	4
	2026	12,971	5	14,114	5	15,382	6
	2029	20,084	7	22,015	8	22,024	8
Isolated	2017	717	0	723	0	732	0
	2020	1,607	0	1,638	0	1,654	0
	2023	2,831	1	2,832	1	2,852	1
	2026	4,343	1	4,363	1	4,355	1
	2029	6,165	1	6,187	1	6,177	1

9.9 Net-to-Gross

Net-to-gross ratios are used to estimate the free-ridership occurring in CDM programs. Free riders are program participants who would have undertaken an efficiency or demand management measure naturally, even without the influence of the utility's program. A net-to-gross ratio is a factor that represents the net program impact divided by the gross program impact. The net impact can be found by multiplying the gross impact by the net-to-gross ratio.

Net-to-gross ratios have been estimated for many of the utility programs conducted in NL over the past several years. Though net-to-gross ratios are dependent on many factors, the estimates from previous programs were assumed to provide a reasonable approximation for the ratios in the near future. Where measures in the present study were not included in past programs, the net-to-gross ratio for the most similar program was used.

Sources:

The following sources were used to estimate the measure net-to-gross ratios shown in Exhibit 88:

- Net-to-gross ratios provided by Newfoundland Power, from evaluations of the CDM programs that have been run in the province.
- Ontario Energy Board TRC Guide recommendations.[39]
- Performance Plus Impact and Process Evaluation, 2012, from the Efficiency Nova Scotia Corporation.[40]
- Emera Maine Heat Pump Pilot Program Final Report, 2014.[41]

Caviat:

The estimates produced by the models in this study are not purely gross achievable potential estimates, because the reference case includes some naturally occurring savings. In order to calibrate the model's reference case to the Utilities' load forecast, it was essential to make reasonable assumptions about what efficiency improvements customers would make during the study period, in the absence of new utility programs. The economic, upper achievable, and lower achievable potentials were all calculated from this reference baseline that includes some naturally occurring savings. If the results are then adjusted for net-to-gross ratios, the following adjustments are both being made in the model:

- Naturally occurring savings, from customers who would adopt the efficiency measures in the absence of new utility programs, are being accounted for in the reference case.
- Free-ridership, from customers who participate in a program but would have adopted the efficiency measures without its influence, are being accounted for in the net-to-gross ratio.

It appears likely that there is some double-counting between naturally occurring savings and free-ridership: some of the customers who would have adopted the measures naturally and some of the customers who would be free-riders in a program are actually the same people. Therefore, the exhibits shown below with net upper and lower achievable potential, are likely underestimates of the true net potential.

[39] Ontario Energy Board, *Total Resource Cost Guide.* October, 2006.
[40] Efficiency Nova Scotia Corporation, *Performance Plus Impact and Process Evaluation, 2012*. March, 2013.
[41] Emera Maine, *Heat Pump Pilot Program Final Report*. November, 2014.

Results:

The net and gross achievable potential results are presented in the following four exhibits:

- Exhibit 88 shows the gross and net upper achievable potential for energy efficiency, by measure and region for the year 2029, along with the net-to-gross ratios used. The gross values do not add up to the same total as in previous exhibits, because the HVAC interaction measure is not included in this exhibit.
- Exhibit 89 shows the gross and net lower achievable potential for energy efficiency, by measure and region for the year 2029, along with the net-to-gross ratios used. The gross values do not add up to the same total as in previous exhibits, because the HVAC interaction measure is not included in this exhibit.
- Exhibit 90 shows the gross and net upper achievable potential for demand reduction, by measure and region for the year 2029, along with the net-to-gross ratios used.
- Exhibit 91 shows the gross and net lower achievable potential for demand reduction, by measure and region for the year 2029, along with the net-to-gross ratios used.

At this time, net-to-gross ratios were not available for demand reduction programs in NL. Because these measures offer no financial advantages to the customer where time of use rates are not in use, free-ridership is assumed to be zero for these measures. The net-to-gross ratios are therefore assumed to be 1.0, and the net potential is equal to the gross potential.

Exhibit 88 Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
Mini-Splits	0.88	254,769	224,196	-	-	1,595	1,404
Basement Insulation	0.80	55,847	44,677	8,341	6,673	313	250
Crawl Space Insulation	0.80	51,934	41,547	3,138	2,510	196	157
Sealing & Insul. - Old Homes	0.80	48,272	38,617	-	-	163	131
Refrigerator Retirement	0.90	34,748	31,273	1,548	1,393	554	498
Min Hot Wash	0.70	23,145	16,202	1,100	770	381	266
Power Bars (TVs)	0.95	20,305	19,289	434	413	295	280
Attic Insulation	0.80	18,202	14,562	1,615	1,292	84	67
Clothes Lines	0.70	14,740	10,318	593	415	292	204
Power Bars (PCs)	0.95	14,590	13,860	319	303	309	294
Overnight Setback	0.70	13,064	9,145	1,309	916	79	55
Door Systems	0.50	12,297	6,148	930	465	42	21
Efficient Clothes Washers	0.70	11,617	8,132	380	266	154	108
Air Sealing	0.90	11,904	10,714	-	-	43	38
Weather Stripping Maintenance	0.70	9,154	6,408	1,097	768	19	13
Close Blinds	0.70	8,481	5,937	730	511	45	32
Daytime Setback	0.70	7,829	5,481	764	535	47	33
ECPM Fan Motors	0.90	7,950	7,155	115	104	171	154
LED Lamps	0.95	6,505	6,179	226	214	79	75
Showerheads	0.70	5,829	4,081	271	190	59	41
Faucets	0.70	4,074	2,852	93	65	44	31
Hot Tub Covers	0.90	3,576	3,218	300	270	71	64
DHW Temperature	0.70	2,823	1,976	134	94	46	32
Benchmarking	1.00	2,587	2,587	122	122	48	48
Faucet Aerator	0.70	2,589	1,812	121	84	26	18
ESTAR TVs	0.70	2,281	1,597	-	-	232	163
Electronic Thermostats	0.70	1,868	1,307	196	137	17	12

Exhibit 88 Continued: Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
ESTAR Computers	0.70	1,992	1,394	66	46	22	15
Turn Off TVs	0.70	1,900	1,330	85	59	30	21
Clothes Dryer Sensor	0.70	1,838	1,287	59	42	21	15
Refrigerator Temperature	0.70	1,590	1,113	72	51	22	15
Motion Detectors - Outdoor	0.80	1,464	1,171	42	34	15	12
DHW Tank Insulation	0.95	954	906	-	-	11	10
DHW Pipe Insulation	0.90	858	772	40	36	9	8
ESTAR Dehumidifiers	0.70	831	582	27	19	5	3
Unplug Chargers	0.70	754	528	29	20	15	10
Min Outdoor Lighting	0.70	670	469	29	20	11	8
Timers - Outdoor	0.80	690	552	-	-	9	7
PC Power Management	0.70	640	448	27	19	13	9
Prog. Thermostats	0.85	592	503	72	61	4	3
Freezer Temperature	0.70	519	363	25	18	16	11
ESTAR Freezers	0.70	409	286	18	13	7	5
High-Perf. New Homes	0.76	-	-	-	-	362	275
Super Efficient Clothes Washers	0.70	187	131	-	-	31	22
Air-to-Water Heat Pumps	0.88	-	-	-	-	202	178
AC Temperature	0.70	157	110	-	-	-	-
Air-Source Heat Pump	0.88	-	-	-	-	92	81
Block Heater Timers	0.75	-	-	69	52	-	-
Car Warmer Timers	0.75	-	-	49	37	-	-
Turn Off Lights	0.70	37	26	2	1	1	1
Cold Climate Heat Pump	0.88	-	-	-	-	34	30
Professional Air Sealing	0.90	-	-	-	-	34	30
Super Efficient Freezers	0.70	-	-	-	-	20	14
Super Efficient Refrigerators	0.70	-	-	-	-	20	14
HRVs	0.85	-	-	-	-	9	8
T8 Fixtures	0.75	7	5	0	0	0	0

Exhibit 88 Continued: Gross Versus Net Upper Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
ESTAR Windows	0.50	-	-	-	-	7	3
Super Windows	0.50	-	-	-	-	6	3
ESTAR Dishwashers	0.70	-	-	-	-	5	3
Motion Detectors - Indoor	0.80	-	-	-	-	4	3
Prog. Thermostats (Central)	0.85	0	0	0	0	0	0
Grand Total	0.82	667,067	551,247	24,590	19,039	6,437	5,307

Exhibit 89 Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Mini-Splits	0.88	134,507	118,366	-	-	829	729
Basement Insulation	0.80	39,891	31,912	7,448	5,958	223	179
Crawl Space Insulation	0.80	37,096	29,676	2,802	2,241	140	112
Refrigerator Retirement	0.90	17,374	15,636	774	697	277	249
Sealing & Insul. - Old Homes	0.80	14,947	11,957	-	-	51	40
Attic Insulation	0.80	13,002	10,401	1,442	1,153	60	48
Min Hot Wash	0.70	10,160	7,112	480	336	167	117
Door Systems	0.50	8,788	4,394	831	415	30	15
Power Bars (TVs)	0.95	8,752	8,315	186	177	132	125
Overnight Setback	0.70	6,388	4,472	565	396	39	28
Power Bars (PCs)	0.95	6,289	5,974	137	131	133	126
Efficient Clothes Washers	0.70	5,808	4,066	190	133	77	54
Close Blinds	0.70	4,113	2,879	315	221	23	16
ECPM Fan Motors	0.90	4,063	3,657	58	52	86	77
Daytime Setback	0.70	3,828	2,680	330	231	23	16
Air Sealing	0.90	3,663	3,296	-	-	13	12
Weather Stripping Maintenance	0.70	3,176	2,223	341	239	7	5
LED Lamps	0.95	3,252	3,090	113	107	40	38
Showerheads	0.70	1,457	1,020	68	48	15	10
ESTAR TVs	0.70	1,140	798	-	-	116	81
Benchmarking	1.00	1,122	1,122	53	53	21	21
Faucets	0.70	1,018	713	23	16	11	8
ESTAR Computers	0.70	996	697	33	23	11	8
Hot Tub Covers	0.90	894	805	75	68	18	16
Clothes Dryer Sensor	0.70	937	656	30	21	11	8
Turn Off TVs	0.70	873	611	37	26	14	10
Refrigerator Temperature	0.70	756	529	34	24	11	8
Faucet Aerator	0.70	647	453	30	21	7	5

Exhibit 89 Continued: Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Electronic Thermostats	0.70	546	382	49	35	5	3
ESTAR Dehumidifiers	0.70	416	291	14	10	2	2
Motion Detectors - Outdoor	0.80	366	293	11	8	4	3
Unplug Chargers	0.70	323	226	12	9	6	4
Min Outdoor Lighting	0.70	310	217	13	9	5	3
High-Perf. New Homes	0.76	-	-	-	-	294	223
PC Power Management	0.70	275	193	11	8	6	4
DHW Tank Insulation	0.95	238	226	-	-	3	3
Freezer Temperature	0.70	223	156	11	8	7	5
DHW Pipe Insulation	0.90	215	193	10	9	2	2
ESTAR Freezers	0.70	204	143	9	6	3	2
Prog. Thermostats	0.85	174	148	18	15	1	1
Timers - Outdoor	0.80	172	138	-	-	2	2
Super Efficient Clothes Washers	0.70	96	67	-	-	16	11
Air-to-Water Heat Pumps	0.88	-	-	-	-	105	93
AC Temperature	0.70	62	43	-	-	-	-
Air-Source Heat Pump	0.88	-	-	-	-	48	42
Cold Climate Heat Pump	0.88	-	-	-	-	18	16
Turn Off Lights	0.70	17	12	1	1	0	0
Block Heater Timers	0.75	-	-	17	13	-	-
Car Warmer Timers	0.75	-	-	12	9	-	-
Professional Air Sealing	0.90	-	-	-	-	10	9
Super Efficient Freezers	0.70	-	-	-	-	10	7
Super Efficient Refrigerators	0.70	-	-	-	-	10	7
HRVs	0.85	-	-	-	-	5	4
ESTAR Windows	0.50	-	-	-	-	5	2
Super Windows	0.50	-	-	-	-	3	2
ESTAR Dishwashers	0.70	-	-	-	-	2	2
T8 Fixtures	0.75	2	1	0	0	0	0
Motion Detectors - Indoor	0.80	-	-	-	-	1	1

Exhibit 89 Continued: Gross Versus Net Lower Achievable EE Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
Prog. Thermostats (Central)	0.85	0	0	0	0	0	0
Grand Total	0.83	338,574	280,240	16,586	12,927	3,157	2,613

Exhibit 90 Gross Versus Net Upper Achievable Demand Reduction Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)	Gross Upper Achievable Potential (MWh/yr.)	Net Upper Achievable Potential (MWh/yr.)
DHW Cycling	1.00	28	28	1	1	0	0
Dual Fuel Heat Cycling	1.00	5	5	0	0	0	0
Electric Heat Cycling	1.00	3	3	0	0	0	0
3-Element DHW	1.00	3	3	0	0	0	0
Heat Pump Cycling	1.00	0	0	0	0	0	0
Car Warmer Demand	1.00	-	-	0	0	-	-
Block Heater Demand	1.00	-	-	0	0	-	-
Grand Total	1.00	38	38	2	2	0	0

Exhibit 91 Gross Versus Net Lower Achievable Demand Reduction Potential by Measure and Region, 2029

Measure	Assumed Net-to-Gross Ratio	Island Interconnected		Labrador Interconnected		Isolated	
		Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)	Gross Lower Achievable Potential (MWh/yr.)	Net Lower Achievable Potential (MWh/yr.)
DHW Cycling	1.00	7	7	0	0	0	0
Dual Fuel Heat Cycling	1.00	3	3	-	-	0	0
3-Element DHW	1.00	1	1	0	0	0	0
Car Warmer Demand	1.00	-	-	-	-	0	0
Block Heater Demand	1.00	-	-	-	-	0	0
Grand Total	1.00	12	12	0	0	1	1

10 References

The sources listed below include references used in preparation of this report and additional resources likely to be helpful for research on energy consumption patterns and efficient technologies. Additional references on specific technologies can be found in the TRM Analysis workbooks, supplied as accompanying deliverables with this report.

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11 Glossary

Achievable Potential:
The portion of the economic conservation potential that is achievable through utility interventions and programs given institutional, economic and market barriers.

Avoided Cost:
By reducing electricity consumption and capacity requirements through the implementation of conservation and demand management programs, the NL utilities avoid the cost of having to buy electricity on the open market, contract for long term supply, and/or build and run new generation facilities. This avoided cost is used to develop a benchmark against which the cost of energy efficiency measures can be compared.

Base Year:
The base year for the 2015 CDM potential assessment is the 2014 sales for the two utilities. This number is derived from 2014 sales and forecast 2014 electric energy and capacity requirements as is explained in each report.

Benchmark for Economic Analysis:
The study established benchmarks for the economic cut-off for new avoided electrical supply on each of the different supply systems in NL. These values were selected to provide the CDM potential assessment with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost-effective over time. The following values were used:

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.11	$0.04	$0.21
2017	$0.13	$0.04	$0.23
2020	$0.05	$0.05	$0.26
2023	$0.06	$0.05	$0.29
2026	$0.07	$0.06	$0.34
2029	$0.08	$0.07	$0.37

Cost of Conserved Energy (CCE):
The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Cost of Electric Peak Reduction (CEPR):
The CEPR for a peak load reduction measure is defined as the annualized incremental capital and O&M cost of the measure divided by the annual peak reduction achieved, excluding any administrative or program costs. The CEPR represents the cost of reducing one kW of electricity during a peak period; it can be compared to the cost of supplying one new kW of electric capacity during the same period.

Conservation and Demand Management (CDM):
CDM is the influencing of customers' electricity use to obtain desirable and quantifiable changes in that use. For example, CDM comprises such cooperative joint customer and utility initiatives as peak

clipping, valley filling, load shifting, strategic conservation, strategic load growth, flexible load shape, customer on-site generation and other similar activities.

Economic Potential:
The Economic Potential is the savings in electricity consumption due to energy efficient measures whose Cost of Conserved Energy (CCE) is less than or equal to the Benchmark for Economic Analysis.

Effective Measure Life (EML):
The estimated median number of years that the measures installed under a program are still in place and operable. EML incorporates: field conditions, obsolescence, building remodelling, renovation, demolition, and occupancy changes.

Electricity Audit:
An on-site inspection and cataloguing of electricity-using equipment/buildings, electricity consumption and the related end uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, for CDM program design, and identifying specific energy savings projects.

Electric Capacity:
The maximum electric power that a device or network is capable of producing or transferring.

Electricity Conservation:
Activities by utilities or electricity users that result in a reduction of electric energy use without adversely affecting the level or quality of energy service provided. Electricity conservation measures include substitution of high-efficiency motors for standard efficiency ones, occupancy sensors in office buildings, insulation in residences, etc.

Electricity Efficiency:
The ratio of the useful energy delivered by a dynamic system to the amount of electric energy supplied to it.

Electric Energy:
Energy in the form of electricity. Energy is the ability to perform work. Electric energy is different from electric power. Electric energy is measured in kilowatt-hours, megawatt-hours or gigawatt-hours.

Electricity Intensity:
Electric energy use measured per application or end use. Examples would include kilowatt-hours per square meter of lit office space per day, kilowatt-hours per tonne of pulp produced, and kilowatt-hours per year per residential refrigerator. Electricity intensity increases as electricity efficiency decreases.

Electric Power:
The rate at which electric energy is produced or transferred, usually measured in watts, kilowatts and megawatts.

End use:
The services of economic value to the users of energy. For example, office lighting is an end use, whereas electricity sold to the office tenant is of no value without the equipment (light fixtures, wiring, etc.) necessary to convert the electricity into visible light. End use is often used interchangeably with energy service.

Energy Service:
An amenity or service supplied jointly by energy and other components such as buildings, motors and lights. Examples of energy services include residential space heating, commercial refrigeration, paper production, and lighting. The same energy service can frequently be supplied with different mixes of equipment and energy.

Financial Incentive:
Certain financial features in the utility's conservation and demand management programs designed to motivate customer participation. These may include features designed to reduce a customer's net cash outlay, pay-back period or cost of finance to participate in a specific conservation and demand management measure or technology.

Flexible Load Shape:
This is utility action to present customers with variations in service quality in exchange for incentives. Programs involved may be variations of interruptible or curtailable load, concepts of pooled, integrated energy management systems, or individual customer load control devices offering service constraints.

Gigawatt-hour (GWh):
One gigawatt-hour is one million kilowatt-hours.

Integrated Planning or Integrated Resource Planning (IRP):
See Supply Planning.

Integrated Electricity Planning (IEP):
See Supply Planning.

Kilowatt (kW):
One thousand watts; the basic unit of measurement of electric energy. One kilowatt-hour represents the power of one thousand watts (one kilowatt) for a period of one hour. A typical non-electrically heated detached home in NL uses about 10,700 kWh per year. A four foot fluorescent lamp in an office might use about 100-200 kWh per year and a large coal-fired plant might produce about three billion kWh per year.

Levelized Cost of Conservation (LCC):
The LCC is calculated for each energy efficiency measure. The LCC is the annualized incremental capital and O&M cost of the measure divided by the annual energy conserved, excluding any administrative or program costs. The LCC represents the cost of generating or conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity. In the context of commercial energy efficiency measures, it is essentially the same as the cost of conserved energy (CCE), which is the term used in this report.

Load Forecast:
This is a forecast of electricity demand over a specified time period. Long-term load forecasts usually pertain to a 10 to 20-year period. In the case of NL, the load forecast assumes a specific set of rates or prices for electricity and competing energy forms, as well as many other economic variables. In addition, forecasts of electricity conserved through CDM programs are incorporated into the Supply Planning process.

Load Research:
Research to disaggregate and analyze patterns of electricity consumption by various sub-sectors and end uses is defined as load research. Load research supports the development of the load forecast and the design of conservation and demand management programs.

Load Shape:
The time pattern and magnitude of a utility's electrical demand.

Load Shifting:
Utility program activity to shift demand from peak to off-peak periods is defined as load shifting.

Measure Total Resource Cost (TRC):
The measure TRC calculates the net present value of energy savings that result from an investment in an energy-efficiency measure. The measure TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual energy and O&M costs. This calculation includes, among others, the following inputs: the avoided electricity supply costs, the life of the technology, and the selected discount rate, which in this analysis has been set at 7%.

A measure with a positive measure TRC value is included in subsequent stages of the analysis, which consists of the Economic and Achievable Potential scenarios. A measure with a negative TRC value is not economically attractive and is therefore not included in subsequent stages of the analysis.

Megawatt (MW):
One thousand kilowatts.

Natural Change in Electricity Intensity:
The future change in electricity intensity in a given end use that is expected to occur in the absence of conservation and demand management programs. In developing an estimate of natural change in electricity intensity it is necessary to make an explicit assumption about the future prices of electricity and competing fuels.

Peak Clipping:
Utility program activity to reduce peak demand without reducing demand at other times of the day or year.

Peak Demand:
Peak demand is the maximum electric power required by a customer or electric system during a short time period, typically one hour. The peak is the time (usually of day or year) at which peak demand occurs. The peak period of interest in NL is from 7 a.m. to noon and 4 p.m. to 8 p.m. on the four coldest days of the winter, for a total of 36 hours.

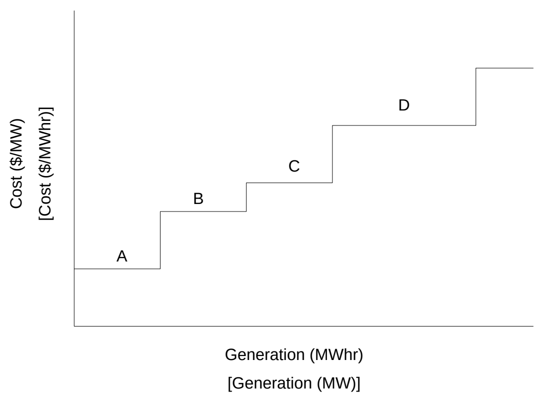
Rate Structure:
The formulas used to calculate charges for the use of electricity. For example, the present rate structures for both NL utilities for most commercial customers consists of a fixed monthly charge and charges for both electric energy usage and monthly peak demand usage.

Reference Case:
Provides a forecast of electricity sales that includes natural conservation (that which would occur in the absence of CDM programs) but no impacts of utility CDM programs. The reference case for the study is based on the 2014 base year and the Utilities' Load Forecast.

Sector:
A group of customers having a common type of economic activity. This CDM potential assessment includes the Residential, Commercial, and Industrial sectors.

Sub-sectors:
A classification of customers within a sector by common features. Residential sub-sectors are by type of home (single-family dwelling or apartment). Commercial sub-sectors are generally by type of commercial service (retail and wholesale trade).

Supply Curves:
A graph that depicts the volume of energy at the appropriate screened price in ascending order of cost. Steps A through D below represent programs options, or technologies arranged as a supply curve.



Supply Planning:
The process of long-term planning of electricity generation and associated transmission facilities, in combination with supply reductions made possible through conservation and demand management, in order to meet forecast demands. Supply Planning in NL is done in a framework that recognizes economic, financial, environmental and social costs, risks, and impacts.

Technical Efficiency:
Efficiency of a system, process, or device in achieving a certain purpose, measured in terms of the physical inputs required to produce a given output. In the context of electricity conservation the relevant input is electric energy.

Technology-Based Potential:
Energy and or capacity/demand savings realized through the implementation of energy-efficiency technologies.

Watt:
The basic unit of measurement of electric power.

Appendix A Background-Section 3: Base Year Electricity Use

Introduction

Appendix A provides additional detailed information related to each of the major steps employed to generate the profile of Residential sector Base Year electricity use. The major steps involved are:

- **Step 1:** Determine net space heating and cooling loads for each existing dwelling type
- **Step 2:** Determine annual electricity use for the existing stock of major residential appliances
- **Step 3:** Determine appliance saturation levels for each dwelling type
- **Step 4:** Determine electricity share for each appliance, by dwelling type
- **Step 5:** Calibrate to sales data for the study Base Year of 2014.

A.1 Step 1: Determine Net Space Heating Loads

Net space heating load is the space heating load of a building that must be met by the space heating system. This is equal to the total heat loss through the building envelope minus solar and internal gains. The net space heating loads for each dwelling type were developed based on the following combination of data sources:

- ICF's database of residential energy consumption from other jurisdictions,
- Responses on house size and insulation values in the building envelope from the Residential End Use Survey (REUS),
- Current utility sales data combined with knowledge of the electricity consumption and saturation of other end uses.

The net space heating load for each dwelling type is given by the following equation:

$$NetHL_1 = HL_1 + a_{i,1} * s_{i,1}$$

Where:
$NetHL_1$ = Net heating load for dwelling type #1
HL_1 = Load on primary heating appliance for dwelling type #1
$a_{i,1}$ = Average consumption for supplementary heating in dwelling type #1
$s_{i,1}$ = Saturation of supplementary heating in dwelling type #1

HL_1 was estimated for each dwelling type and service region, based on utility customer sales data for electrically and non-electrically heated dwellings combined with data on the electricity consumption of non-space heating end uses. The values for a_{i1} and s_{i1} were developed based on the estimated share of space heating that is provided by electricity (versus supplementary fuels), as taken from the REUS. The net space heating loads are presented in Exhibit 92.

It should be noted that the values shown in Exhibit 92 are not fuel specific; rather, they represent the total tertiary space heat load for each dwelling. The efficiency of the space heating appliances used to meet these loads is considered in subsequent stages of the analysis.

Exhibit 92 Existing Residential Units, 2010, Net Space Heating Loads by Dwelling Type (kWh/yr.)

Dwelling Type	Island Interconnected	Labrador Interconnected	Isolated
Single-family detached, electric space heat	14,512	28,678	24,794
Single-family detached, non-electric space heat	13,163	28,907	23,306
Attached, electric space heat	9,943	24,165	11,377
Attached, non-electric space heat	8,601	24,165	11,377
Apartment, electric space heat	4,932	6,886	5,742
Apartment, non-electric space heat	3,876	8,920	5,742
Other and non-dwellings	5,520	-	-
Vacant and partial	3,123	4,284	2,311

A.1.1 Development of Thermal Archetypes – Existing Stock

The next major step involved the development of a thermal archetype for each of the major dwelling types noted in Exhibit 92 using HOT2000.

Each HOT2000 file contains a comprehensive physical description of the size, layout and thermal characteristics of each dwelling type. HOT2000 then uses these inputs to create a full computer model of the residence, calculating loads, interactive effects and energy consumption. In each case, the net heating and cooling loads simulated by HOT2000 were calibrated to the values shown in Exhibit 92, which had been established on the basis of the sources described above. The process of calibrating simulation models to the loads estimated from available data served to further confirm the estimated loads. Adjustments were made to the estimates as required.

The physical and operating characteristics of each residential thermal archetype were researched using a number of sources, including:

- Data from the NL Residential End Use Survey
- HOT2000 models developed for the 2007-2008 CDM Potential Study in NL
- Natural Resources Canada (NRCan) and Statistics Canada housing data
- Consultations with energy auditors and residential housing experts located in NL.

For the existing housing stock, archetypes were created for the two primary dwelling types in each service region: single-family detached and attached. A brief description of each housing archetype is provided below. The

Single detached houses

For the Island and Isolated service region, a typical existing, single-detached dwelling can be defined as a single-story bungalow of approximately 149 m^2 (1600 ft^2), with a finished basement. This home has 12 m^2 (130 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.6 (R-15) insulation values, ceilings RSI-3.5 (R-20) and the basement is insulated to a value of RSI-0.6 (R-3.5). The houses are typically not very airtight with about five air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Over 40% of Island homes have HRV systems, with ductwork dedicated to distributing the ventilation air.[42]

For the Labrador Interconnected service region, a typical existing, single-detached dwelling can be defined as a single-story bungalow of approximately 149 m^2 (1600 ft^2), with a heated basement. This home has 12 m^2 (130 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.1 (R-12) insulation values, ceilings RSI-3.2 (R-18) and there is no

[42] The predominant source of information on house size and insulation levels is averages developed based on survey responses in the NL REUS.

insulation in the basement. The houses are typically not very airtight with about seven air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Approximately 25% of Labrador homes have HRV systems, with ductwork dedicated to distributing the ventilation air.

Attached Dwellings

For the Island and Isolated service region, a "typical" existing, attached dwelling can be defined as a two-story middle-unit of approximately 125 m^2 (1350 ft^2), with a finished basement. This home has 8.5 m^2 (92 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.4 (R-13.5) insulation values, ceilings RSI-4.5 (R-25.5) and the basement is insulated to a value of RSI-0.6 (R-3.5). The houses are typically not very airtight with about five air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Over 40% of Island homes have HRV systems, with ductwork dedicated to distributing the ventilation air.

For the Labrador Interconnected service region, a "typical" existing, attached dwelling can be defined as a two-story middle-unit of approximately 125 m^2 (1350 ft^2), with a heated basement. This home has 8.5 m^2 (92 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.1 (R-12) insulation values, ceilings RSI-2.6 (R-15) and there is no insulation in the basement. The houses are typically not very airtight with about seven air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Approximately 25% of Labrador homes have HRV systems, with ductwork dedicated to distributing the ventilation air.

A.2 Step 2: Determine Annual Appliance Electricity Use

The next major task involved the development of estimated average annual unit electricity consumption (UEC) values for each of the major residential appliances.

Electrical consumption of appliances is related to age. According to NRCan data[43] most appliances have increased in efficiency over time. Estimates of the evolving energy consumption of the stock of appliances in NL were developed using an appliance stock model that takes into account the expected useful life of each type of appliance, the rate of purchase and retirement of appliances, the average annual consumption of newly purchased appliances in a given year, and the average annual consumption of appliances being retired in a given year. The stock average consumption thus evolves with time. In any specific year, the average age of appliances in place is assumed to be half of the expected useful life of the appliance and the stock average is built up of all the appliances purchased and installed up to that point.

An important driver of appliance electricity consumption is the difference in average number of occupants in different types of homes. This influences the size of some appliances, such as refrigerators, and the intensity of use for others, such as laundry and cooking appliances. The estimated annual electricity consumption of appliances by dwelling type reflects these differences.

The exhibits showing estimated average annual UEC for the current stock mix of major end-uses are provided as follows:

- Exhibit 93 summarizes the UEC values for the Island Interconnected region
- Exhibit 94 summarizes the UEC values for the Labrador Interconnected region
- Exhibit 95 summarizes the UEC values for the Isolated region.

The space heating end use has been omitted from Exhibit 93 through Exhibit 95 because it was presented in Exhibit 92.

[43] NRCan, 2012. *Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010.*

Further commentary on the individual end uses is provided below the three following exhibits. An overall summary of changes to end use consumption since the 2008 study is provided in Section 3.4 above.

Exhibit 93 Annual Appliance Unit Electricity Consumption (UEC), Island Interconnected (kWh/yr.)

Dwelling Type	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	224	250	2,629	654	590	426	96	50	937
Single-family detached, non-electric space heat	203	741	2,385	593	590	426	87	46	850
Attached, electric space heat	101	224	2,694	670	590	426	99	52	960
Attached, non-electric space heat	88	648	2,330	580	590	426	85	45	831
Apartment, electric space heat	50	87	1,930	480	398	242	71	37	688
Apartment, non-electric space heat	34	205	1,302	324	398	242	48	25	464
Other and non-dwellings	179	97	1,363	339	590	426	50	26	486
Vacant and partial	46	25	654	163	122	88	24	13	233

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other
Single-family detached, electric space heat	722	1,137	388	238	291	170	14,512	266
Single-family detached, non-electric space heat	655	1,031	352	216	264	154	14,512	241
Attached, electric space heat	722	1,011	388	238	291	170	14,512	83
Attached, non-electric space heat	625	874	335	206	251	147	14,512	72
Apartment, electric space heat	620	507	333	205	250	146	-	126
Apartment, non-electric space heat	487	342	262	161	196	114	-	99
Other and non-dwellings	-	500	213	105	128	75	-	1,715
Vacant and partial	-	283	96	59	72	42	-	800

Exhibit 94 Annual Appliance Unit Electricity Consumption (UEC), Labrador Interconnected (kWh/yr.)

Dwelling Type	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	224	196	2,722	677	590	426	100	52	970
Single-family detached, non-electric space heat	225	741	2,744	683	590	426	101	53	978
Attached, electric space heat	101	155	2,789	694	590	426	102	53	994
Apartment, electric space heat	50	48	1,824	447	398	242	66	34	640
Other and non-dwellings	40	22	1,953	486	590	426	72	37	696

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other
Single-family detached, electric space heat	722	1,283	388	238	291	170	258	28,678	266
Single-family detached, non-electric space heat	728	1,293	391	240	293	171	258	28,678	243
Attached, electric space heat	722	1,009	388	238	291	170	258	28,678	83
Apartment, electric space heat	557	533	299	184	224	131	-	-	113
Other and non-dwellings	-	180	295	33	41	24	-	-	1,305

Exhibit 95 Annual Appliance Unit Electricity Consumption (UEC), Isolated (kWh/yr.)

Dwelling Type	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	224	181	2,677	666	590	426	98	51	954
Single-family detached, non-electric space heat	210	689	2,516	626	590	426	92	48	897
Other and non-dwellings	179	97	581	145	590	426	21	11	207
Vacant and partial	46	25	341	85	122	88	13	7	122

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other
Single-family detached, electric space heat	722	1,168	388	238	291	170	24,794	266
Single-family detached, non-electric space heat	679	1,098	364	224	273	159	24,794	227
Other and non-dwellings	-	215	89	44	54	31	-	718
Vacant and partial	-	149	49	30	37	22	-	495

Occupancy

Occupancy rates[44] for each dwelling type were based on the Newfoundland and Labrador REUS conducted in 2014. They are used, as applicable, to estimate electricity use for occupant-sensitive end uses, such as DHW, laundry and lighting. Exhibit 96 summarizes the occupancy rates assumed for this study. Cells coloured yellow in the exhibit had sample sizes of fewer than 10 respondents in the REUS and were therefore considered too uncertain to be used in this study. They are provided for comparison only.

Exhibit 96 Occupancy Rates by Dwelling Type (average occupants/dwelling)

House Type	Island Interconnected	Labrador Interconnected	Isolated
Detached	2.5	2.6	2.5
Attached Side by Side	2.6	4.0	
Attached Above Apartment	2.5	2.0	5.0
Basement Apartment	2.1	1.0	2.0
Mobile	2.3	1.8	2.7
Apartment in Multi-Unit Building	2.1		

Sample less than 10

Ventilation and Circulation

Ventilation electricity is associated with fan/blower electricity in heating systems, kitchen fans, bathroom fans and heat recovery ventilators.

A furnace fan UEC of approximately 510 kWh was assumed for single detached houses with forced air systems. This figure is consistent with estimates used in ICF's most recent studies in other jurisdictions and is somewhat lower than estimates used in earlier studies. This reflects the steady increase in the prevalence of ECM motors as furnaces age out and are replaced with new ones that are typically equipped with the new motors, reaching a penetration of approximately 30% by the base year of this study. The 510 kWh value is also consistent with the range of Canadian end-use metered data reported in a study conducted for Natural Resources Canada.[45]

Typical consumption for an HRV fan was assumed to be 300 kWh per year.[46] The prevalence of HRVs in different types of houses in NL was drawn from the REUS. Exhibit 97 shows the percentage of dwellings with HRVs, by dwelling type and region, based on the REUS. Cells shown in yellow in the exhibit had too small a sample size to be reliable. Those values were not used in the study.

[44] Electricity use related to personal consumption increases with number of occupants in dwelling.
[45] This area is the focus of extensive research efforts. *See*: Gusdorf, John, *Final Report on the Project to Measure the Effects of ECM Furnace Motors on Gas Use at the CCHT Research Facility*, Natural Resources Canada, January 2003. Current estimates of fan energy use vary widely; upper range estimates (heat mode only) exceed 1,000 kWh/yr. Continuous ventilation or use with space cooling equipment would increase fan motor consumption.
[46] Source: http://www.greenbuildingadvisor.com/blogs/dept/musings/are-hrvs-cost-effective

Exhibit 97 Prevalence of HRVs by Dwelling Type (percentage of dwellings with HRV)

House Type	Island Interconnected	Labrador Interconnected	Isolated
Detached	43.1%	25.0%	20.0%
Attached Side by Side	31.7%	0.0%	
Attached Above Apartment	61.5%	100.0%	0.0%
Basement Apartment	51.9%	100.0%	50.0%
Mobile	33.3%	25.0%	66.7%
Apartment in Multi-Unit Building	38.5%		

Sample less than 10

For the purpose of estimating kitchen and bathroom fan electricity, it was assumed that a typical exhaust fan is rated at 75 Watts and operates, on average, for two hours per day. In homes with heat supplied by baseboard electric or by hydronic systems, these exhaust fans are the predominant ventilation load. With two such fans in a typical house, consumption would be approximately 100-110 kWh/yr.

The UEC for a forced air system includes the electricity consumed by the furnace fan, the HRV fan and the exhaust fans. Overall UEC for forced air systems is assumed to be lower in this study than in the 2008 study, because improvements to the furnace fans outweigh the energy used by HRV fans. The UEC for a baseboard electric system includes only the electricity consumed by the latter two. Overall UEC for baseboard systems is assumed to be higher in this study than in the 2008 study, because of the inclusion of HRV fan energy in the end use.

Note: The ventilation and circulation UEC values shown previously in Exhibit 93 reflect the mix between forced air systems and baseboard systems.

Ventilation and circulation UEC values for the Labrador Interconnected and the Isolated regions are scaled based on the tertiary heating loads to best fit the electricity sales for those regions.

Domestic Hot Water

UEC estimates for DHW assume a per capita hot water consumption of 45 litres per person per day and a temperature rise of 45°C. Exhibit 98 shows the distribution of DHW load by major end use.

Exhibit 98 Distribution of DHW Electricity Use by End Use in Existing Stock, (kWh/yr.)

DHW Sub End Uses	Electricity per Sub End Use (kWh/yr.)	Electricity per Sub End Use (%)
Clothes Washers	440	17%
Showers	660	25%
Faucets	511	19%
Baths	120	5%
Dishwashers	315	12%
Leaks	179	7%
Tank (Standby) Losses	202	8%
Pipe Losses	202	8%
Total	2,629	100%

Note: Any differences in totals are due to rounding.

The DHW values shown in Exhibit 98 are based on a combination of sources including available data from other jurisdictions, NRCan studies (NRCan, 2005) and the results of other recent ICF studies. Overall DHW UEC is assumed to be lower in this study than in the 2008 study, primarily because of lower hot water use in the newer clothes washers and dishwashers. Data from the NL REUS were used to update the efficiency of clothes washers and dishwashers, based on reported average ages of these appliances. DHW consumption by dwelling type was varied based on the reported average occupancies in the REUS.

UEC values for DHW and other non-HVAC end uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Indoor Lighting

The indoor lighting loads shown in Exhibit 93 were developed from the following sources:

- Residential utility data on lighting types and usage patterns from other jurisdictions
- NL's REUS
- NRCan's End Use Energy Data Handbook (NRCan, 2005).

Exhibit 99 shows the estimated counts of different types of lighting based on the data from the REUS and residential lighting data from other ICF studies. Lighting counts have increased as larger houses have been built in Canada, but the hours of use for each lighting fixture has decreased at the same time.

The average wattage and hours of use per year shown in the exhibit are based on ICF's energy use database, developed during several previous conservation potential studies. They were adjusted for consistency with the sources listed above. The resulting calculation shown in the exhibit provides a basis for the estimate of overall indoor lighting energy consumption for different dwelling types. Overall UECs for lighting in the new study are assumed to be lower than in the 2008 study, primarily because of the increased penetration of compact fluorescent and LED lighting.

UEC values for lighting in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 99 Indoor Lighting by Dwelling Type

Dwelling Types	Incandescent Lamps	Linear Fluorescent Tubes	Compact Fluorescent Lamps	Halogen Lamps	LED Lamps	
SDH	10.7	0.7	9.0	1.4	2.2	(lamps)
Attached	9.6	0.6	8.1	1.3	2.0	(lamps)
Apartment	4.9	0.3	4.1	0.7	1.0	(lamps)
Average Wattage	60	28	15	45	12	(w atts)
Average Hours/Year	1,032	344	1,548	1,032	1,548	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)						Total
SDH	664	7	208	67	41	986
Attached	597	6	187	60	37	887
Apartment	300	3	94	30	18	446

Outdoor Lighting

The outdoor lighting loads shown in Exhibit 93 were developed from the following sources:

- Residential utility data on lighting types and usage patterns from other jurisdictions
- NL's REUS

- NRCan's End Use Energy Data Handbook (NRCan, 2005).

Exhibit 100 shows the estimated counts of different types of lighting based on the data from the REUS and residential lighting data from other ICF studies.

The average wattage and hours of use per year shown in the exhibit are based on ICF's energy use database, developed during several previous conservation potential studies. They were adjusted for consistency with the sources listed above. The resulting calculation shown in the exhibit provides a basis for the estimate of overall outdoor lighting energy consumption for different dwelling types.

UEC values for lighting in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 100 Outdoor Lighting by Dwelling Type

Dwelling Types	Incandescent Lamps	Linear Fluorescent Tubes	Compact Fluorescent Lamps	Halogen Lamps	LED Lamps	
SDH	1.7	0.2	1.5	0.3	0.4	(lamps)
Attached	1.5	0.2	1.4	0.3	0.4	(lamps)
Apartment	0.7	0.1	0.6	0.1	0.2	(lamps)
Average Wattage	60	28	15	45	12	(watts)
Average Hours/Year	730	243	1460	730	1460	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)						Total
SDH	73	2	34	10	7	126
Attached	66	1	30	9	6	113
Apartment	31	1	14	4	3	53

Holiday Lighting

The holiday lighting loads shown in Exhibit 93 were developed from the following sources:

- Residential utility data on lighting types and usage patterns from other jurisdictions
- NL's REUS
- NRCan's End Use Energy Data Handbook (NRCan, 2005).

Exhibit 101 shows the estimated counts of different types of holiday lighting based on the data on residential lighting data from other ICF studies.

The average wattage and hours of use per year shown in the exhibit are based on ICF's energy use database, developed during several previous conservation potential studies. They were adjusted for consistency with the sources listed above. The resulting calculation shown in the exhibit provides a basis for the estimate of overall holiday lighting energy consumption for different dwelling types.

UEC values for lighting in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 101 Holiday Lighting by Dwelling Type

Dwelling Types	Indoor Incandescent Holiday Strings	Indoor LED Holiday Strings	Outdoor Incandescent Holiday Strings	Outdoor LED Holiday Strings	
SDH	2	9	2	6	(lamps)
Attached	1	5	1	4	(lamps)
Apartment	1	2	0	0	(lamps)
Average Wattage	60	1	60	1	(w atts)
Average Hours/Year	95	95	125	125	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)					Total
SDH	11	1	15	1	28
Attached	6	0	8	1	14
Apartment	6	0	0	0	6

Cooking Appliances, Refrigerator, Freezer and Dishwasher

UEC estimates for the existing stock of this group of food preparation and storage appliances were obtained from *Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010* (NRCan, 2012). The values shown for dishwashers are for mechanical electricity only; hot water use is included with the DHW UEC. Average consumption values for refrigerators, freezers, and dishwashers have all decreased over time, according to the NRCan data. Cooking appliances have remained relatively stable.

UEC values for appliances and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Clothes Washer and Dryer

Appliance UEC data was obtained from *Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010* (NRCan, 2012). The values shown for clothes washers are for mechanical electricity only; hot water use is included with the DHW UEC. Average consumption values for clothes washers have decreased over time, according to the NRCan data. The NRCan data indicates that average consumption for new dryers has actually been rising slightly in recent years.

UEC values for appliances and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Computers

UEC data for computers is based on calculations drawing on data from the *Survey of Household Energy Use 2007: Detailed Statistical Report* (NRCan, 2007) and is consistent with ICF's previous work for studies in other jurisdictions.

UEC values for electronics and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Television

UEC data for televisions was obtained from *Technology and Market Profile: Consumer Electronics* (ICF, 2006). Saturation of televisions (number of sets per household) is adjusted by dwelling type based on data from the REUS, and consumption per television is varied modestly by dwelling type in this study based on assumed differences in occupancy.

UEC values for electronics and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Television Peripherals

UECs, saturations and numbers per household for television peripherals were obtained from *Technology and Market Profile: Consumer Electronics* (ICF, 2006) and other published data. In some parts of Canada, internet protocol television (IP-TV) is becoming a major player in the marketplace. The equipment for IP-TV uses about 40% less than the average cable or satellite system. IP-TV is assumed to occupy only a very small part of the NL market at this time, and has not been included in the calculations for this study. The weighted UEC for this end use as a whole was generated from the numbers shown in Exhibit 102. UEC was varied by dwelling type based on differences in occupancy.

UEC values for electronics and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 102 Derivation of UEC for Television Peripherals

	% of TVs in households	UEC kWh/yr.
Digital Cable Service	138%	
Digital Adaptor	138%	78
Standard Digital STB	61%	185
Advanced Digital STB	77%	309
Average UEC		332
Satellite Service	60%	
Standard Satellite STB	30%	134
Advanced Satellite STB	30%	260
Average UEC		197
Total Weighted UEC		291

Home Entertainment Electronics

Due to the large presence of electronic entertainment devices in many residential dwellings, this end use was separated from the general "other" category. UECs were obtained from *Technology and Market Profile: Consumer Electronics* (ICF, 2006), *Residential Miscellaneous Electricity Use* (LBL) and other published data. A weighted UEC for the end use as a whole was generated based on recent ICF studies, as shown in Exhibit 103.

UEC values for electronics and all the other non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 103 Derivation of UECs for Other Electronics

	Saturation (average number per household)	UEC (kWh/yr.)	Weighted UEC (kWh/yr.)
DVD	66%	35	23
VCR	18%	55	10
Audio System	38%	55	21
Surround Sound	25%	50	13
Compact Audio	119%	25	30
Game Console	44%	55	24
Other Electronic Entertainment	228%	22	50
Total Weighted UEC			170

Spas

This end use includes only spas. The incidence of swimming pools in NL is assumed to be small. The UEC includes the spa heater if it is electric, and also includes the consumption of the pump. Figures are derived from ICF's previous work in other jurisdictions and manufacturer literature on spa heater consumption. Exhibit 104 shows the derivation of the UECs used in Exhibit 93. The market penetration numbers in the exhibit are estimates of the shares of each technology within the subset of spas with that electric end use. For example, the estimate of 75% spa heaters using resistance heating elements is the share of electrically heated spas using resistance heat. Spas that are heated with propane or solar are not included.

UEC values for all non-HVAC uses in the Labrador Interconnected and the Isolated regions were scaled to best fit actual electricity sales to the accounts in those regions.

Exhibit 104 Derivation of UECs for Spas, Island Interconnected Region

	UEC (kWh/yr.)	Market Penetration	Weighted UEC (kWh/yr.)
Spa Heaters			
Resistance	15,870	75%	11,903
Heat Pump	5,290	25%	1,323
		Weighted UEC	13,225
Spa Pumps			
Standard	1,500	75%	1,125
High Efficiency	900	25%	225
		Weighted UEC	1,350
Total Weighted UEC			14,575

Block Heaters and Car Warmers

Consumption for block heaters was based on previous studies in other jurisdictions. Block heaters typically draw 500 watts. They were assumed to be used several hours per day for 90 days of the year. Approximately one-quarter of them were assumed to be on timers, which would reduce their runtime by 70%. The resulting total consumption of block heaters was estimated at 228 kWh/yr. The car warmers use more power, typically 1200 watts. They were assumed to be used fewer hours per day, but over a longer season of 110 days. More of them were assumed to be on timers – nearly half – with savings of about 50% of runtime. There are typically fewer car warmers than block heaters in use. Therefore, the car warmers were assumed to add only about 30 kWh/yr. to the total consumption for this end use, bringing it to 258 kWh/yr. The block heater end use is included only in the Labrador Interconnected region. The incidence of these devices in the other two regions is considered to be so small that any consumption for them is included under the Small Appliances and Other end use.

Small Appliances and Other

"Other" end uses include a wide range of appliances and equipment found in most homes. Reliable data on the actual annual electricity use of this collection of appliances and equipment within NL is not available.

Exhibit 105 illustrates the major items included in this end use and presents sample UEC data estimated in earlier studies undertaken in other jurisdictions.[47] It should be noted that actual UECs for individual appliances will vary from those shown in Exhibit 105 and are affected by factors such as saturations by dwelling type and occupancy rates. Saturation information from LBL was not applied for this study because reliable information for NL was not available. The "other" category is not built up based on detailed analysis, but is an approximation only. The LBL data provided should be treated as being illustrative of the types of energy-using items in the category and how much electricity they typically use.

Consumption for the Small Appliances and Other end use is assumed to be lower in this study than in the 2008 study, largely because the consumption for space cooling, block heaters, and hot tubs has been separated into distinct end uses.

[47] Lawrence Berkeley National Laboratory (LBL), *Residential Miscellaneous Electricity Use,* 1997.

Exhibit 105 Typical UECs for Selected "Other" Appliances

Appliance	UEC (kWh/yr.)	Appliance	UEC (kWh/yr.)
Home radio, small/clock	18	Timer	18
Battery Charger	21	Hot Plate	30
Clock	18	Stand Mixers	1
Power Strip	3	Hand-Held Rechargeable	16
Vacuum	31	Hand-Held Electric Vacuum	4
Hand Mixers	2	Air Corn Popper	6
Iron	53	Security System	195
Hair Dryer	36	Perc Coffee	65
Toaster	39	Deep Fryer	20
Auto Coffee Maker	116	Waterbed Heaters	900
Blender	7	Humidifier	100
Heating Pads	3	Electric Toothbrush	20
Doorbell	18	Hot Oil Corn Popper	2
Answering Machine	29	Women's Shaver	12
Can Opener	3	Aquariums	548
Slow Cooker	16	Espresso Maker	19
Curling Iron	1	Electric Lawn Mower	100
Food Slicer	1	Mounted Air Cleaner	500
Garbage Disposer	10	Multi-fcn Device	41
Electric Knife	1	Electric Kettle	75
Portable Fans	8	Bottled Water Dispenser	300
Men's Shaver	13	Central Vacuum	24
Waffle Iron/Sandwich Grill	25	Grow Lights	800
Electric Blankets	120	Home Medical Equipment	400
Garage Door Opener	30		
Hair Setter	10		

A.3 Step 3: Determine Appliance Saturation, by Dwelling Type

Exhibit 106 through Exhibit 108 summarize the saturation levels that are used in the present analysis. The assumed saturation levels are developed from the most recent REUS. End uses fall into several categories:

- For the purposes of this study, saturation is defined as the presence of the end use. It does not include fuel share, which is discussed in the next section. The saturation of 100% for space heating, for example, indicates that all dwellings are assumed to be heated with some kind of fuel. The number of people who do not heat their homes at all is assumed to be vanishingly small.

- Some end uses are present in 100% of fully-occupied dwellings, including space heating,[48] ventilation and circulation, DHW, indoor and outdoor lighting, cooking, home entertainment electronics, and small appliance and other. These end uses are analyzed on the basis of UEC per dwelling, rather than UEC per appliance. Some of these end uses are not assumed to be present in all of the seasonal accounts, as the exhibit shows.
- Most of the remaining end uses are analyzed on the basis of UEC per appliance. Their saturation, as indicated in the table, reflects the average number of appliances per household. For example, the average household includes more than one refrigerator, and the saturation values in the exhibit reflect that.

The saturation levels by region are provided as follows:

- Exhibit 106 provides the estimated saturation levels for the Island Interconnected region
- Exhibit 107 provides the estimated saturation levels for the Labrador Interconnected region
- Exhibit 108 provides the estimated saturation levels for the Isolated region.

[48] As noted, the saturation of space heating, DHW, and cooking do not reflect how many households use electricity for those purposes. Electric share is discussed in the next section.

Exhibit 106 Appliance Saturation Levels, Island Interconnected Region (%)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer
Single-family detached, electric space heat	100%	8%	100%	100%	100%	144%	118%	72%	100%
Single-family detached, non-electric space heat	100%	0%	100%	100%	100%	144%	118%	72%	100%
Attached, electric space heat	100%	1%	100%	100%	100%	147%	92%	75%	100%
Attached, non-electric space heat	100%	0%	100%	100%	100%	147%	92%	75%	100%
Apartment, electric space heat	100%	0%	100%	100%	100%	118%	41%	43%	78%
Apartment, non-electric space heat	100%	0%	100%	100%	100%	118%	41%	43%	78%
Other and non-dwellings	100%	0%	100%	100%	100%	100%	100%	33%	100%
Vacant and partial	100%	0%	100%	100%	100%	100%	100%	33%	100%

Dwelling Type	Clothes dryer	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other
Single-family detached, electric space heat	98%	55%	100%	180%	265%	100%	100%	5%	100%
Single-family detached, non-electric space heat	98%	55%	100%	180%	265%	100%	100%	5%	100%
Attached, electric space heat	100%	55%	100%	177%	254%	100%	100%	3%	100%
Attached, non-electric space heat	100%	55%	100%	177%	254%	100%	100%	3%	100%
Apartment, electric space heat	76%	37%	100%	182%	168%	100%	100%	0%	100%
Apartment, non-electric space heat	76%	37%	100%	182%	168%	100%	100%	0%	100%
Other and non-dwellings	100%	33%	100%	167%	267%	100%	100%	0%	100%
Vacant and partial	100%	33%	100%	167%	267%	100%	100%	0%	100%

Exhibit 107 Appliance Saturation Levels, Labrador Interconnected Region (%)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	100%	0%	100%	100%	100%	163%	150%	81%	100%	100%
Single-family detached, non-electric space heat	100%	0%	100%	100%	100%	163%	150%	81%	100%	100%
Attached, electric space heat	100%	0%	100%	100%	100%	166%	117%	85%	100%	102%
Apartment, electric space heat	100%	0%	100%	100%	100%	134%	52%	48%	78%	78%
Other and non-dwellings	100%	0%	100%	100%	100%	100%	100%	33%	100%	100%

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other
Single-family detached, electric space heat	44%	100%	193%	294%	100%	100%	62%	6%	100%
Single-family detached, non-electric space heat	44%	100%	193%	294%	100%	100%	62%	6%	100%
Attached, electric space heat	44%	100%	184%	281%	100%	100%	62%	3%	100%
Apartment, electric space heat	29%	100%	187%	186%	100%	100%	53%	0%	100%
Other and non-dwellings	33%	100%	167%	267%	100%	100%	65%	0%	100%

Exhibit 108 Appliance Saturation Levels, Isolated Region (%)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer
Single-family detached, electric space heat	100%	0%	100%	100%	100%	120%	188%	48%	100%
Single-family detached, non-electric space heat	100%	0%	100%	100%	100%	120%	188%	48%	100%
Other and non-dwellings	100%	0%	100%	100%	100%	100%	100%	33%	100%
Vacant and partial	100%	0%	100%	100%	100%	100%	100%	33%	100%

Dwelling Type	Clothes dryer	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other
Single-family detached, electric space heat	96%	28%	100%	205%	248%	100%	100%	4%	100%
Single-family detached, non-electric space heat	96%	28%	100%	205%	248%	100%	100%	4%	100%
Other and non-dwellings	100%	33%	100%	167%	267%	100%	100%	0%	100%
Vacant and partial	100%	33%	100%	167%	267%	100%	100%	0%	100%

A.4 Step 4: Determine Fuel Share, by End Use and Dwelling Type

Data on fuel shares, for all end uses except space heating, is taken from the most recent NL REUS. In the case of space heating, the starting point was the distribution of space heating appliances, by fuel type, as reported in the REUS, but the actual fuel share includes not only the presence of different appliances but also how much they are used. In particular it is affected by supplementary heating appliances, such as:

- Electric space heaters in non-electrically heated dwellings
- Non-electric sources (e.g., wood stoves) in electrically heated dwellings.

The space heating fuel shares presented in the exhibit[49] have been selected on the basis that they provide a reasonable fit with:

- General market description (i.e., known distribution of heating appliances by fuel)
- Electricity sales to different categories of homes.

The following exhibits summarize the electricity fuel shares assumed for each of the end uses by region, as follows:

- Exhibit 109 shows the assumed fuel shares for the Island Interconnected Region
- Exhibit 110 shows the assumed fuel shares for the Labrador Interconnected Region
- Exhibit 111 shows the assumed fuel shares for the Isolated Region.

Exhibit 109 Electricity Fuel Shares, Island Interconnected Region (%)

Dwelling Type	Space heating	Domestic Hot Water (DHW)	Cooking
Single-family detached, electric space heat	89%	100%	97%
Single-family detached, non-electric space heat	11%	75%	91%
Attached, electric space heat	88%	100%	100%
Attached, non-electric space heat	10%	64%	98%
Apartment, electric space heat	99%	100%	100%
Apartment, non-electric space heat	23%	79%	100%
Other and non-dwellings	50%	90%	100%
Vacant and partial	50%	90%	100%

[49] Adjustment of fuel shares for space heating was done in tandem with the adjustment of space heating loads described in Section 3.4 above.

Exhibit 110 Electricity Fuel Shares, Labrador Interconnected Region (%)

Dwelling Type	Space heating	Domestic Hot Water (DHW)	Cooking
Single-family detached, electric space heat	97%	100%	100%
Single-family detached, non-electric space heat	26%	75%	96%
Attached, electric space heat	96%	100%	100%
Apartment, electric space heat	99%	100%	100%
Other and non-dwellings	60%	90%	100%

Exhibit 111 Electricity Fuel Shares, Isolated Region (%)

Dwelling Type	Space heating	Domestic Hot Water (DHW)	Cooking
Single-family detached, electric space heat	74%	100%	100%
Single-family detached, non-electric space heat	3%	75%	96%
Other and non-dwellings	56%	90%	100%
Vacant and partial	56%	90%	100%

A.5 Step 5: Calibrate to sales data for the study Base Year of 2014

The Utilities provided electricity sales data for the year 2014, which was the latest year for which a complete year of data was available at the time of the study. Electricity sales were divided among the dwelling types and vintages according to the best information available from the utilities' customer databases and from ICF's energy end-use modelling. The RSEEM model was populated with data for UEC, saturation and electricity share and calibrated for a close match to the 2014 sales data.

A.6 Results by Region

This section of the appendix presents the base year electricity consumption for the Island Interconnected, Labrador Interconnected, and Isolated regions. For each region, versions of Exhibit 6 and Exhibit 7 (which appear in Section 3 of the main body of the report) are provided below. The underlying assumptions such as unit energy consumption, saturation and electricity share are not presented by region. In general, the sample sizes for the Isolated region are too small to develop these detailed assumptions for the houses there. Instead, the end use consumptions are scaled to calibrate the model to the sales of electricity in the Isolated region.

This section also does not replicate the pie charts and other graphs presented in Section 3. If those graphs are needed for each region, they can be created using the Data Manager.

Exhibit 112 Average Electricity Use per Dwelling Unit, Island Interconnected (kWh/yr.)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	12,921	17	250	2,629	637	850	501	69	50	916
Single-family detached, non-electric space heat	1,405	-	741	1,780	538	850	501	63	45	831
Attached, electric space heat	8,753	1	224	2,694	669	868	390	74	52	960
Attached, non-electric space heat	866	-	648	1,500	570	868	390	64	45	831
Apartment, electric space heat	4,883	-	87	1,930	480	472	99	30	29	523
Apartment, non-electric space heat	907	-	205	1,035	324	472	99	21	19	353
Other and non-dwellings	2,760	-	97	1,227	339	590	426	17	26	486
Vacant and partial	1,561	-	25	589	163	122	88	8	13	233

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	399	1,137	698	631	291	170	709	266	23,143
Single-family detached, non-electric space heat	362	1,031	633	573	264	154	709	241	10,721
Attached, electric space heat	400	1,011	688	604	291	170	380	83	18,312
Attached, non-electric space heat	346	874	595	523	251	147	380	72	8,970
Apartment, electric space heat	227	507	606	344	250	146	-	126	10,738
Apartment, non-electric space heat	179	342	476	270	196	114	-	99	5,111
Other and non-dwellings	-	500	355	279	128	75	-	1,715	9,020
Vacant and partial	-	283	161	158	72	42	-	800	4,318

Exhibit 113 Average Electricity Use per Dwelling Unit, Labrador Interconnected (kWh/yr.)

Dwelling Type	Space heating	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	27,934	196	2,722	677	959	639	81	52	970
Single-family detached, non-electric space heat	7,380	741	2,047	653	959	639	82	53	978
Attached, electric space heat	23,297	155	2,789	694	980	498	87	54	1,017
Apartment, electric space heat	6,817	48	1,824	447	532	127	32	27	498
Other and non-dwellings	2,571	22	1,757	486	590	426	24	37	696

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	316	1,283	748	700	291	170	160	1,792	266	39,956
Single-family detached, non-electric space heat	318	1,293	754	706	293	171	160	1,792	243	19,263
Attached, electric space heat	316	1,009	713	670	291	170	159	960	83	33,940
Apartment, electric space heat	162	533	561	343	224	131	-	-	113	12,417
Other and non-dwellings	-	180	492	89	41	24	-	-	1,305	8,740

Exhibit 114 Average Electricity Use per Dwelling Unit, Isolated Region (kWh/yr.)

Dwelling Type	Space heating	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	18,298	181	2,677	666	709	801	47	51	916
Single-family detached, non-electric space heat	811	689	1,878	599	709	801	44	48	861
Other and non-dwellings	1,290	97	523	145	590	426	7	11	207
Vacant and partial	894	25	307	85	122	88	4	7	122

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	202	1,168	795	591	291	170	992	266	28,819
Single-family detached, non-electric space heat	190	1,098	747	556	273	159	992	227	10,681
Other and non-dwellings	-	215	149	117	54	31	-	718	4,580
Vacant and partial	-	149	82	81	37	22	-	495	2,519

Exhibit 115 Electricity Consumption by End Use and Dwelling Type in the Base Year (2014), Island Interconnected (MWh/yr.)

Dwelling Type	Space heating	Space cooling	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	1,292,846	1,723	25,048	263,075	63,738	85,070	50,091	6,950	5,014	91,701
Single-family detached, non-electric space heat	91,434	-	48,207	115,811	35,005	55,329	32,579	4,100	2,958	54,095
Attached, electric space heat	199,039	22	5,089	61,251	15,204	19,743	8,878	1,691	1,173	21,836
Attached, non-electric space heat	3,990	-	2,982	6,908	2,622	3,998	1,798	296	205	3,825
Apartment, electric space heat	113,543	-	2,015	44,866	11,166	10,966	2,312	707	667	12,162
Apartment, non-electric space heat	2,244	-	507	2,561	802	1,167	246	51	48	874
Other and non-dwellings	21,074	-	739	9,368	2,590	4,508	3,252	127	199	3,711
Vacant and partial	26,804	-	428	10,105	2,794	2,091	1,508	137	215	4,002
Grand Total	1,750,974	1,745	85,015	513,943	133,923	182,872	100,664	14,059	10,480	192,205

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	39,973	113,782	69,884	63,165	29,082	16,968	70,990	26,589	2,315,689
Single-family detached, non-electric space heat	23,580	67,121	41,225	37,262	17,156	10,010	46,172	15,685	697,729
Attached, electric space heat	9,091	22,986	15,633	13,741	6,609	3,856	8,640	1,893	416,374
Attached, non-electric space heat	1,592	4,026	2,738	2,407	1,158	675	1,750	332	41,302
Apartment, electric space heat	5,289	11,797	14,088	7,991	5,805	3,387	-	2,922	249,684
Apartment, non-electric space heat	442	848	1,178	668	486	283	-	244	12,650
Other and non-dwellings	-	3,818	2,714	2,134	976	569	-	13,097	68,875
Vacant and partial	-	4,856	2,759	2,714	1,241	724	-	13,742	74,121
Grand Total	79,968	229,235	150,219	130,081	62,513	36,473	127,552	74,503	3,876,424

Exhibit 116 Electricity Consumption by End Use and Dwelling Type in the Base Year (2014), Labrador Interconnected (MWh/yr.)

Dwelling Type	Space heating	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	131,947	926	12,857	3,200	4,532	3,017	383	246	4,583
Single-family detached, non-electric space heat	2,624	263	728	232	341	227	29	19	348
Attached, electric space heat	66,188	440	7,923	1,972	2,784	1,415	247	152	2,889
Apartment, electric space heat	5,604	40	1,499	367	437	104	26	22	409
Other and non-dwellings	2,506	22	1,713	474	576	415	23	36	679
Grand Total	208,869	1,691	24,720	6,245	8,670	5,179	709	476	8,908

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Block heaters & car warmers	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	1,492	6,060	3,532	3,307	1,373	801	755	8,466	1,255	188,733
Single-family detached, non-electric space heat	113	460	268	251	104	61	57	637	86	6,849
Attached, electric space heat	898	2,866	2,026	1,904	826	482	450	2,727	236	96,425
Apartment, electric space heat	133	438	461	282	184	108	-	-	93	10,207
Other and non-dwellings	-	175	479	87	40	23	-	-	1,273	8,522
Grand Total	2,636	9,999	6,766	5,830	2,527	1,474	1,263	11,831	2,944	310,735

Exhibit 117 Electricity Consumption by End Use and Dwelling Type in the Base Year (2014), Isolated Region (MWh/yr.)

Dwelling Type	Space heating	Ventilation	Domestic Hot Water (DHW)	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer
Single-family detached, electric space heat	6,413	63	938	233	248	281	17	18	321
Single-family detached, non-electric space heat	2,174	1,847	5,033	1,606	1,899	2,146	119	129	2,308
Other and non-dwellings	227	17	92	25	104	75	1	2	36
Vacant and partial	284	8	98	27	39	28	1	2	39
Grand Total	9,098	1,936	6,160	1,892	2,290	2,529	138	151	2,704

Dwelling Type	Dehumidifier	Lighting	Computer and peripherals	Television	Television peripherals	Other electronics	Hot tubs	Small appliance & other	Total
Single-family detached, electric space heat	71	409	279	207	102	59	348	93	10,100
Single-family detached, non-electric space heat	509	2,942	2,002	1,489	732	427	2,658	607	28,628
Other and non-dwellings	-	38	26	21	9	6	-	127	807
Vacant and partial	-	47	26	26	12	7	-	157	800
Grand Total	580	3,436	2,333	1,743	855	499	3,006	984	40,335

Appendix B Background-Section 4: Base Year Peak Load

Introduction

Appendix B provides additional detailed information related to each of the major steps employed in the generation of the Residential sector Base Year peak loads. The discussion is organized as follows:

- Overview of peak load methodology
- Segmentation of residential dwellings
- Detailed results.

B.1 Overview of Peak Load Profile Methodology

As noted in the main text, development of the electric peak load estimates employs four specific factors as outlined below:

- **Monthly Usage Allocation Factor:** This factor represents the percent of annual electric energy usage that is allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. This allocation factor can be obtained from either (in decreasing order of priority): (a) monthly consumption statistics from end-use load studies; (b) monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months; or (c) heating or cooling degree days on an appropriate base.
- **Weekend to Weekday Factor:** This factor is a ratio that describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. This may vary by month or season. Based on this ratio, the average electric energy per day type can be computed from the corresponding monthly electric energy.
- **Peak Day Factor:** This factor reflects the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.
- **Per Unit Hourly Factor:** The relationship of load among different hours of the day for each day type (weekday, weekend day, peak day) and for each month reflects the operating hours of the electric equipment or end use within residences by sub-sector. For example, for lighting, this would be affected by time of day, season (affected by daylight), and room type, where applicable. For the Base Year, lighting is treated on an aggregate basis by total residence.

The four factors (sets of ratios) defined above provide the basis for converting annual energy to any hourly demand specified including the grouping of hours used in the peak period defined in this study. Exhibit 118, below, illustrates how each of the above four factors is applied sequentially to a known annual energy value to produce a peak load value, defined as a specific peak period. In the example, the 36-hour winter peak period is used. The winter peak is defined as follows:

> *The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.*[50]

[50] Source: NL (Feb 2014) http://hydroblog.nalcorenergy.com/meeting-peak-demand/

Exhibit 118 Illustrative Application of Annual Energy to Peak Period Value Factors

The Winter Peak demand is computed based on the average demand for the 36-hour period. The NL peak is assumed to occur on the four coldest days in December and January.

The following steps are required:

- **Step 1:** The monthly usage allocation factor for December and January are applied to the annual energy use to calculate December and January energy use.
- **Step 2:** The average weekday in December and January is calculated based on the formula shown below, which adjusts the average day type use to reflect any difference in typical weekend use versus typical weekday use.

$$\frac{1}{Days\ in\ Month \times \left[\frac{5}{7} + \left(\frac{2}{7} \times Weekend\ Ratio\right)\right]}$$

- **Step 3:** The peak day factor is then applied to the average weekday electric energy use to determine the peak day use for the four peak days (as defined by the NL utilities).
- **Step 4:** The average peak over the 9 hours of peak period per day is then calculated based on allocating the peak day use according to the per unit hourly load factor for a peak winter day, using the percentage of use in those hours versus the daily usage for the peak day.

It should be noted that the methodology shown in Exhibit 118 produces aggregate diversified average loads for all customers or end uses in the defined sub-sector.

Exhibit 119 provides a specific numeric example for the calculation of Winter Peak Period demand (kW). The example presented in Exhibit 119 is for DHW use in electrically heated single detached homes, prior to adjustment for fuel share. The example shows how the annual consumption of 2,629 kWh can be converted to a peak demand value for the Winter Peak Period by the calculation of a corresponding hours-use value.

Exhibit 119 Sample Hours-Use Calculation for Electric Water Heating

Winter Peak Period =

$$\frac{Annual\ kWh\ \times Mo.Allocation}{Days\ in\ Month \times \left[\frac{5}{7} + \left(\frac{2}{7} \times Weekend\ Ratio\right)\right]} \times Peak\ Day\ Factor \times Peak\ Hour\ \%\ Daily\ kWh$$

Peak Period Average Demand =

$$\frac{2{,}629\ [\text{Ann. kWh}] \times\ 17.44\%\ [\text{Mo. Alloc.}]}{62 \times \left[\frac{5}{7} + \left(\frac{2}{7} \times 1.0\ [\text{Wkend Ratio}]\right)\right]} \times 1.0\ [\text{Peak Day Fact.}]\ \times 0.10223\ [\text{Peak Hrs \% Day kWh}]$$

= 0.756 kW

$$\frac{2{,}629\ [\text{annual kWh}]}{0.756\ [\text{Winter Peak Period}]} = 3{,}476\ [\text{Winter Peak Hours Use}]$$

This means that any applicable single-family detached annual water heating kWh can be converted to average demand in kW during the 36-hour winter peak period by dividing by 3,476 hours.

B.2 Segmentation of Residential Dwellings

The Residential sector segmentation used to generate the electric peak load profiles is the same as that used for electric energy use. That is, there is a load profile that corresponds to each combination of dwelling type and end use.

Exhibit 120 shows the residential dwelling types that were addressed.

Exhibit 120 Residential Dwelling Types Used for Electric Peak Load Calculations

Dwelling Type (SDH, Row house and main houses above basement apartments, Apartments including basement apartments, Other)
Heating Fuel (Electric vs. Non-electric)

B.3 Hours-Use Factors

Exhibit 121 describes the assumptions and data sources for the load profile factors that were used to develop the corresponding hours-use factors. To produce a demand for a combination of sub-sector and end use, the corresponding annual energy is divided by the hours-use factor for the peak period for the applicable load shape. For certain end uses that are assumed to have no usage during the winter months (e.g., cooling) the hours-use values are considered infinite (noted by 1E+15), resulting in virtually zero demand when divided into annual energy.

Most of the studies referenced in the exhibit are the same as those used to develop hours-use factors for the CDM Potential Study completed for NL in 2008 and are also the same as those used for studies in other provinces. For most end uses, hours-use factors remain very stable from year to year and across jurisdictions, as long as the peak period of interest is the same. The amount of energy consumed varies from year to year and from place to place, but the shape of the load – when the energy is used – remains very similar.

In this analysis, therefore, the initial estimate of peak demand used the hours-use factors from the 2008 CDM Potential Study. The results were within a few percent of utility measured values. The team then calibrated the model by adjusting the hours-use factors for the weather-sensitive end uses (such as space heating) for all three sectors simultaneously, until the model peak demand output agreed closely with the Utilities' measured peak demand.

Exhibit 121 Residential End Use Load Shape Parameters

Load Shape #	End Use	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
1001	Space Heating, general – not used in this study	N/A	N/A	N/A	N/A
1002	Central A/C – All	Assumed 100% off winter peak	1.00 various studies	Assumed 100% off winter peak	RG&E 1991 Study
1003	Room A/C – All	Assumed 100% off winter peak	1.00 various studies	Assumed 100% off winter peak	RG&E 1991 Study
1004	Water Heating – All	RG&E 1991 Study	1.00 various studies	1.0 Assumed	RG&E 1991 Study
1005	Cooking – All	Mass. JUMP	Mass JUMP[51, 52]	1.0 Assumed	Mass. JUMP
1006	Refrigerator – All	Mass. JUMP	1.00 various studies	1.0 Assumed	Mass. JUMP
1007	Freezer – All	Mass. JUMP Refrigerator	Mass. JUMP	1.0 Assumed	Mass. JUMP
1008	Dishwasher – All	LILCO DSM Program Eval 1988-1991	1.00 various studies	1.0 Assumed	ELCAP DOE[53]
1009	Clothes Washer – All	LILCO DSM			
1010	Clothes Dryer – All	Mass. JUMP Refrigerator	Mass. JUMP	1.0 Assumed	Mass. JUMP
1011	Lighting – All	LILCO Direct Install Program 1991 adj. by DOE[54] Seasonality	LILCO[55]	1.0 Assumed	LILCO Direct Install Program 1991 adj. by DOE Seasonality
1012	Computer – All	USDOE Building America 2008 Misc. Electric Loads[6]	1.00 Assumed	1.0 Assumed	USDOE Building America 2008 Misc. Electric Load
1013	Television – All	California Energy Commission			
1014	Television Peripherals – All	USDOE Building America 2008 Misc. Electric Loads[6]	1.00 Assumed	1.0 Assumed	USDOE Building America 2008 Misc. Electric Load
1015	General Plug Loads	USDOE Building America 2008 Misc. Electric Loads[6]	1.00 Assumed	1.0 Assumed	USDOE Building America 2008 Misc. Electric Load

[51] Massachusetts JUMP Update and Analysis (Appliance Monitoring Project), AEIC Northeast Regional Conference and Proceedings; Hartford, CT; September 16, 1988; S. Chiara (ComEnergy) and J. Lopes (AEG).
[52] Massachusetts Joint Utility End Use Monitoring Project Final Report – Final Report; Applied Energy Group, Inc.; Feb 15, 1989.
[53] Description of Electric Energy Use in Single-Family Residences in the Pacific Northwest (ELCAP), DOE/BP-13795-21, PNNL; ref. in "Building America Research Benchmark Definition"; Jan. 2008.
[54] Building America Research Benchmark Definition – Updated December 20, 2007; USDOE Renewable Energy Laboratory NREL/TP-550-42662; January 2008.
[55] Long Island Lighting Company; DSM Program Evaluations; 1988 – 1991.

Load Shape #	End Use	Monthly Breakdown	Wkend / Wkday Ratio	Peak Day Factor	Hourly Profile
1016	Space Heating – Single Family Detached	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.09 BCH Residential Premise Load Model - SFD[56]	Adj. From BCH 10-yr. Avg. Monthly Peak/Wkday HDD Ratio[57]	Hr end 6pm = 5.57% of daily kWh BCH Residential Premise Load Model - SFD
1017	Space Heating – Attached, Apartment, Isolated, Other, Vacant and Partial	St. John's Newfoundland 1971-2000 (30-year) Normal HDD; then calibrated to actual utility demand	1.06 BCH Residential Premise Load Model - Row	Adj. From BCH 10-yr. Avg. Monthly Peak/Wkday HDD Ratio	Hr end 6pm = 5.54% of daily kWh BCH Residential Premise Load Model - Row
1018	Pool Pumps, Hot Tubs	BCH REUS[58] & SCE RAEUS[59]; then calibrated to actual utility demand	SCE RAEUS	SCE RAEUS	Hr End 7pm SCE RAEUS
1019	Engine Block Heater	Monthly shape for Labrador assumed similar to SK; then calibrated to actual utility demand	1.00 assumed	Peak Day factor assumed similar to SK	Flat, average 7.9 hrs/day for 90 days[60]

Exhibit 122 shows the distinct hour-use values developed for each combination of region, residential sub-sector and end use employed in this study, as generated from the applicable load shape.

The hours-use value represents the divisor to convert annual energy (e.g., MWh) to that peak period demand. For example, dividing the annual electricity consumed for space heating in single detached houses by the hours-use value for the Winter Peak Period (i.e., 2,980 for Island Interconnected) will convert annual MWh to demand at the annual system winter peak period.

[56] BC Hydro FY 2005 (April 2004 – March 2005) Residential Load Research data by segment (SFD – Single Family; Row – Row Houses)
[57] To account for longer winter, used BCH Nov Peak Day Factors for NL Oct; BCH Oct for NL Sept; BCH April for NL May; BCH June for NL May
[58] BC Hydro REUS (Appliance Saturation Study) estimates of saturation of component appliances (outdoor and indoor pools, outdoor hot tubs and indoor Jacuzzis), and SCE RAEUS monthly energy use used to calculate weighted monthly energy use for monthly allocation averages.
[59] Southern California Edison 1988 RAEUS (End Use) Study – Indoor/outdoor Pool Pumps and Electric Spas/Jacuzzis.
[60] Ontario Power Authority – OPA Measures and Assumptions List (prescriptive) as of January 31, 2010; 1450 watts at 7.9 hours/day x 90 days.

Exhibit 122 Residential Sector Load Shape Hours-Use Values

Code	Sector Type	Sub-Sector	Region	End Use	End Use Sub	Measure	Hours-Use Factor
1001	Res	All	All	Space Heat	All	Base	2,849
1002	Res	All	All	Space Cool	All	Base	1.00E+15
1003	Res	All	All	Room A/C	All	Base	1.00E+15
1004	Res	All	All	Water Heat	All	Base	3,476
1005	Res	All	All	Stove	All	Base	5,042
1006	Res	All	All	Refrigerator	All	Base	10,066
1007	Res	All	All	Freezer	All	Base	10,066
1008	Res	All	All	Dishwasher	All	Base	6,012
1009	Res	All	All	Clothes Washer	All	Base	6,012
1010	Res	All	All	Dryer	All	Base	6,012
1011	Res	All	All	Lighting	All	Base	5,994
1012	Res	All	All	Computer	All	Base	7,758
1013	Res	All	All	Television	All	Base	5,994
1014	Res	All	All	TV Peripherals	All	Base	7,758
1015	Res	All	All	General Plug Loads	All	Base	7,758
1016	Res	SFD	Island	Space Heat	All	Base	2,980
1017	Res	Row	Island	Space Heat	All	Base	2,895
1018	Res	All	Island	Pools and Hot tubs	All	Base	6,444
1019	Res	All	Island	Engine Block Heaters	All	Base	964
1020	Res	SFD	Labrador	Space Heat	All	Base	3,550
1021	Res	Row	Labrador	Space Heat	All	Base	3,448
1022	Res	All	Labrador	Pools and Hot tubs	All	Base	7,676
1023	Res	All	Labrador	Engine Block Heaters	All	Base	1,148
1024	Res	SFD	Isolated	Space Heat	All	Base	2,537
1025	Res	Row	Isolated	Space Heat	All	Base	2,465
1026	Res	All	Isolated	Pools and Hot tubs	All	Base	5,487
1027	Res	All	Isolated	Engine Block Heaters	All	Base	821

Since the Utilities do not conduct regular class or end-use load analysis studies, there is no actual total (or dwelling type) end-use load profile upon which to calibrate the load profile models developed for this study. The best option for calibrating NL-specific load profile parameters is the weather-sensitive loads, since that is the most area specific.

Since separately metered space heating end-use load data was not available from the Utilities, normal weather for the past 10 years was used to determine monthly allocations, and weekend/weekday ratios were developed during the 2008 study based on the sources listed in Exhibit 121.

For peak day factors, analysis of the past 30 years' average vs. peak weather conditions (in heating degree days) for St. John's was analyzed to determine typical peak day factors for normal weather, which ranged from about 1.4 to 1.5 for winter months. For non weather-sensitive end uses, a factor of 1.0 was assumed, absent specific load study data.

Hours-use factors for weather sensitive end uses (codes 1016 through 1027 above, along with similar end uses in the commercial and industrial sectors) were adjusted to calibrate the model's estimate of peak load to the utility's recorded averages during the peak period, for each of the three regions.

B.4 Detailed Results

The following exhibits shows peak demand by dwelling type and end use for the peak period identified for this study. This is followed by three more showing the results by region.

Note that in each of the exhibits, the end uses are sorted from largest peak demand to smallest peak demand, so they do not appear in the same order in the three exhibits.

Exhibit 123 Residential Sector Base Year (2014) Peak Hour Demand, by Dwelling Type and End Use, All NL (MW)*

Dwelling Types	Reference Case Peak Demand (MW)								
	Space heating	Domestic Hot Water (DHW)	Lighting	Clothes dryer	Ventilation	Cooking	Television	Hot tubs	Computer and peripherals
Single-family detached, electric space heat	473	80	20	16	9	13	11	12	9
Single-family detached, non-electric space heat	32	35	12	9	17	7	7	8	6
Attached, electric space heat	88	20	4	4	2	3	3	2	2
Attached, non-electric space heat	1	2	1	1	1	1	0	0	0
Apartment, electric space heat	41	13	2	2	1	2	1	-	2
Apartment, non-electric space heat	1	1	0	0	0	0	0	-	0
Other and non-dwellings	8	3	1	1	0	1	0	-	0
Vacant and partial	9	3	1	1	0	1	0	-	0
Grand Total	654	157	40	34	30	28	23	22	21

Dwelling Types	Reference Case Peak Demand (MW)								
	Refrigerator	Freezer	Small appliance & other	Television peripherals	Other electronics	Dishwasher	Clothes washer	Block heaters & car warmers	Grand Total
Single-family detached, electric space heat	9	5	4	4	2	1	1	1	671
Single-family detached, non-electric space heat	6	3	2	2	1	1	1	0	149
Attached, electric space heat	2	1	0	1	1	0	0	0	134
Attached, non-electric space heat	0	0	0	0	0	0	0	-	8
Apartment, electric space heat	1	0	0	1	0	0	0	-	68
Apartment, non-electric space heat	0	0	0	0	0	0	0	-	3
Other and non-dwellings	1	0	2	0	0	0	0	-	17
Vacant and partial	0	0	2	0	0	0	0	-	18
Grand Total	19	11	10	8	5	2	2	1	1,067

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 124 Residential Sector Base Year (2014) Peak Hour Demand, Island Interconnected, by Dwelling Type and End Use (MW)*

Dwelling Types	Reference Case Peak Demand (MW)								
	Space heating	Domestic Hot Water (DHW)	Lighting	Clothes dryer	Ventilation	Cooking	Television	Hot tubs	Computer and peripherals
Single-family detached, electric space heat	434	76	19	15	8	13	11	11	9
Single-family detached, non-electric space heat	31	33	11	9	16	7	6	7	5
Attached, electric space heat	69	18	4	4	2	3	2	1	2
Attached, non-electric space heat	1	2	1	1	1	1	0	0	0
Apartment, electric space heat	39	13	2	2	1	2	1	-	2
Apartment, non-electric space heat	1	1	0	0	0	0	0	-	0
Other and non-dwellings	7	3	1	1	0	1	0	-	0
Vacant and partial	9	3	1	1	0	1	0	-	0
Grand Total	591	148	38	32	29	27	22	20	19

Dwelling Types	Reference Case Peak Demand (MW)							
	Refrigerator	Freezer	Small appliance & other	Television peripherals	Other electronics	Dishwasher	Clothes washer	Grand Total
Single-family detached, electric space heat	8	5	3	4	2	1	1	620
Single-family detached, non-electric space heat	5	3	2	2	1	1	0	141
Attached, electric space heat	2	1	0	1	0	0	0	109
Attached, non-electric space heat	0	0	0	0	0	0	0	8
Apartment, electric space heat	1	0	0	1	0	0	0	65
Apartment, non-electric space heat	0	0	0	0	0	0	0	3
Other and non-dwellings	0	0	2	0	0	0	0	15
Vacant and partial	0	0	2	0	0	0	0	17
Grand Total	18	10	10	8	5	2	2	979

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 125 Residential Sector Base Year (2014) Peak Hour Demand, Labrador Interconnected, by Dwelling Type and End Use (MW)*

Dwelling Types	Reference Case Peak Demand (MW)								
	Space heating	Domestic Hot Water (DHW)	Lighting	Hot tubs	Clothes dryer	Cooking	Block heaters & car warmers	Television	Computer and peripherals
Single-family detached, electric space heat	37	4	1	1	1	1	1	1	0
Single-family detached, non-electric space heat	1	0	0	0	0	0	0	0	0
Attached, electric space heat	19	2	0	0	0	0	0	0	0
Apartment, electric space heat	2	0	0	-	0	0	-	0	0
Other and non-dwellings	1	0	0	-	0	0	-	0	0
Grand Total	59	7	2	2	1	1	1	1	1

Dwelling Types	Reference Case Peak Demand (MW)								
	Refrigerator	Ventilation	Freezer	Small appliance & other	Television peripherals	Other electronics	Dishwasher	Clothes washer	Grand Total
Single-family detached, electric space heat	0	0	0	0	0	0	0	0	48
Single-family detached, non-electric space heat	0	0	0	0	0	0	0	0	2
Attached, electric space heat	0	0	0	0	0	0	0	0	25
Apartment, electric space heat	0	0	0	0	0	0	0	0	3
Other and non-dwellings	0	0	0	0	0	0	0	0	2
Grand Total	1	1	1	0	0	0	0	0	78

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Exhibit 126 Residential Sector Base Year (2014) Peak Hour Demand, Isolated, by Dwelling Type and End Use (MW)*

Dwelling Types	Reference Case Peak Demand (MW)								
	Space heating	Domestic Hot Water (DHW)	Ventilation	Lighting	Hot tubs	Clothes dryer	Cooking	Computer and peripherals	Television
Single-family detached, electric space heat	2.5	0.3	0.0	0.1	0.1	0.1	0.0	0.0	0.0
Single-family detached, non-electric space heat	0.9	1.4	0.6	0.5	0.5	0.4	0.3	0.3	0.2
Other and non-dwellings	0.1	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
Vacant and partial	0.1	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
Grand Total	3.6	1.8	0.6	0.6	0.5	0.4	0.4	0.3	0.3

Dwelling Types	Reference Case Peak Demand (MW)							
	Freezer	Refrigerator	Small appliance & other	Television peripherals	Other electronics	Clothes washer	Dishwasher	Grand Total
Single-family detached, electric space heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Single-family detached, non-electric space heat	0.2	0.2	0.1	0.1	0.1	0.0	0.0	5.8
Other and non-dwellings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Vacant and partial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Grand Total	0.3	0.2	0.1	0.1	0.1	0.0	0.0	9.4

*Results are measured at the customer's point-of-use and do not include line losses. Any differences in totals are due to rounding.

Appendix C Background-Section 5: Reference Case Electricity Use

Introduction

Appendix C provides additional detailed information related to each of the major steps employed to generate the profile of residential sector Reference Case electricity use. The major steps involved are:

- **Step 1:** Estimate net space heating and cooling loads for each new dwelling type
- **Step 2:** Estimate naturally-occurring changes in net space heating and cooling loads for existing dwelling types
- **Step 3:** Estimate naturally-occurring changes in annual electricity use for the evolving stock of major residential appliances
- **Step 4:** Estimate future appliance saturation trends for each dwelling type
- **Step 5:** Estimate changes in electricity share for each appliance, by dwelling type
- **Step 6:** Estimate the growth in number of residential dwellings, by type.

C.1 Step 1: Estimation of Net Space Heating and Cooling Loads—New Dwellings

The first task in building the Reference Case involved the development of estimates of the net space heating loads for new dwellings to be built over the study period. As was the case with the existing building stock, the study relied on several sources to prepare these estimates, including:

- Estimated electricity consumption per dwelling from the NL load forecast,
- Comparisons of housing characteristics between the dwellings built since 2000 and the average dwellings, as reported in the REUS,
- Review of experience in other jurisdictions.

Based on consideration of the best available data from the above sources, this study assumes that the net space heating loads in new dwellings are likely to decrease slightly compared to existing dwellings. This conclusion recognizes that while thermal efficiencies are improving in new dwellings, they are being partially offset by changing construction practices.

Examples of these offsetting trends include:

- Overall, window, wall and roofing thermal efficiency levels have increased in new residential buildings and air leakage rates have been reduced compared to typical existing dwellings
- The amount of window area in new houses tends to be greater compared to typical existing homes
- The new stock tends to have floor areas that are slightly larger, on average, than existing dwellings, though this trend has levelled off recently
- Buildings also feature an increase in exterior wall surface area. This reflects both the increased floor area and a tendency for homes to include architectural features with more corners and details that diverge from the standard rectangular shapes.

Exhibit 127 summarizes the resulting new net space heating and cooling loads.

Exhibit 127 New Residential Units—Net Space Heating Loads by Dwelling Type, (kWh/yr.)

Dwelling Type	Island Interconnected	Labrador Interconnected	Isolated
Single-family detached, electric space heat	13,577	27,764	25,309
Single-family detached, non-electric space heat	12,205	27,736	23,745
Attached, electric space heat	9,220	23,186	11,591
Attached, non-electric space heat	7,975	23,186	11,591
Apartment, electric space heat	4,573	6,607	5,850
Apartment, non-electric space heat	3,594	8,559	5,850
Other and non-dwellings	5,118	4,111	2,355
Vacant and partial	2,895	-	1,632

C.1.1 Development of Thermal Archetypes – New Stock

Although the study assumes that the net space heating loads decrease only slightly for new dwellings, the physical and thermal specifications of the new dwellings differ from the existing dwellings. Thus, as in the Base Year discussion, a thermal archetype for each of the major new dwelling types was developed using HOT2000.

For the new housing stock, archetypes were created for the two primary dwelling types in each service region: single-family detached and attached. A brief description of each housing archetype is provided below.

Single detached houses

For the Island and Isolated service region, a typical new single-family detached dwelling can be defined as a single-story bungalow of approximately 176 m^2 (1,900 ft^2), including a finished basement. This home has approximately 20.0 m^2 (215 ft^2) of window area, typically low-e, argon-filled, triple-glazed window units with vinyl frames. Walls are represented by RSI-3.5 (R-20) insulation values and ceilings by RSI-4.3 (R-24). The houses are reasonably airtight with about 1.5 ACH@50Pa (air changes per hour at 50 Pascal depressurization).

For the Labrador Interconnected service region, a typical new, single-detached dwelling is expected to be similar to the new detached dwelling in the Island Interconnected region, though the consumption data indicates it may be slightly larger. All new homes are assumed to have an HRV, with ductwork to distribute the ventilation air.

Attached Dwellings

A typical new attached dwelling can be defined as a one-story end unit of approximately 137 m^2 (1,470 ft^2), including a finished basement. This home has 12 m^2 (130 ft^2) of windows, typically low-e, argon-filled, triple-glazed window units with vinyl frames. Walls are represented by RSI-3.5 (R-20) insulation values, as are the ceilings. The houses are reasonably airtight, with an air change rate of about 1.5 ACH@50Pa.

For the Labrador Interconnected service region, a typical new, attached dwelling is expected to be similar to the new attached dwelling in the Island Interconnected region, though the consumption data indicates it may be slightly larger. All new homes are assumed to have an HRV, with ductwork to distribute the ventilation air.

C.2 Step 2: Natural Changes to Space Heating Loads – Existing Dwellings

In addition to new dwellings, space heating loads in existing dwellings are also expected to change over the study period. However, no specific data are available and, as outlined in the preceding discussion of new dwellings, contrary trends[61] are occurring.

Examples of trends that tend to decrease the net space heating loads include:

- Insulation and other improvements that occur when renovation projects are undertaken
- Replacement of old windows with new models that provide comfort and aesthetic benefits as well as improved energy efficiency
- Installation of more efficient thermostatic controls.

Examples of trends that tend to increase net space heating loads include:

- Enlargement of houses with additions
- Reductions in internal gains due to more efficient appliances and lights.

Dwellings that undergo a major energy retrofit to the building shell are moved from the existing dwelling category into renovated dwellings. On average, these projects are assumed to include two building envelope retrofits (though they may not all happen in the same month), such as replacement of half the windows and the addition of insulation to the attic. In past projects, window replacement has been used as an indicator of the percentage of dwellings being renovated. Window sales are typically divided roughly evenly between installation in new homes and replacement in existing homes. A typical window replacement project involves approximately half the windows in the dwelling. Therefore, the rate of renovation is approximately double the rate of new construction.

Trial energy simulation runs were undertaken in HOT2000, assuming a variety of combinations of retrofit measures. The results varied widely, from a 2% to 15% reduction in space heat and cooling loads, depending on assumptions related to the number of windows replaced, or the part of the house being insulated. These decreases will be partly or wholly offset in those renovation jobs that also increase the floor area of the dwelling.

In the absence of more comprehensive data, this study assumes that a renovation to a home built after 1980 would experience a net reduction in space heating load of 3%. An older home (in which it was assumed more likely there would be an addition to the floor area) would experience a net reduction in space heating load of 2%. This study assumed a net improvement of 2%.

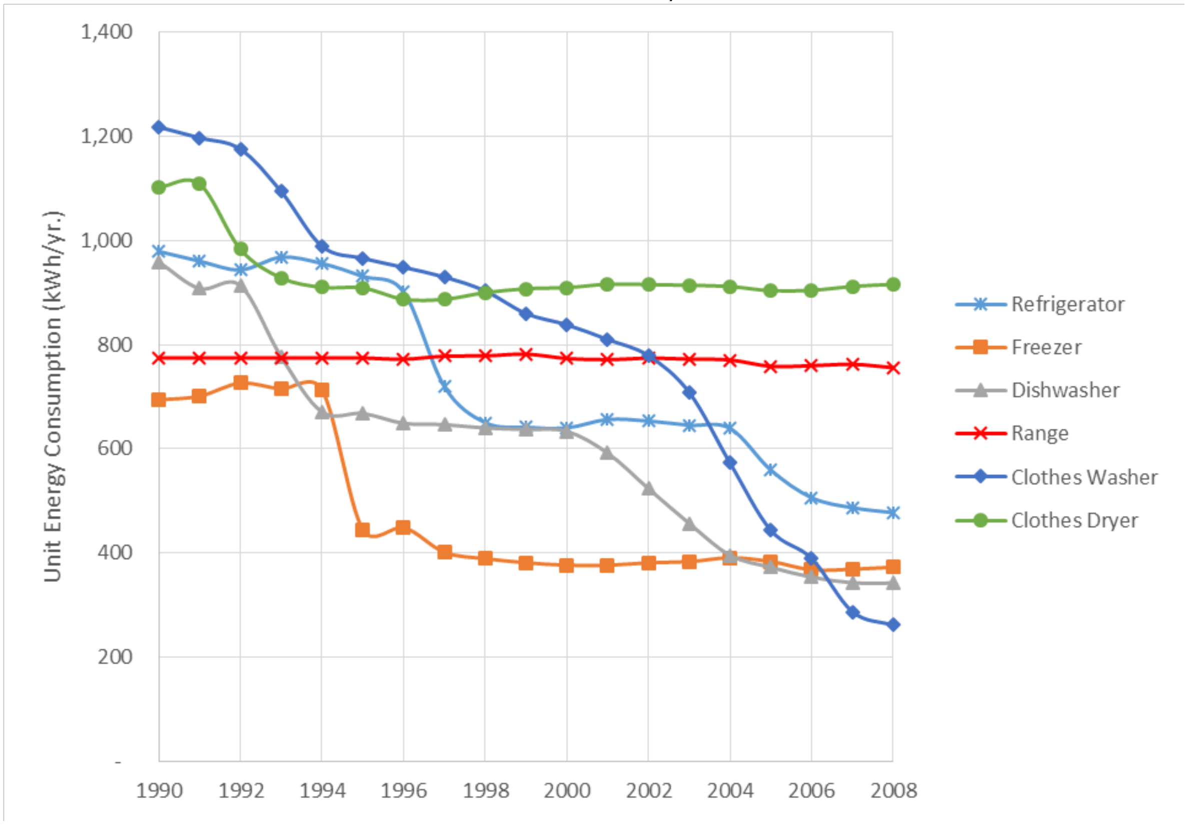
[61] Replacement of the heating equipment itself is not one of these factors because it does not actually change the net heating load.

C.3 Step 3: Natural Changes to Electric Appliance UECs

This section identifies the annual unit electricity consumption (UEC) for the major household appliances and equipment for both "stock in place" and new sales for the period 2010 to 2029.

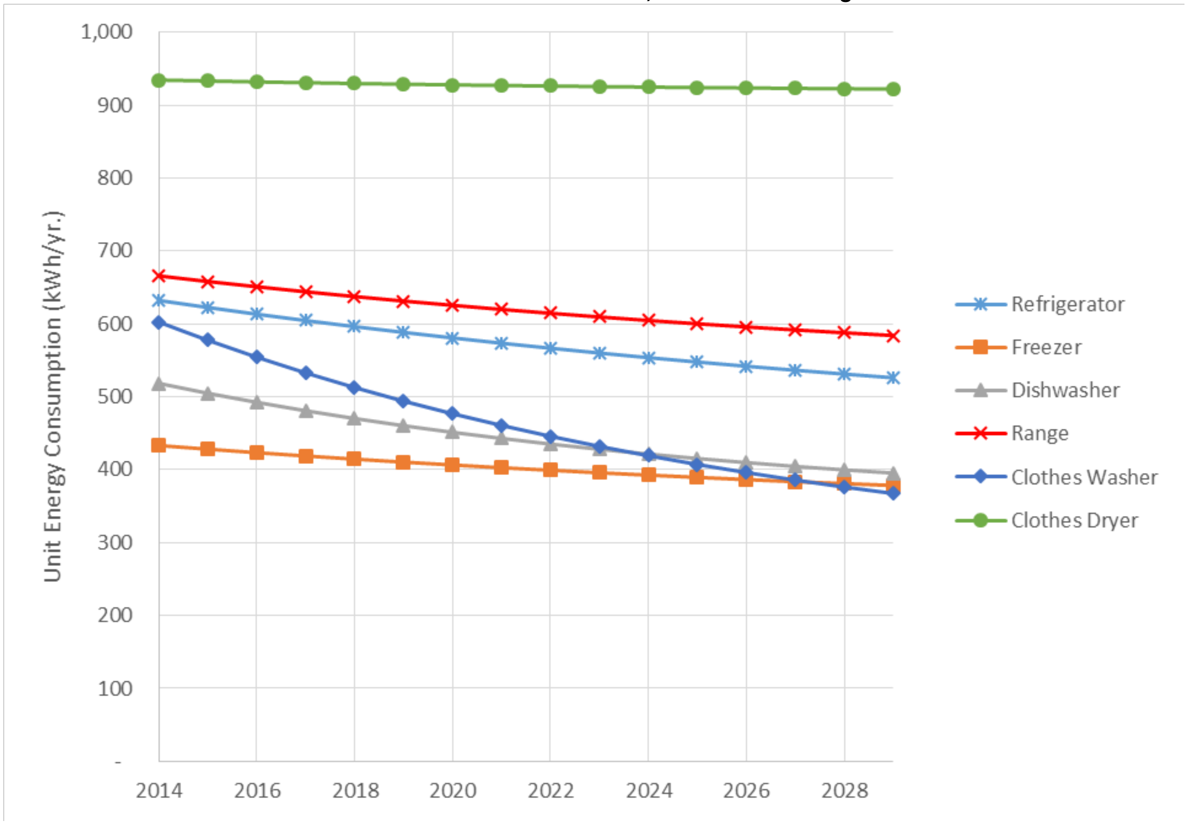
Exhibit 128 shows Canadian trend information for the new sales of white goods for the period 1990 to 2008. Exhibit 129 incorporates the average consumption data for new sales into ICF's appliance stock model to develop forecasts for average consumption of the white goods appliances throughout the study period.

Exhibit 128 Canadian White Goods, UECs for New Sales



Source: NRCan, *Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010*.

Exhibit 129 Canadian White Goods, UECs for Existing Stock



Source: Original NRCan UEC data for new sales (see source note for previous exhibit), incorporated into ICF's appliance stock model.

As shown in Exhibit 129, the annual UEC for most major household white good type appliances in existing stock is expected to decline steadily due to stock turnover and to continuing improvements in new stock. Future regulations or innovations may bring additional improvements in the white goods in the later years of the study period, but no assumptions have been made to that effect. Instead, the consumption improvements of the different appliances are assumed to slow down towards the end of the study period.

Further discussion of the modelled assumptions applied to each of the major appliances follows.

Cooking

A UEC, which includes both ranges and microwave ovens, of 670 kWh/yr. is assumed in the Base Year, declining to 588 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore use of cooking appliances), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a cooking UEC of 599 kWh/yr. on average, declining to 588 kWh/yr. by 2029.

Refrigerator

A UEC of 610 kWh/yr. is assumed in the Base Year, declining to 508 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore average size of refrigerators), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a refrigerator UEC of 523 kWh/yr. on average, declining to 508 kWh/yr. by 2029.

Freezer

A UEC of 436 kWh/yr. is assumed in the Base Year, declining to 381 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore average size of freezers), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a freezer UEC of 389 kWh/yr. on average, declining to 381 kWh/yr. by 2029.

Dishwasher

A UEC of 98 kWh/yr. is assumed in the Base Year, declining to 74 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore use of dishwashers), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a dishwasher UEC of 77 kWh/yr. on average, declining to 74 kWh/yr. by 2029.

The values shown are for mechanical energy only. Mechanical energy is assumed to be approximately 19% of the values reflected in Exhibit 129. Hot water use is included with the DHW UEC.

Clothes Washer

A UEC of 52 kWh/yr. is assumed in the Base Year, declining to 31 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore use of clothes washers), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a clothes washer UEC of 34 kWh/yr. on average, declining to 31 kWh/yr. by 2029.

The values shown are for mechanical energy only. Mechanical energy is assumed to be approximately 8% of the values reflected in Exhibit 129. Hot water use is included with the DHW UEC.

Clothes Dryer

A UEC of 940 kWh/yr. is assumed in the Base Year, declining to 927 kWh/yr. in the final milestone year. The variation by dwelling type, mainly due to differences in occupancy (and therefore use of clothes dryers), follows the pattern shown in Exhibit 93. In new dwellings, the appliances are assumed to be approximately 10 years newer than in existing dwellings. New homes built right after the Base Year are assumed to have a dryer UEC of 929 kWh/yr. on average, declining to 927 kWh/yr. by 2029.

Ventilation

Ventilation energy in existing stock is assumed to decrease modestly over the study period. This assumption recognizes that there are a number of competing trends that remain unresolved at this time. On the one hand, there is a trend towards manufacturers' use of larger fan motors (1/2-HP versus 1/3-HP) in new furnaces. This means that furnaces replaced in the study period may have a larger furnace fan motor. However, the trend towards larger fan motors is likely to be more than offset by efficiency improvements. Efficient ventilation fan motors are assumed to reduce fan energy by approximately 65% and are assumed to be installed in 80% of the replacement furnaces being installed. Overall, more efficient but larger fan motors would have the effect of reducing furnace fan energy in existing homes with forced air systems by approximately 22% by 2029, from approximately 740 kWh/yr. to 575 kWh/yr.

In new stock, average ventilation energy (including furnace fans, HRV fans, other fans such as exhaust fans in the kitchen, and pumps in boiler systems) was assumed to increase by nearly 40%, relative to existing systems with larger but more efficient fans, to approximately 810 kWh/yr. This value was based on the HOT2000 modeling of newer homes with the furnace fan operating continuously. According to previous studies in other jurisdictions, occupants of newer dwellings are more likely to run their furnace blower fan continuously. All new homes are also assumed to have HRVs installed.

Domestic Hot Water

Exhibit 130 summarizes the DHW UECs by end use for new dwellings. A comparison with the values presented previously for existing dwellings (see Appendix A) shows a significant reduction for hot water use in clothes washing, with slightly more modest changes for personal consumption.

DHW electricity for new and existing appliances is obtained from NRCan, as discussed above (see Exhibit 130). For existing and retrofitted buildings, the DHW UEC is assumed to decrease as dishwashers and clothes washers are replaced in the appliance stock, but is otherwise assumed to be constant. The UEC for DHW in new buildings is assumed to be constant.

Exhibit 130 Distribution of DHW Electricity Use by End Use in New Stock, (kWh/yr.)

DHW Sub End Uses	Electricity per Sub End Use (kWh/yr.)	Electricity per Sub End Use (%)
Clothes Washers	267	11%
Showers	660	28%
Faucets	511	21%
Baths	120	5%
Dishwashers	243	10%
Leaks	179	8%
Tank (Standby) Losses	202	8%
Pipe Losses	202	8%
Total	2,384	100%

Indoor Lighting

The lighting UEC was assumed to decrease as incandescent lamps are phased out and replaced primarily by LED lamps. It is assumed that all remaining incandescent lamps would be replaced by the end of the study period and that 50% of CFL lamps would also be replaced by LED if there was no utility involvement in CDM programming or revision of efficiency standards. Exhibit 131 shows the assumed lighting counts, average wattage, and hours of use per year used to develop estimates of the overall indoor lighting energy consumption for different dwelling types in 2029.

Exhibit 131 Indoor Lighting by Dwelling Type, 2029

Dwelling Types	Linear Fluorescent Tubes	Compact Fluorescent Lamps	Halogen Lamps	LED Lamps	
SDH	0.7	4.5	0.5	18.3	(lamps)
Attached	0.6	4.0	0.4	16.5	(lamps)
Apartment	0.3	1.8	0.2	7.5	(lamps)
Average Wattage	23	15	45	12	(w atts)
Average Hours/Year	344	1,548	1,032	1,548	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)					Total
SDH	5	104	23	341	473
Attached	5	94	21	306	425
Apartment	2	42	9	139	193

Outdoor Lighting

The lighting UEC was assumed to decrease as incandescent lamps are phased out and replaced by LED lamps. It is assumed that all remaining incandescent lamps would be replaced by the end of the study period and that 50% of the CFL lamps would also be replaced by LED if there was no utility involvement in CDM programming or revision of efficiency standards. Exhibit 132 shows the assumed lighting counts, average wattage, and hours of use per year used to develop estimates of the overall outdoor lighting energy consumption for different dwelling types in 2029.

Exhibit 132 Outdoor Lighting by Dwelling Type, 2029

Dwelling Types	Linear Fluorescent Tubes	Compact Fluorescent Lamps	Halogen Lamps	LED Lamps	
SDH	0.2	0.8	0.1	3.1	(lamps)
Attached	0.2	0.7	0.1	2.8	(lamps)
Apartment	0.1	0.3	0.0	1.2	(lamps)
Average Wattage	23	15	45	12	(w atts)
Average Hours/Year	243	1460	730	1460	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)					Total
SDH	1	17	2	54	74
Attached	1	15	2	49	67
Apartment	0	6	1	20	28

Holiday Lighting

The holiday lighting UEC was assumed to decrease as incandescent strings are phased out and replaced by LED strings. This transition is assumed to be complete by the end of the study period. Exhibit 133 shows the assumed lighting counts, average wattage, and hours of use per year used to develop estimates of the overall holiday lighting energy consumption for different dwelling types in 2029.

Exhibit 133 Holiday Lighting by Dwelling Type, 2029

Dwelling Types	Indoor LED Holiday Strings	Outdoor LED Holiday Strings	
SDH	11	8	(lamps)
Attached	6	5	(lamps)
Apartment	3	0	(lamps)
Average Wattage	1	1	(w atts)
Average Hours/Year	95	125	(hr/yr.)
Total Base Year Energy Use (kWh/yr.)			Total
SDH	1	1	2
Attached	1	1	1
Apartment	0	0	0

Televisions

The North American television industry has been converting to digital broadcasting since August 31, 2011. These broadcast changes have been occurring at a time when television technology and programming options are also rapidly changing. Some television technology changes, such as the introduction of liquid crystal display (LCD) and plasma models, have had significant impacts on household electricity consumption. For example, these changes have increased rate of turnover in the current stock of televisions to models that are better able to take advantage of the high definition (HD) digital signal.

LCD is now the dominant television technology. Although LCD screens typically use less electricity per square inch of screen, consumers typically choose screens that are larger when purchasing an LCD screen compared to cathode ray tube screens (CRTs). When CRTs predominated, the most popular size was 27” but consumers are now more likely to buy a 40” widescreen TV, or even larger. This trend has the effect of reducing the electricity advantage that would be gained from a direct switch to the new LCD technology.

In addition to the increase in screen size, HD television models typically consume more power than equivalent standard definition televisions for all technology types. Since the trend with televisions is towards HD sets with greater resolution, television unit electricity use is expected to increase in the future.

In the long term, ENERGY STAR® and improved energy efficiency standards for electronics will start to bring down the average electricity use per television, even in the absence of new CDM programs in NL. The effects of these improvements will likely be masked by the effects of increasing television size and resolution until after 2020.

In light of these changes, UECs for televisions are assumed to increase from 238 kWh/yr. to 269 kWh/yr. by 2029. These assumptions draw on both a 2006 ICF study, *Technology and Market Profile: Consumer Electronics*,[62] and subsequent work for the Ontario Power Authority in 2009.

[62] ICF Resource Consultants. Technology and Market Profile: Consumer Electronics, September 2006.

Television Peripherals

One implication of the pending changes towards digital television broadcasting is that new signal adaptors, commonly referred to as set-top boxes (STBs), will need to be added to nearly two-thirds of Canadian households to receive a television signal.

Industry representatives estimate that each Canadian subscriber household had, on average, 1.5 set-top boxes by 2006.[63] The number of STBs has continued to increase since then and is now estimated at over two per subscriber household. The growing number of STBs is factored into the UEC estimates for this end use, rather than being reflected in increasing saturation percentage.

When complete, the switch to digital broadcasting is expected to increase national STB electricity consumption by up to four times its current level due to the added requirement for STBs among those televisions currently operating on analog cable or over-the-air broadcast signals. Moreover, within these STBs, the most significant trend is towards greater functionality, which is directly associated with further increases in unit electricity consumption.

At the same time, ENERGY STAR® and improved energy efficiency standards for electronics will begin to affect STBs. Currently, many of these products consume a substantial fraction of their electricity when no one is watching the television. Standards that specify maximum consumption in standby mode will therefore make a dramatic difference in the UEC for these devices.

In light of these changes, UECs per dwelling for television peripherals are assumed to increase modestly from 291 kWh/yr. to 308 kWh/yr. over the study period.[64]

Computers and Peripherals

Electricity consumption for personal computers is expected to decrease modestly, as monitors move to more energy-efficient flat screen technology and ENERGY STAR® increasingly predominates. This is somewhat counteracted by a growing preference for larger screens, a trend towards longer operating hours both in full operating mode and in idle mode, and the increasing numbers of peripherals. The growth in the number of computers per household is discussed in the saturation section of this appendix (Section C.4).

UECs for personal computers and their peripherals are assumed to decrease from 388 kWh/yr. to 384 kWh/yr. over the study period.

Spas

No increase in the size or heating load of spas has been assumed. In a previous ICF study for the OPA in 2009, assumptions were developed on the trend towards the use of heat pumps to heat pools and spas. By 2029, the electric resistance heaters are assumed to be completely phased out, even in the absence of new CDM programs in NL.

The analysis also assumes that high-efficiency pumps will gradually become more popular in the market, without new CDM intervention, reaching a penetration of 60% by 2029.

UECs for spas, including both the electric heating units (resistance or heat pump) and the pumps, are expected to decline from 14,575 kWh/yr. in 2010 to 7,081 kWh/yr. in 2029.

[63] Ibid.
[64] Ibid.

Home Entertainment Electronics

As functionality increases, other entertainment devices, such as computer games and music systems are becoming more powerful. For example, the new PlayStation 3 games console uses 360 Watts compared to its predecessor, which uses only 45 Watts. One of the selling features of the Nintendo Wii and other next generation products is that they can be left on-line for 24 hours a day.

UECs for both the home entertainment electronics category and the small appliances and other category are likely to increase over the study period. UECs for home entertainment electronics are assumed to increase from 170 kWh/yr. to 191 kWh/yr. over the study period.

Block Heaters and Car Warmers

No change was assumed in the consumption of block heaters and car warmers over the study period, in the absence of new utility CDM initiatives.

Small Appliances and Other

The UECs for the small appliances and other categories increase over the study period in anticipation of new end uses, but there is considerable uncertainty in the amount of this increase.

Based on the changes observed in previous studies, new end uses are constantly emerging, some of which are substantial consumers of electricity. One example is electric vehicle charging. Electric cars and plug-in hybrids could achieve substantial penetration by the end of the study period; charging of a typical electric vehicle would require approximately 7,000 kWh/yr.[65]

The UEC for this category is assumed to remain relatively stable over the study period. The growth rate in this end use was adjusted to improve the calibration between the model and the NL load forecast, and little change was required. Because there is so much uncertainty in the emergence of new “other” end uses and considerably more knowledge of trends in other end uses, this miscellaneous category was used to increase the consumption per account to match the forecast. The forecast changes in consumption per house vary among the three regions. No growth was applied to Small Appliances and Other in order to match the forecast increase in overall consumption per house in the Island Interconnected region. A growth rate of over 0.2% per year was applied to Small Appliances and Other in order to match the forecast increase in overall consumption per house in the Labrador Interconnected region. A growth rate of over 0.6% per year was applied to Small Appliances and Other in order to match the forecast increase in overall consumption per house in the Isolated region.

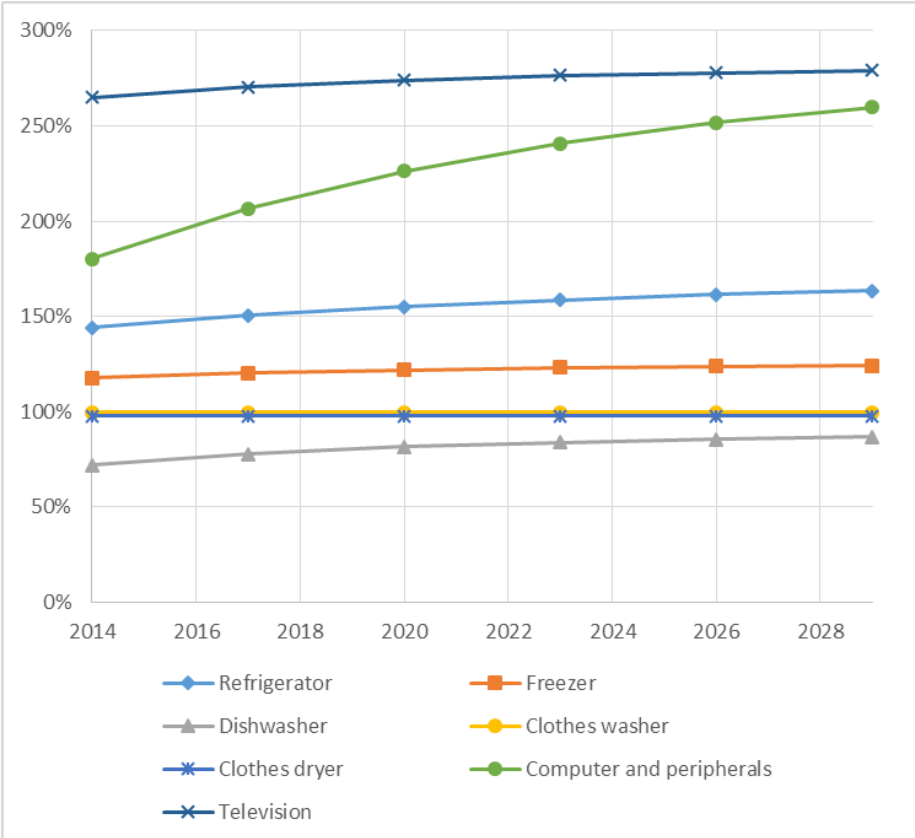
C.4 Step 4: Appliance Saturation Trends

To develop estimates of the future saturation of residential equipment, references from NL and previous studies in other jurisdictions were reviewed along with data on trends in the increasing use of entertainment-based electronics.

We have applied the growth rates from these sources to estimate saturations to the end of the study period. The results are shown in Exhibit 134.

[65] California EPA, Air Resources Board. *Fact Sheet: Battery Electric Vehicles*, Sacramento, CA, 2003, http://www.arb.ca.gov/msprog/zevprog/factsheets/clean_vehicle_incentives.pdf.

Exhibit 134 Trends in Appliance Saturation, 2014 to 2029



All of the end-use appliances shown in Exhibit 134 are forecast to increase in saturation per household. For the white goods end uses, this results in a relatively stable overall consumption per household because the increase in saturation is approximately cancelled out by the decrease in UEC that is expected to occur over the same period. For the three electronics end uses shown in the exhibit, the overall consumption is expected to rise during the period, as increases in saturation will likely have a larger effect than improvements in efficiency.

C.5 Step 5: Fuel Shares

No changes in the fuel shares for any end uses are assumed over the study period.

C.6 Step 6: Estimate Growth in Dwellings, by Type

This step involved the development and application of estimated levels of growth in each dwelling type over the study period.

The Utilities provided the forecast growth dwelling units as estimated numbers by milestone year for each region. The REUS provided data on the percentage of recently-built dwellings in the Island Interconnected region that are predominantly heated by electricity – approximately 85%. Relative growth rates were adjusted to approximately match this but also to match the Utilities' estimated growth in consumption in electrically heated versus non-electrically heated dwellings. REUS data were also used to estimate the relative growth rate in attached versus detached dwellings. In the

Island Interconnected region, attached dwellings appear to be growing at only about 1.1 times the rate of detached dwellings. In the Labrador Interconnected region, in contrast, attached dwellings appear to be growing at nearly 1.8 times the rate of detached dwellings. The relative growth rates were adjusted to capture this difference.

Exhibit 135 presents a summary of the resulting percentage stock growth, by year and dwelling type, for NL as a whole.

Exhibit 135 Residential Stock Growth Rates, 2014 to 2029

Dwelling Types	Annualized Stock Growth Rates by Period				
	2014 - 2017	2017 - 2020	2020 - 2023	2023 - 2026	2026 - 2029
Single-family detached, electric space heat	1.5%	1.2%	1.3%	0.9%	0.8%
Single-family detached, non-electric space heat	0.3%	0.2%	0.2%	0.2%	0.2%
Total Single Family	1.0%	0.8%	0.9%	0.6%	0.5%
Attached, electric space heat	1.6%	1.3%	1.3%	0.9%	0.8%
Attached, non-electric space heat	0.0%	0.0%	0.0%	0.0%	0.0%
Total Attached	1.3%	1.1%	1.2%	0.8%	0.7%
Apartment, electric space heat	1.6%	1.3%	1.4%	0.9%	0.8%
Apartment, non-electric space heat	0.0%	0.0%	0.0%	0.0%	0.0%
Total Apartment	1.0%	0.8%	0.9%	0.6%	0.6%
Other and non-dwellings	1.1%	0.9%	0.9%	0.6%	0.5%
Vacant and partial	1.0%	0.8%	0.9%	0.6%	0.6%
Grand Total	1.1%	0.9%	1.0%	0.7%	0.6%

Exhibit 136 provides growth rates by region.

Exhibit 136 Residential Stock Growth Rates by Region, 2014 to 2029

Regions	Annualized Stock Growth Rates by Period				
	2014 - 2017	2017 - 2020	2020 - 2023	2023 - 2026	2026 - 2029
Island Interconnected	1.1%	0.9%	1.0%	0.7%	0.6%
Labrador Interconnected	1.6%	1.0%	0.6%	0.6%	0.5%
Isolated	0.4%	0.3%	0.6%	0.5%	0.5%
Grand Total	1.1%	0.9%	1.0%	0.7%	0.6%

C.6 Results by Region

This section of the appendix presents the base year electricity consumption for the three regions. For each region, a version of Exhibit 16 is provided below. The underlying assumptions such as unit energy consumption, saturation and electricity share are not presented by region. This section also does not replicate the pie charts and other graphs presented in Section 5. If those graphs are needed for each region, they can be created using the Data Manager.

Exhibit 137 Reference Case Electricity Consumption, Modelled by End Use, Dwelling Type and Milestone Year, Island Interconnected Region (MWh/yr.)

Dwelling Types	Year	Consumption						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	1,319,617	342,538	263,075	179,099	97,579	113,782	2,315,689
	2017	1,373,901	351,593	269,656	200,644	85,120	85,161	2,366,075
	2020	1,420,642	358,299	274,134	219,518	70,800	70,887	2,414,279
	2023	1,472,884	367,669	279,346	238,252	71,574	64,833	2,494,560
	2026	1,510,176	373,587	281,071	253,436	71,707	62,272	2,552,249
	2029	1,543,766	378,839	281,753	267,134	72,152	61,806	2,605,451
Single-family detached, non-electric space heat	2014	139,641	207,647	115,811	105,652	61,857	67,121	697,729
	2017	138,528	215,998	114,563	123,088	50,632	48,484	691,292
	2020	137,255	214,113	113,147	130,943	40,653	39,207	675,319
	2023	136,092	212,960	111,791	137,878	40,077	34,768	673,567
	2026	134,635	211,675	110,166	143,706	39,571	32,707	672,461
	2029	133,099	210,475	108,456	148,804	39,373	31,881	672,087
Attached, electric space heat	2014	204,149	77,616	61,251	39,839	10,533	22,986	416,374
	2017	212,767	73,449	62,997	44,788	8,024	17,298	419,324
	2020	220,166	75,805	64,223	49,141	5,997	14,467	429,799
	2023	228,506	78,803	65,641	53,495	5,586	13,297	445,328
	2026	234,371	80,722	66,183	57,018	5,317	12,822	456,434
	2029	239,629	82,408	66,463	60,204	5,133	12,773	466,610
Attached, non-electric space heat	2014	6,972	14,337	6,908	6,978	2,081	4,026	41,302
	2017	6,837	15,336	6,779	8,363	1,649	2,891	41,855
	2020	6,703	15,104	6,650	8,841	1,261	2,327	40,885
	2023	6,568	14,908	6,521	9,242	1,227	2,052	40,517
	2026	6,434	14,735	6,392	9,582	1,198	1,923	40,265
	2029	6,300	14,576	6,263	9,876	1,182	1,869	40,066
Apartment, electric space heat	2014	115,559	43,269	44,866	31,272	2,922	11,797	249,684
	2017	120,432	52,857	46,145	39,532	2,717	8,701	270,383
	2020	124,615	53,982	47,043	43,573	2,913	7,132	279,258
	2023	129,331	55,533	48,082	47,551	3,130	6,426	290,053
	2026	132,648	56,531	48,479	50,739	3,316	6,075	297,787
	2029	135,621	57,426	48,684	53,582	3,497	5,933	304,743
Apartment, non-electric space heat	2014	2,751	3,630	2,561	2,616	244	848	12,650
	2017	2,727	5,265	2,513	3,802	181	596	15,084
	2020	2,703	5,182	2,465	4,042	197	470	15,059
	2023	2,680	5,111	2,417	4,238	213	407	15,065
	2026	2,656	5,048	2,370	4,401	228	374	15,077
	2029	2,632	4,992	2,322	4,538	244	356	15,084
Other and non-dwellings	2014	21,813	14,387	9,368	6,393	13,097	3,818	68,875
	2017	22,403	19,353	9,478	10,739	8,642	2,821	73,435
	2020	22,906	19,353	9,536	11,116	10,110	2,324	75,345
	2023	23,472	19,487	9,612	11,563	11,674	2,102	77,910
	2026	23,868	19,542	9,602	11,941	13,203	2,005	80,161
	2029	24,221	19,608	9,567	12,312	14,752	1,978	82,439
Vacant and partial	2014	27,232	10,747	10,105	7,438	13,742	4,856	74,121
	2017	27,967	9,520	10,223	6,760	16,503	3,587	74,561
	2020	28,593	9,520	10,286	7,013	16,328	2,955	74,696
	2023	29,298	9,586	10,368	7,308	16,169	2,674	75,403
	2026	29,791	9,613	10,358	7,560	15,851	2,550	75,723
	2029	30,231	9,646	10,319	7,807	15,479	2,515	75,997

Exhibit 138 Reference Case Electricity Consumption, Modelled by End Use, Dwelling Type and Milestone Year, Labrador Interconnected Region (MWh/yr.)

Dwelling Types	Year	Consumption						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	132,873	17,454	12,857	9,012	10,477	6,060	188,733
	2017	138,545	17,546	13,170	10,038	8,933	4,536	192,768
	2020	142,544	17,689	13,301	10,848	7,130	3,753	195,266
	2023	145,439	17,703	13,313	11,496	7,040	3,371	198,363
	2026	148,259	17,731	13,314	12,077	6,971	3,217	201,569
	2029	150,775	17,736	13,280	12,639	6,948	3,175	204,552
Single-family detached, non-electric space heat	2014	2,887	1,309	728	684	780	460	6,849
	2017	2,892	1,267	719	730	640	332	6,580
	2020	2,897	1,251	710	771	498	268	6,395
	2023	2,902	1,234	701	806	484	238	6,365
	2026	2,907	1,219	692	836	473	224	6,351
	2029	2,912	1,205	683	866	467	219	6,351
Attached, electric space heat	2014	66,628	10,357	7,923	5,237	3,414	2,866	96,425
	2017	71,106	9,902	8,343	5,992	2,577	2,210	100,130
	2020	74,184	10,247	8,571	6,585	1,971	1,864	103,423
	2023	76,281	10,419	8,669	7,049	1,888	1,695	106,002
	2026	78,324	10,593	8,755	7,477	1,821	1,636	108,606
	2029	80,107	10,728	8,804	7,890	1,778	1,631	110,938
Apartment, electric space heat	2014	5,643	1,499	1,499	1,034	93	438	10,207
	2017	6,023	1,964	1,579	1,447	100	331	11,443
	2020	6,283	2,012	1,622	1,599	104	274	11,894
	2023	6,461	2,035	1,640	1,717	108	244	12,205
	2026	6,634	2,059	1,656	1,824	111	231	12,516
	2029	6,785	2,078	1,666	1,925	114	226	12,794
Other and non-dwellings	2014	2,528	2,203	1,713	629	1,273	175	8,522
	2017	2,655	2,509	1,773	845	1,343	133	9,259
	2020	2,743	2,518	1,802	872	1,392	110	9,439
	2023	2,804	2,513	1,811	892	1,426	100	9,546
	2026	2,863	2,515	1,818	912	1,460	95	9,664
	2029	2,916	2,516	1,819	931	1,491	94	9,767

Exhibit 139 Reference Case Electricity Consumption, Modelled by End Use, Dwelling Type and Milestone Year, Isolated Region (MWh/yr.)

Dwelling Types	Year	Consumption						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	6,476	1,189	938	647	441	409	10,100
	2017	7,251	1,276	1,028	766	405	328	11,054
	2020	7,833	1,333	1,088	860	342	285	11,740
	2023	8,848	1,456	1,204	998	374	283	13,163
	2026	9,853	1,572	1,313	1,132	405	294	14,569
	2029	10,845	1,679	1,417	1,277	437	314	15,969
Single-family detached, non-electric space heat	2014	4,021	8,716	5,033	4,651	3,265	2,942	28,628
	2017	3,989	8,810	5,039	5,275	2,721	2,156	27,989
	2020	3,954	8,703	5,041	5,604	2,149	1,768	27,219
	2023	3,924	8,610	5,051	5,889	2,125	1,590	27,188
	2026	3,894	8,530	5,059	6,133	2,108	1,518	27,242
	2029	3,862	8,458	5,067	6,422	2,109	1,502	27,420
Other and non-dwellings	2014	244	244	92	62	127	38	807
	2017	252	440	93	222	131	28	1,166
	2020	258	433	94	226	134	23	1,169
	2023	267	431	95	233	139	21	1,186
	2026	276	430	97	240	144	20	1,207
	2029	284	430	98	248	149	20	1,229
Vacant and partial	2014	292	136	98	71	157	47	800
	2017	301	173	97	105	162	34	873
	2020	309	171	96	107	167	27	877
	2023	320	170	96	110	173	24	893
	2026	330	170	95	113	179	23	910
	2029	341	170	104	119	185	26	944

Appendix D Background-Section 6: Reference Case Peak Load

Introduction

The methodology for estimating forecast peak loads is identical to the methodology described in Appendix B, employing the same hours-use factors. The following exhibits show the Reference Case peak load profiles for each region.

Exhibit 140 Electric Peak Loads, by Milestone Year, End Use and Dwelling Type, Island Interconnected Region (MW)

Dwelling Types	Year	Reference Case Peak Demand (MW)						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	442	43	76	25	14	19	620
	2017	460	44	78	28	12	14	637
	2020	476	45	79	31	10	12	653
	2023	494	46	80	34	10	11	675
	2026	506	47	81	36	10	10	690
	2029	517	48	81	38	10	10	704
Single-family detached, non-electric space heat	2014	47	26	33	15	9	11	141
	2017	46	27	33	17	7	8	140
	2020	46	27	33	19	6	7	137
	2023	46	27	32	20	6	6	136
	2026	45	27	32	20	6	5	135
	2029	45	27	31	21	6	5	135
Attached, electric space heat	2014	71	10	18	6	2	4	109
	2017	73	9	18	6	1	3	111
	2020	76	9	18	7	1	2	114
	2023	79	10	19	8	1	2	118
	2026	81	10	19	8	1	2	121
	2029	83	10	19	9	1	2	124
Attached, non-electric space heat	2014	2	2	2	1	0	1	8
	2017	2	2	2	1	0	0	8
	2020	2	2	2	1	0	0	8
	2023	2	2	2	1	0	0	8
	2026	2	2	2	1	0	0	8
	2029	2	2	2	1	0	0	8
Apartment, electric space heat	2014	40	6	13	4	0	2	65
	2017	42	7	13	5	0	1	69
	2020	43	7	14	6	0	1	71
	2023	45	7	14	7	0	1	74
	2026	46	8	14	7	0	1	76
	2029	47	8	14	7	0	1	77
Apartment, non-electric space heat	2014	1	0	1	0	0	0	3
	2017	1	1	1	1	0	0	3
	2020	1	1	1	1	0	0	3
	2023	1	1	1	1	0	0	3
	2026	1	1	1	1	0	0	3
	2029	1	1	1	1	0	0	3
Other and non-dwellings	2014	7	2	3	1	2	1	15
	2017	8	3	3	2	1	0	16
	2020	8	3	3	2	1	0	17
	2023	8	3	3	2	2	0	17
	2026	8	3	3	2	2	0	17
	2029	8	3	3	2	2	0	18
Vacant and partial	2014	9	2	3	1	2	1	17
	2017	9	1	3	1	2	1	17
	2020	10	1	3	1	2	0	18
	2023	10	1	3	1	2	0	18
	2026	10	1	3	1	2	0	18
	2029	10	1	3	1	2	0	18

Exhibit 141 Electric Peak Loads, by Milestone Year, End Use and Dwelling Type, Labrador Interconnected Region (MW)

Dwelling Types	Year	Reference Case Peak Demand (MW)						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	37	2	4	1	2	1	48
	2017	39	2	4	1	2	1	49
	2020	40	2	4	2	2	1	50
	2023	41	2	4	2	2	1	51
	2026	42	2	4	2	2	1	52
	2029	43	2	4	2	2	1	52
Single-family detached, non-electric space heat	2014	1	0	0	0	0	0	2
	2017	1	0	0	0	0	0	1
	2020	1	0	0	0	0	0	1
	2023	1	0	0	0	0	0	1
	2026	1	0	0	0	0	0	1
	2029	1	0	0	0	0	0	1
Attached, electric space heat	2014	19	1	2	1	1	0	25
	2017	21	1	2	1	1	0	26
	2020	22	1	2	1	1	0	27
	2023	22	1	2	1	1	0	28
	2026	23	1	3	1	1	0	29
	2029	23	1	3	1	1	0	29
Apartment, electric space heat	2014	2	0	0	0	0	0	3
	2017	2	0	0	0	0	0	3
	2020	2	0	0	0	0	0	3
	2023	2	0	0	0	0	0	3
	2026	2	0	0	0	0	0	3
	2029	2	0	0	0	0	0	3
Other and non-dwellings	2014	1	0	0	0	0	0	2
	2017	1	0	1	0	0	0	2
	2020	1	0	1	0	0	0	2
	2023	1	0	1	0	0	0	2
	2026	1	0	1	0	0	0	2
	2029	1	0	1	0	0	0	2

Exhibit 142 Electric Peak Loads, by Milestone Year, End Use and Dwelling Type, Isolated Region (MW)

Dwelling Types	Year	Reference Case Peak Demand (MW)						
		HVAC	Appliances	DHW	Electronics	Other	Lighting	Grand Total
Single-family detached, electric space heat	2014	2.5	0.2	0.3	0.1	0.1	0.1	3.2
	2017	2.9	0.2	0.3	0.1	0.1	0.1	3.5
	2020	3.1	0.2	0.3	0.1	0.1	0.0	3.8
	2023	3.5	0.2	0.3	0.1	0.1	0.0	4.3
	2026	3.9	0.2	0.4	0.2	0.1	0.0	4.7
	2029	4.3	0.2	0.4	0.2	0.1	0.1	5.2
Single-family detached, non-electric space heat	2014	1.5	1.1	1.4	0.7	0.6	0.5	5.8
	2017	1.5	1.2	1.4	0.7	0.5	0.4	5.6
	2020	1.5	1.1	1.5	0.8	0.4	0.3	5.5
	2023	1.5	1.1	1.5	0.8	0.4	0.3	5.5
	2026	1.4	1.1	1.5	0.9	0.3	0.3	5.5
	2029	1.4	1.1	1.5	0.9	0.3	0.3	5.5
Other and non-dwellings	2014	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2017	0.1	0.1	0.0	0.0	0.0	0.0	0.2
	2020	0.1	0.1	0.0	0.0	0.0	0.0	0.2
	2023	0.1	0.1	0.0	0.0	0.0	0.0	0.3
	2026	0.1	0.1	0.0	0.0	0.0	0.0	0.3
	2029	0.1	0.1	0.0	0.0	0.0	0.0	0.3
Vacant and partial	2014	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2017	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2020	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2023	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2026	0.1	0.0	0.0	0.0	0.0	0.0	0.2
	2029	0.1	0.0	0.0	0.0	0.0	0.0	0.2

Appendix E Background-Section 7: Technology Assessment: Energy efficiency Measures

Introduction

Exhibit 143 provides an example of part of the worksheet that calculates the CCE for clothes lines and drying racks, one of the analyzed measures. For more detail on this and all the other measures, refer to the TRM Workbook submitted with this deliverable.

Exhibit 143 Sample Measure CCE Calculation Worksheet

NP + NLH: Residential, Island - Electric efficiency

Clothes Lines and Drying Racks

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Measure Description

Description:	Electric clothes dryers represented approximately 2.4% of all residential consumption in Newfoundland and Labrador in 2014. Switching to passive methods of clothes drying, such as clothes lines during summer months and indoor drying racks, is an effective way of reducing energy consumption at little-to-no cost.
Baseline:	An electric clothes dryer with a moisture sensor
Upgrade:	No clothes dryer
Baseline:	Annual by end use
Heating Fuel Type:	Electricity
Main End Use:	Clothes Dryers
Resource Costs:	Baseload

Fuel	Customer Cost		Avoided Costs (NPV)				Reference + Notes
Electricity	$0.112	$/kWh	$0.938	$0.938	$0.938	$0.938	Please see "Avoided Costs" and "Customer Costs" tabs
Electric Demand	-	$/kW	$1.193	$1.193	$1.193	$1.193	Please see "Avoided Costs" and "Customer Costs" tabs

Measure Cost Definitions & Calculations

		Detached (Electric)	Detached (Non-Electric)	Attached (Electric)	Attached (Non-Electric)	Weighted Average	Reference + Notes
Baseline Consumption	Electricity kWh/yr	940	858	963	838	**826**	
Upgrade Consumption	Electricity kWh/yr	-	-	-	-	-	
	Winter Peak Hours-Use Factor	6,012	6,012	6,012	6,012	**6,012**	
Resource Savings	Electricity (kWh/yr.)	940	858	963	838	**826**	
	Electricity (kW peak)	0.156	0.143	0.160	0.139	**0.14**	
Cost Parameters	Upgrade, Material ($)	$45.00	$45.00	$45.00	$45.00	**$45**	Canadian Tire, average for full clothes line kit or drying rack
	Upgrade, Installation ($)	-	-	-	-	-	
	Baseline, Material ($)	$600.00	$600.00	$600.00	$600.00	**$600**	Sears.ca
	Baseline, Installation ($)	-	-	-	-	-	
	Total Measure Cost [A]	$45	$45	$45	$45	**$45**	
	Basis (Full/Incremental)	Full	Full	Full	Full	**Full**	
	Incremental O&M ($/yr.)	-	-	-	-	-	
Lifetimes	Upgrade (yrs.)	21	21	21	21	**21**	Maximum life based on provided marginal costs
	Baseline (yrs.)	11	11	11	11	**11**	NRC (http://www.nrcan.gc.ca/energy/products/categories/appliances/clothes-washer/13984)
	Cost Savings ($/yr.)	$105	$96	$108	$94	**$92**	
	Simple Payback (yrs.)	0.4	0.5	0.4	0.5	**0.6**	
	NPV of O&M Costs ($) [B]	-	-	-	-	-	
Total Avoided Supply Costs (NPV, $) [C]	Electric Energy	$882	$805	$904	$786	**$775**	
	Electric Demand	$0	$0	$0	$0	**$0**	
Total Customer Bill Reduction (NPV, $) [D]	Electric Energy	$1,218	$1,112	$1,248	$1,086	**$1,071**	
	Electric Demand	-	-	-	-	-	

Economic Tests

		Detached (Electric)	Detached (Non-Electric)	Attached (Electric)	Attached (Non-Electric)	Weighted Average	Reference + Notes
Incentive	Target Payback (yrs.)	5	5	5	5	**5**	
	Percent of Measure Costs	-	-	-	-	-	
	Incentive ($) [E]	-	-	-	-	-	
Administration Costs	% of Incentive [F]	15%	30%	30%	30%	**24%**	
	% of Savings Value to Utility [G]	6%	6%	6%	6%	**6%**	
	Admin. Costs per Unit ($) [H]	$53	$48	$54	$47	**$47**	
	Net-to-Gross Ratio [I]	90%	90%	90%	90%	**90%**	
Total Resource Cost Test	TRC Benefits ($)	$794	$725	$813	$708	**$698**	
	TRC Costs ($)	$93	$89	$95	$88	**$87**	
	Measure TRC ($)	$701	$636	$719	$620	**$611**	
	TRC Benefit/Cost Ratio	8.50	8.16	8.59	8.07	**7.86**	
	Cost of Conserved Electricity (CCE) (¢/kWh)	**0.44**	**0.48**	**0.43**	**0.50**	0.58	
Participant Cost Test	PCT Benefits ($)	$1,218	$1,112	$1,248	$1,086	**$1,071**	
	PCT Costs ($)	$45	$45	$45	$45	**$45**	
	Measure PCT ($)	$1,173	$1,067	$1,203	$1,041	**$1,026**	
	PCT Benefit/Cost Ratio	27.07	24.72	27.74	24.13	**23.80**	
Ratepayer Impact Measure Test	RIM Benefits ($)	$794	$725	$813	$708	**$698**	
	RIM Costs ($)	$1,149	$1,049	$1,178	$1,024	**$1,010**	
	Measure RIM ($)	$882	$805	$904	$786	**$775**	
	RIM Benefit/Cost Ratio	5.58	5.58	5.58	5.58	**5.58**	
Program Administrator Costs Test	PAC Benefits ($)	$794	$725	$813	$708	**$698**	
	PAC Costs ($)	$53	$48	$54	$47	**$47**	
	Measure PAC ($)	$741	$677	$759	$661	**$651**	
	PAC Benefit/Cost Ratio	15.00	15.00	15.00	15.00	**15.00**	

Applies? (Yes = 1, 0 = No) — Resource Savings Assumptions (Percent relative to baseline, not including heating penalties/cooling benefits)

Fuel	End Use	Sub End Use	Baseline	Upgrade	Measure Resource Savings (%)				Weighted Average	Reference + Notes
Electricity	Clothes Dryers	General	1	1	100.0%	100.0%	100.0%	100.0%	**100.0%**	

Applies? (Yes = 1, 0 = No) — Resource Savings Wrap-Up (Percent relative to baseline, main end uses, including heating penalties/cooling benefits)

Fuel	End Use	Baseline	Upgrade	Measure Resource Savings (%)				Weighted Average	Reference + Notes
Electricity	Clothes Dryers	1	1	100.0%	100.0%	100.0%	100.0%	**100.0%**	

Exhibit 144 provides a list of all the residential measures initially considered for this study. It indicates which measures were included for further study. For those measures excluded from the study, the exhibit provides the reason for that decision.

Exhibit 144 Residential Measures Considered

End Use	Measure		Reasons for Exclusion
Block Heaters and Car Warmers	Block Heater Demand	Included	
	Car Warmer Demand	Included	
	Car Warmer Timers	Included	
	Block Heater Timers	Included	
	Battery Blanket Timers	Included	
Clothes Dryers	Efficient Clothes Dryers	Included	
	Heat Pump Clothes Dryers	Included	
	Clothes Lines	Included	
	Clothes Dryer Sensor	Included	
Clothes Washers	Efficient Clothes Washers	Included	
	Super Efficient Clothes Washers	Included	
Computers and Peripherals	Power Bars (PCs)	Included	
	ESTAR Computers	Included	
	PC Power Management	Included	
Cooking	Induction Cooktops	Included	
	Convection Ovens	Included	
	Microwaves (Behavioral)	Excluded	This measure involves encouraging customers to use microwaves to cook food instead of conventional ovens and ranges, which use more energy. Cooking behaviors are difficult if not impossible to meaningfully change.
Dehumidifier	ESTAR Dehumidifiers	Included	
Dishwashers	ESTAR Dishwashers	Included	
Domestic Hot Water (DHW)	Min Hot Wash	Included	
	Faucets	Included	
	Faucet Aerator	Included	
	DHW Pipe Insulation	Included	
	DHW Tank Insulation	Included	
	Efficient DHW	Included	
	DHW Cycling	Included	
	3-Element DHW	Included	
	DHW Temperature	Included	

End Use	Measure		Reasons for Exclusion
	Showerheads	Included	
	ASHP on HW tanks	Excluded	Current models of air-source heat pumps on DHW tanks are non-ducted and use heat in the surrounding air to heat the water. Since DHW tanks are typically in located in spaces within the home, pulling heat from the interior air results in higher space heating requirements. For a climate like that of Newfoundland and Labrador, this is not an attractive measure. Future studies might consider this technology if ducted ASHP DHW tanks become available that can draw heat from exterior air sources.
Freezers	Super-Efficient Freezers	Included	
	ESTAR Freezers	Included	
	Freezer Temperature	Included	
Hot Tubs	Hot Tub Covers	Included	
Lighting	High-Performance T8s	Included	
	Motion Detectors - Indoor	Included	
	Timers - Outdoor	Included	
	LED Lamps	Included	
	T8 Fixtures	Included	
	Turn Off Lights	Included	
	Motion Detectors - Outdoor	Included	
	Min Outdoor Lighting	Included	
	Lighting Controls	Excluded	Motion detectors and timers included.
	WIFI Control	Excluded	Savings are not different from other lighting control measures.
	Lamp Exchange Program	Excluded	Included in the LED measure's savings.
Other electronics	Unplug Chargers	Included	
Refrigerators	Refrigerator Retirement	Included	
	Super-Efficient Refrigerators	Included	
	Refrigerator Temperature	Included	
	Efficient Refrigerators	Included	
Space Cooling	AC Temperature	Included	
New Homes	LEED Apartments	Included	
	High-Perf. New Homes	Included	
	Net Zero Homes	Included	

End Use	Measure		Reasons for Exclusion
	Passive New Construction	Excluded	Difficult to consider from an aggregate level since passive homes are particular to each location and specific site.
	Complying with Code NBC	Excluded	The National Building Code generally applies to Newfoundland and Labrador jurisdictions. Little is known about the extent of non-compliance and how non-compliant homes are built, making the applicability and defining the baseline unknowns.
Space Heating	Super Windows	Included	
	Air Sealing	Included	
	Cold Climate Heat Pump	Included	
	Wall Insulation	Included	
	Air-Source Heat Pump	Included	
	Sealing & Insul. - Old (pre-1980) homes	Included	
	Crawl Space Insulation	Included	
	Basement Insulation	Included	
	Attic Insulation	Included	
	Close Blinds	Included	
	ESTAR Windows	Included	
	Prog. Thermostats	Included	
	Mini-Splits	Included	
	Overnight Setback	Included	
	Electronic Thermostats	Included	
	Door Systems	Included	
	Professional Air Sealing	Included	
	Weather Stripping Maintenance	Included	
	Prog. Thermostats (Central)	Included	
	Thermal Storage (Baseboard)	Included	
	Daytime Setback	Included	
	Thermal Storage (Central)	Included	
	Apt Recommissioning	Included	
	Air-to-Water Heat Pumps	Included	

End Use	Measure		Reasons for Exclusion
	Convect Air Heaters	Excluded	Convect air heaters are essentially resistance heaters of the same efficiency as baseboard heaters that employ various techniques to transfer the heat to the surrounding air. Manufacturers argue better heat transfer and user perceptions of warmer ambient temperatures; savings are related to a subsequent reduction in the temperature set point. As such, savings for this measure are captured in the temperature setback measures.
	Heat Pump Cycling	Included	
	Electric Heat Cycling	Included	
	Dual Fuel Heat Cycling	Included	
	Wood/Pellet Stoves	Excluded	Fuel switching is out of the scope of this study.
	Wood/Pellet Furnaces	Excluded	Fuel switching is out of the scope of this study.
	Proper Installation of Heat Pumps	Excluded	All measures assume proper installation of new equipment.
	Wi-Fi Thermostats	Excluded	Savings are not different from other programmable thermostats.
Televisions	Power Bars (TVs)	Included	
	Turn Off TVs	Included	
	ESTAR TVs	Included	
	LCD TVs	Excluded	This has become the baseline technology.
Ventilation	Premium Ventilation Motors	Included	
	ECPM Fan Motors	Included	
	HRVs	Included	
	Exhaust Fans Bathroom Timers	Excluded	Runtimes vary significantly and can even increase overall consumption. Collectively decided to remove this measure.
Other	Product Installation	Excluded	All measures assume proper installation of new equipment.
	Electric Vehicles	Excluded	Out of the scope of this study. Increase of energy consumption due to new technologies in considered in the load forecast.
	Energy Audits	Excluded	Energy audits are a delivery mechanism, not a savings measure.
	Education on Code Requirements	Excluded	Similar to "Complying with Code NBC", savings are generally not considered for following baseline building requirements.
	Benchmarking	Included	

End Use	Measure		Reasons for Exclusion
	Home Automation	Excluded	In an Ontario ICF study, the savings for this measure are essentially the sum of several other related measures--not unique savings. Additionally, the cost to implement home automation is greater than the sum of the cost to implement the individual measures.
	Home Energy Monitoring	Excluded	Considered with the benchmarking measure since the two employ home energy monitoring systems and customer feedback.
	Load Reduction Reward Program	Excluded	Programs are a delivery mechanism, not a savings measure.

Appendix F Background-Section 8: Economic Potential: Electric Energy Forecast

Introduction

The following three exhibits provide the economic potential energy efficiency results for the island Interconnected, Labrador Interconnected, and Isolated regions, respectively. The three exhibits following those provide the economic potential load reduction results for the Island Interconnected, Labrador Interconnected, and Isolated regions, respectively. The latter three exhibits do not include the load reduction associated with energy efficiency measures, which were already presented by region in Exhibit 49.

Exhibit F 1 Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year, Island Interconnected (MWh/yr.)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Clothes dryer	Television	Refrigerator	Computer and peripherals	Lighting	Ventilation	Hot tubs
Single Family Dwellings	2017	711,050	119,215	129,621	43,880	51,617	30,041	22,877	9,065	19,578
	2020	723,705	118,382	131,801	46,539	52,314	28,964	18,542	10,592	14,187
	2023	735,620	119,017	135,050	49,477	53,023	31,518	16,522	13,389	13,906
	2026	738,543	123,340	139,687	52,136	53,335	38,079	15,293	21,320	13,581
	2029	744,149	123,323	142,610	54,770	53,522	38,410	14,557	27,578	13,406
Attached Houses	2017	32,537	21,654	13,479	7,022	9,019	4,499	3,357	1,106	1,551
	2020	32,378	21,671	14,246	7,505	9,207	4,514	2,750	1,110	1,026
	2023	31,646	21,968	15,244	8,044	9,410	5,192	2,476	1,270	912
	2026	30,778	23,120	16,768	8,524	9,524	6,402	2,308	1,467	835
	2029	30,389	22,996	17,436	8,997	9,610	6,488	2,210	3,325	780
Apartments	2017	7,041	12,902	4,294	4,388	466	2,245	1,359	190	-
	2020	6,562	13,233	4,143	4,703	477	2,888	1,062	176	-
	2023	5,445	13,767	4,297	5,055	489	4,689	910	175	-
	2026	4,377	14,132	4,404	5,366	496	6,245	810	173	-
	2029	4,111	14,446	4,501	5,673	502	6,340	740	172	-
Other, Vacant and Partial	2017	6,131	5,190	(113)	1,336	182	626	1,066	139	-
	2020	6,277	5,296	(284)	1,414	179	377	859	139	-
	2023	6,301	5,445	(290)	1,508	178	392	761	139	-
	2026	5,996	5,545	(295)	2,393	176	642	700	139	-
	2029	5,850	5,629	(299)	2,503	175	1,192	663	139	-
Grand Total	**2017**	756,758	158,962	147,281	56,627	61,285	37,411	28,659	10,500	21,129
	2020	768,922	158,582	149,907	60,161	62,177	36,744	23,213	12,016	15,213
	2023	779,012	160,196	154,302	64,084	63,100	41,792	20,669	14,972	14,818
	2026	779,693	166,136	160,565	68,419	63,530	51,367	19,112	23,099	14,417
	2029	784,499	166,395	164,248	71,943	63,808	52,430	18,171	31,214	14,185

Exhibit F 1 Continued: Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year, Island Interconnected (MWh/yr.)

Housing Categories	Milestone Years	Television peripherals	Dehumidifier	Freezer	Cooking	Other electronics	Clothes washer	Dishwasher	Space cooling	Grand Total
Single Family Dwellings	2017	4,847	2,190	1,636	2,030	1,338	402	235	(147)	1,149,475
	2020	5,030	1,653	1,272	2,017	1,404	208	237	(150)	1,156,696
	2023	5,232	4,367	2,619	2,020	1,477	187	238	(158)	1,183,505
	2026	5,395	5,629	3,162	2,018	1,540	655	239	(163)	1,213,787
	2029	5,549	5,313	3,739	2,018	1,601	783	239	(168)	1,231,399
Attached Houses	2017	822	372	218	365	224	69	42	3	96,340
	2020	860	283	171	365	237	36	43	4	96,404
	2023	902	753	355	368	251	33	43	4	98,872
	2026	935	976	431	370	263	143	44	4	102,891
	2029	966	926	513	372	275	139	44	4	105,471
Apartments	2017	668	117	77	289	211	34	19	-	34,299
	2020	700	119	60	289	224	15	19	-	34,671
	2023	737	123	126	293	238	14	20	-	36,378
	2026	765	127	153	295	250	14	20	-	37,627
	2029	792	129	182	297	262	13	20	-	38,180
Other, Vacant and Partial	2017	102	-	88	138	128	17	7	-	15,038
	2020	106	-	68	136	135	9	6	-	14,718
	2023	110	-	139	135	142	8	6	-	14,973
	2026	171	-	167	134	148	8	6	-	15,930
	2029	175	-	197	134	154	7	6	-	16,524
Grand Total	**2017**	6,439	2,679	2,019	2,822	1,902	522	303	(144)	1,295,153
	2020	6,696	2,054	1,571	2,808	2,000	268	305	(147)	1,302,489
	2023	6,980	5,243	3,238	2,817	2,108	243	307	(154)	1,333,728
	2026	7,266	6,731	3,913	2,817	2,201	819	308	(159)	1,370,235
	2029	7,483	6,368	4,630	2,820	2,292	943	308	(164)	1,391,573

Exhibit F 2 Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year, Labrador Interconnected (MWh/yr.)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Clothes dryer	Refrigerator	Television	Hot tubs	Computer and peripherals	Lighting	Block heaters & car warmers
Single Family Dwellings	2017	5,293	3,637	4,224	1,798	473	1,538	248	684	142
	2020	37,032	3,743	4,301	1,817	859	1,118	581	552	145
	2023	37,138	3,818	4,346	1,817	1,277	1,088	925	484	147
	2026	41,347	3,890	4,392	1,816	1,469	1,063	1,086	444	358
	2029	41,375	4,144	4,506	1,810	1,533	1,050	1,232	414	362
Attached Houses	2017	1,714	2,185	1,507	1,082	261	386	142	267	81
	2020	3,058	2,290	1,640	1,112	483	253	325	239	84
	2023	2,677	2,362	1,719	1,126	726	231	524	204	87
	2026	2,417	2,560	1,868	1,139	844	213	622	218	213
	2029	9,285	2,619	1,936	1,147	889	200	712	207	217
Apartments	2017	193	413	166	17	50	-	4	40	-
	2020	118	433	172	18	93	-	96	31	-
	2023	59	447	176	18	139	-	154	26	-
	2026	36	460	180	18	162	-	183	23	-
	2029	11	471	183	18	170	-	210	21	-
Other, Vacant and Partial	2017	104	464	150	16	4	-	4	18	-
	2020	109	482	154	16	6	-	9	14	-
	2023	112	493	157	15	8	-	14	13	-
	2026	113	505	159	15	9	-	17	12	-
	2029	88	515	161	15	48	-	33	12	-
Grand Total	**2017**	7,304	6,699	6,047	2,913	789	1,925	398	1,010	223
	2020	40,317	6,947	6,267	2,962	1,441	1,371	1,011	836	230
	2023	39,986	7,120	6,398	2,976	2,150	1,319	1,617	728	233
	2026	43,913	7,414	6,599	2,988	2,484	1,276	1,909	697	572
	2029	50,760	7,750	6,787	2,990	2,641	1,250	2,186	653	579

Exhibit F 2 Continued: Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year, Labrador Interconnected (MWh/yr.)

Housing Categories	Milestone Years	Ventilation	Television peripherals	Freezer	Dehumidifier	Cooking	Other electronics	Clothes washer	Dishwasher	Grand Total
Single Family Dwellings	2017	57	68	48	33	66	42	5	8	18,366
	2020	294	109	48	34	65	44	4	8	50,755
	2023	311	151	48	34	64	46	4	8	51,709
	2026	359	169	122	144	64	48	4	8	56,783
	2029	608	178	143	135	64	50	21	8	57,634
Attached Houses	2017	14	39	22	19	39	24	3	5	7,790
	2020	25	64	23	20	39	26	2	5	9,689
	2023	24	90	23	20	39	27	2	5	9,887
	2026	23	101	58	87	39	29	15	5	10,450
	2029	69	108	69	82	40	30	14	5	17,629
Apartments	2017	1	5	2	-	-	6	-	-	899
	2020	1	10	2	-	-	7	-	-	982
	2023	1	16	2	-	-	7	-	-	1,046
	2026	2	18	6	-	-	7	-	-	1,096
	2029	2	23	7	3	8	8	0	1	1,136
Other, Vacant and Partial	2017	1	-	6	-	-	2	-	-	770
	2020	1	0	6	-	-	3	-	-	799
	2023	1	0	6	-	-	3	-	-	822
	2026	1	0	14	-	-	3	-	-	849
	2029	1	5	17	-	12	3	1	1	911
Grand Total	**2017**	74	112	79	52	105	75	7	13	27,825
	2020	322	184	79	54	105	79	7	13	62,225
	2023	337	258	79	54	104	83	6	13	63,464
	2026	385	288	201	231	103	87	18	13	69,178
	2029	680	314	236	219	123	91	36	14	77,310

Exhibit F 3 Total Economic Potential Electricity Savings by End Use, Dwelling Type and Milestone Year, Isolated (MWh/yr.)

Housing Categories	Milestone Years	Space heating	Clothes dryer	Domestic Hot Water (DHW)	Television	Refrigerator	Computer and peripherals	Ventilation	Hot tubs	Lighting
Single Family Dwellings	2017	3,627	2,436	2,079	735	779	617	939	504	418
	2020	4,154	2,440	2,109	886	859	760	827	366	334
	2023	4,690	2,466	2,143	1,055	902	758	731	362	323
	2026	5,256	2,491	2,178	1,239	944	760	641	359	306
	2029	5,769	2,516	2,198	1,439	970	765	560	360	298
Attached Houses	2017	189	26	54	17	4	30	6	-	10
	2020	186	35	55	30	8	36	7	-	8
	2023	193	45	60	44	11	36	8	-	7
	2026	248	55	63	60	13	35	9	-	7
	2029	262	52	66	77	14	34	11	-	7
Grand Total	**2017**	3,816	2,462	2,133	752	783	647	945	504	428
	2020	4,339	2,475	2,164	916	868	797	834	366	342
	2023	4,883	2,510	2,204	1,099	913	794	739	362	330
	2026	5,504	2,546	2,241	1,299	957	794	650	359	312
	2029	6,031	2,568	2,264	1,516	984	799	571	360	305

Housing Categories	Milestone Years	Freezer	Television peripherals	Dehumidifier	Cooking	Other electronics	Clothes washer	Dishwasher	Grand Total
Single Family Dwellings	2017	88	85	21	37	25	34	4	12,429
	2020	140	86	32	37	27	28	5	13,088
	2023	193	88	44	36	28	23	6	13,848
	2026	247	89	57	36	30	20	8	14,659
	2029	301	99	56	36	32	17	7	15,423
Attached Houses	2017	3	0	-	3	1	0	0	344
	2020	5	0	-	3	1	1	0	377
	2023	7	0	-	3	1	1	0	417
	2026	9	0	-	3	1	1	0	505
	2029	11	1	-	3	2	1	0	539
Grand Total	**2017**	91	85	21	40	27	35	4	12,774
	2020	145	87	32	39	28	29	5	13,464
	2023	201	88	44	39	30	24	6	14,266
	2026	256	89	57	39	31	21	8	15,164
	2029	312	100	56	39	33	18	7	15,962

Exhibit F 4 Economic Potential Load Reduction by End Use, Dwelling Type and Milestone Year, Island Interconnected (MW)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Grand Total
Single Family Dwellings	2017	84	76	161
	2020	89	89	178
	2023	94	91	185
	2026	98	91	189
	2029	102	91	193
Attached Houses	2017	19	14	33
	2020	20	16	36
	2023	21	17	38
	2026	19	17	36
	2029	18	17	35
Apartments	2017	0	10	10
	2020	11	10	21
	2023	11	12	23
	2026	12	12	24
	2029	12	12	24
Other, Vacant and Partial	2017	9	-	9
	2020	11	2	13
	2023	11	2	13
	2026	14	2	16
	2029	14	2	16
Grand Total	**2017**	113	100	212
	2020	130	118	247
	2023	137	122	260
	2026	143	122	264
	2029	146	121	267

Exhibit F 5 Economic Potential Load Reduction by End Use, Dwelling Type and Milestone Year, Labrador Interconnected (MW)

Housing Categories	Milestone Years	Space heating	Domestic Hot Water (DHW)	Block heaters & car warmers	Grand Total
Single Family Dwellings	2017	8.2	3.2	0.3	11.6
	2020	8.2	3.4	0.3	11.9
	2023	7.1	3.4	0.2	10.7
	2026	6.6	3.4	0.2	10.2
	2029	6.3	3.3	0.2	9.9
Attached Houses	2017	5.5	1.9	0.2	7.6
	2020	5.8	2.1	0.2	8.1
	2023	5.4	2.1	0.1	7.7
	2026	5.4	2.1	0.1	7.6
	2029	4.1	2.1	0.1	6.4
Apartments	2017	0.8	0.4	-	1.2
	2020	0.8	0.4	-	1.2
	2023	0.9	0.4	-	1.3
	2026	0.9	0.4	-	1.3
	2029	0.7	0.4	-	1.1
Other, Vacant and Partial	2017	0.4	0.3	-	0.8
	2020	0.5	0.3	-	0.8
	2023	0.5	0.3	-	0.8
	2026	0.5	0.4	-	0.9
	2029	0.5	0.4	-	0.9
Grand Total	**2017**	15.0	5.8	0.4	21.2
	2020	15.3	6.2	0.5	22.0
	2023	13.9	6.3	0.3	20.5
	2026	13.4	6.3	0.3	20.0
	2029	11.7	6.2	0.3	18.3

Exhibit F 6 Economic Potential Load Reduction by End Use, Dwelling Type and Milestone Year, Isolated (MW)

Housing Categories	Milestone Years	Domestic Hot Water (DHW)	Space heating	Grand Total
Single Family Dwellings	2017	1.2	0.6	1.8
	2020	1.3	0.7	2.0
	2023	1.4	0.8	2.2
	2026	1.4	0.9	2.3
	2029	1.5	1.0	2.4
Attached Houses	2017	0.0	0.1	0.1
	2020	0.0	0.1	0.1
	2023	0.0	0.1	0.1
	2026	0.0	0.1	0.1
	2029	0.0	0.1	0.1
Grand Total	**2017**	1.2	0.7	1.9
	2020	1.4	0.8	2.1
	2023	1.4	0.9	2.3
	2026	1.4	1.0	2.4
	2029	1.5	1.1	2.6

Appendix G Background-Section 9: Achievable Workshop Action Profile Slides

CDM Potential Study

Newfoundland and Labrador

ICF INTERNATIONAL

Agenda

1. Overview of the CDM Study Approach, Tools, Outputs
2. Overview of the Residential technology results to date
3. Discussion of Residential Opportunities
4. Wrap Up & Next Steps

9:00 am – 9:15 am	Welcome & Introductions
9:15 am – 9:45 am	Overview Of CDM Potential Study Approach, Outputs & Tools
9:45 am – 10:15 am	Overview of Residential Sector Technology Results to Date and Workshop Discussion Format
10:15 am– 10:30 am	Break
10:30 am – 11:30 am	Discussion of Residential Opportunity # 1 Basement Insulation
11:30 am – 12:00 pm	Discussion of Residential Opportunity #2 Mini-splits
12:00 pm – 12:30 pm	Lunch
12:30 pm – 1:00 pm	Discussion of Residential Opportunity #3 HPNC
1:00 pm – 1:30 pm	Discussion of Residential Opportunity #4 Heat cycling
1:30 pm – 2:00 pm	Discussion of Residential Opportunity #5 ETS
2:00 pm – 2:30 pm	Discussion of Residential Opportunity #6 Air Sealing
2:30 pm – 2:45 pm	Break
2:45 pm – 3:15 pm	Discussion of Residential Opportunity #7 Water Measures
3:15 pm – 3:45 pm	Discussion of Residential Opportunity #8 Behavioural group (clothes lines, minimize hot water wash, second fridge retirement)
3:45 pm – 4:30 pm	Wrap up and Next Steps

1

Overview of the CDM Study Approach, Tools, Outputs

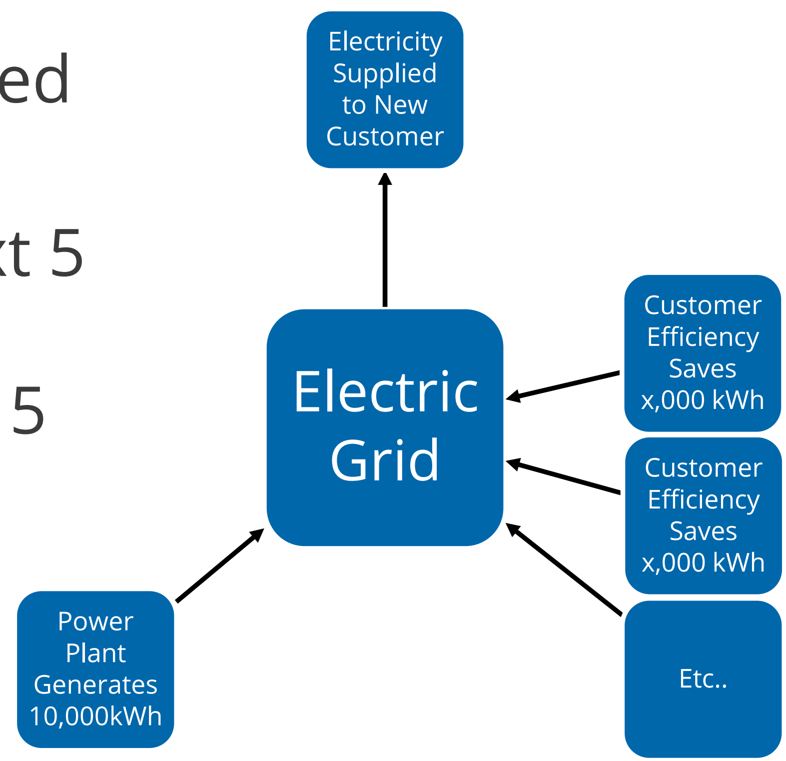
Study Background & Objectives

"The purpose of this Project is to develop a Conservation and Demand Management ("CDM") Potential Study to identify the remaining achievable, cost-effective **electric energy efficiency and demand management potential** in Newfoundland and Labrador."

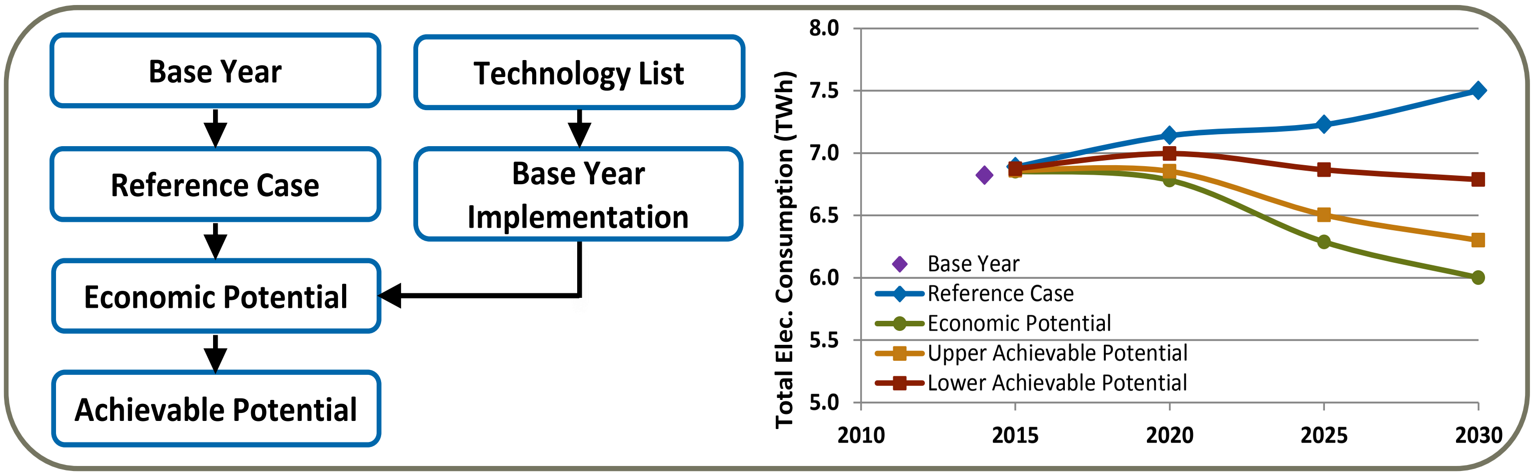
- Characterize available equipment and behaviours: EE and load reduction measures
- Estimate achievable potential EE (GWh) and DR (MW) load reduction

Study Objectives

- Last Study: 2008
- Factors in expected system changes
- Will feed into next 5 year plan – to be completed in 2015



Study Methodology and Outputs



Level of Study Detail

- Sectors: **Residential, Commercial,** and **Industrial**
- Regions: **Newfoundland, Labrador,** and **Isolated Diesel**
- Base Year: calendar year **2014**
- Milestone Years: **2017, 2020, 2023, 2026** and **2029.**
- Subsectors
- End Uses
- Technologies

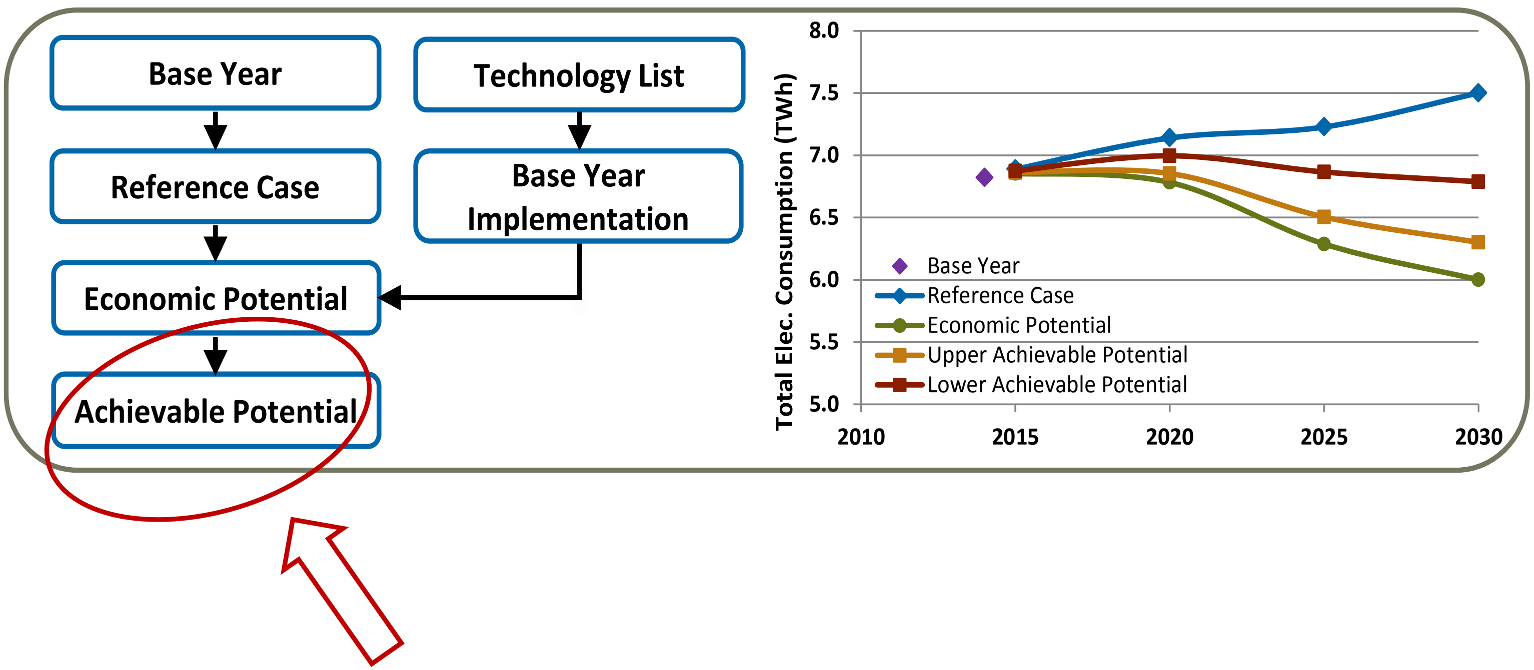
More on these later

What this Study is NOT

- It is not program design
- It is not setting DSM targets
- It is not an IRP

- It is designed to provide input to all those processes.

Today


Base Year
Reference Case
Economic Potential
Achievable Potential
Technology List
Base Year Implementation
Total Elec. Consumption (TWh)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
2010
2015
2020
2025
2030
Base Year
Reference Case
Economic Potential
Upper Achievable Potential
Lower Achievable Potential

Achievable Potential

Achievable Potential: *The achievable potential is the portion of the economic conservation potential that is achievable through utility interventions and programs given institutional, economic, and market barriers.*

- "Upper" = Very Best Possible Case
- "Lower" = Business as Usual

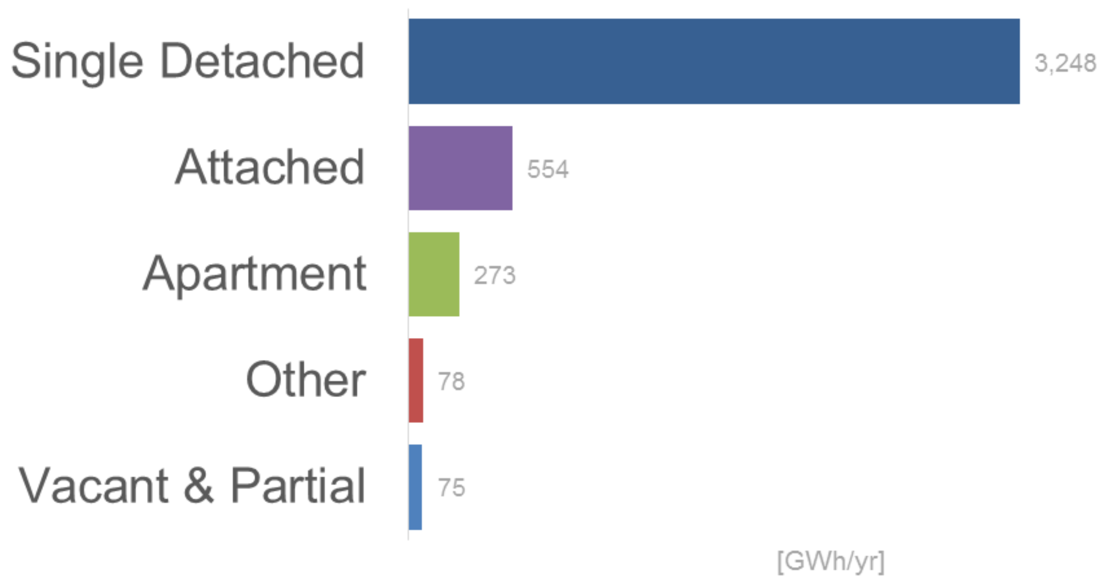
2

Overview of the Residential technology results to date

Segmentation

Region

Segmentation
Dwelling Type

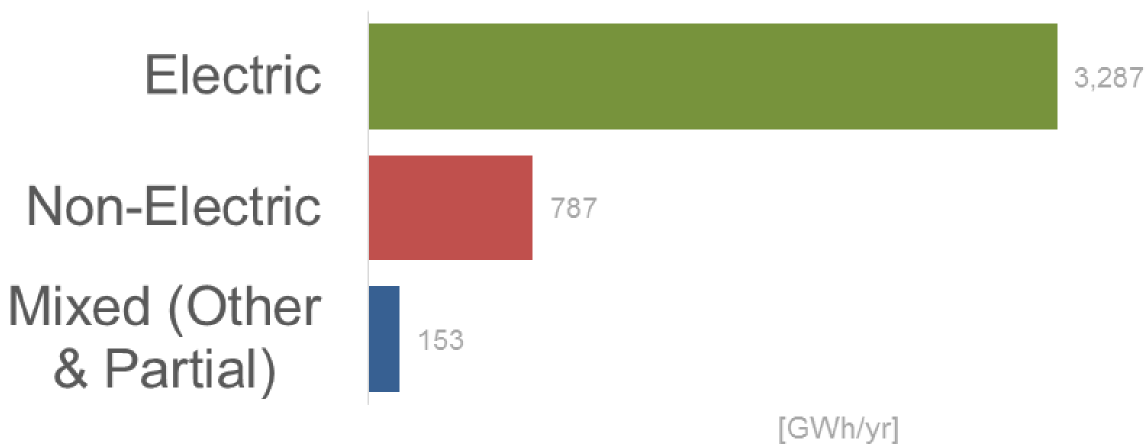


Segmentation

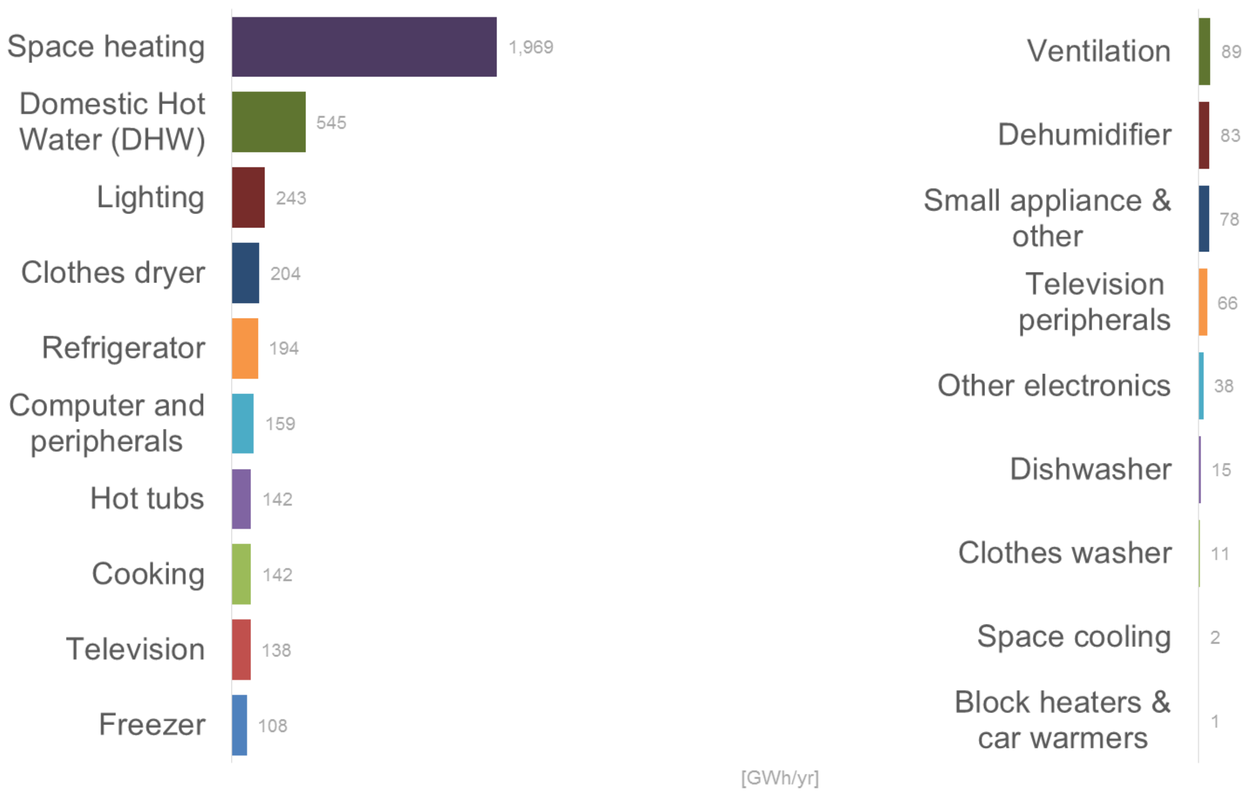
Vintage (2014)

Segmentation

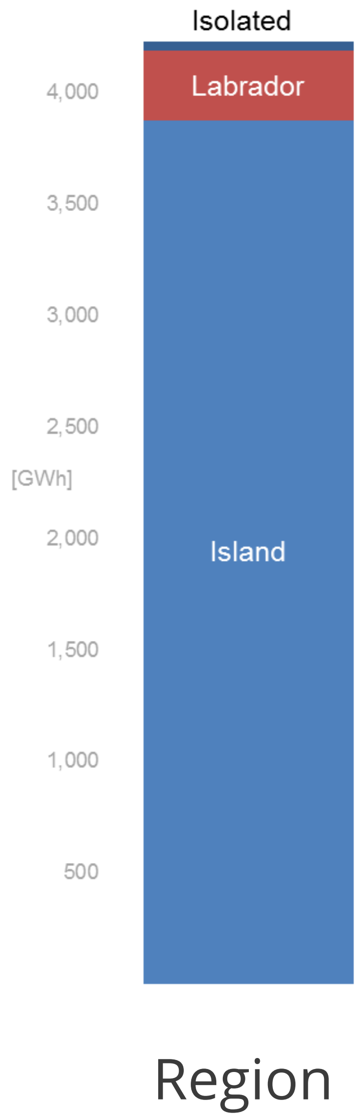
Primary Heating Type



End Uses

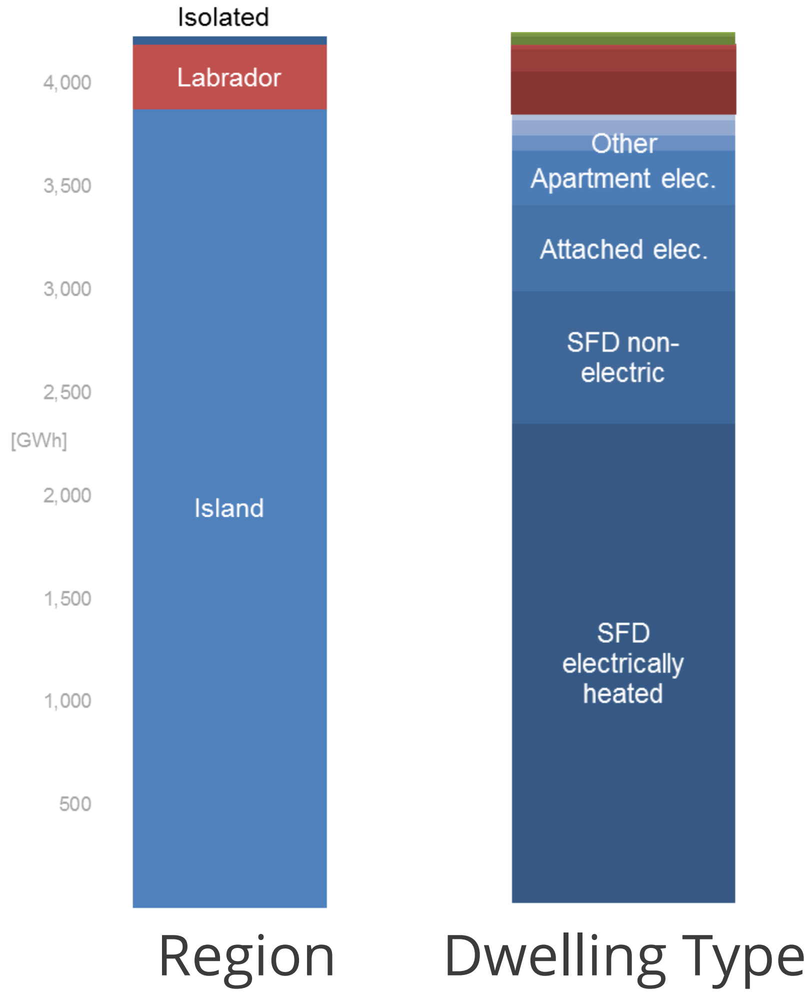

Space heating
1,969
Domestic Hot Water (DHW)
545
Lighting
243
Clothes dryer
204
Refrigerator
194
Computer and peripherals
159
Hot tubs
142
Cooking
142
Television
138
Freezer
108
Ventilation
89
Dehumidifier
83
Small appliance & other
78
Television peripherals
66
Other electronics
38
Dishwasher
15
Clothes washer
11
Space cooling
2
Block heaters & car warmers
1
[GWh/yr]

2014 Base Year

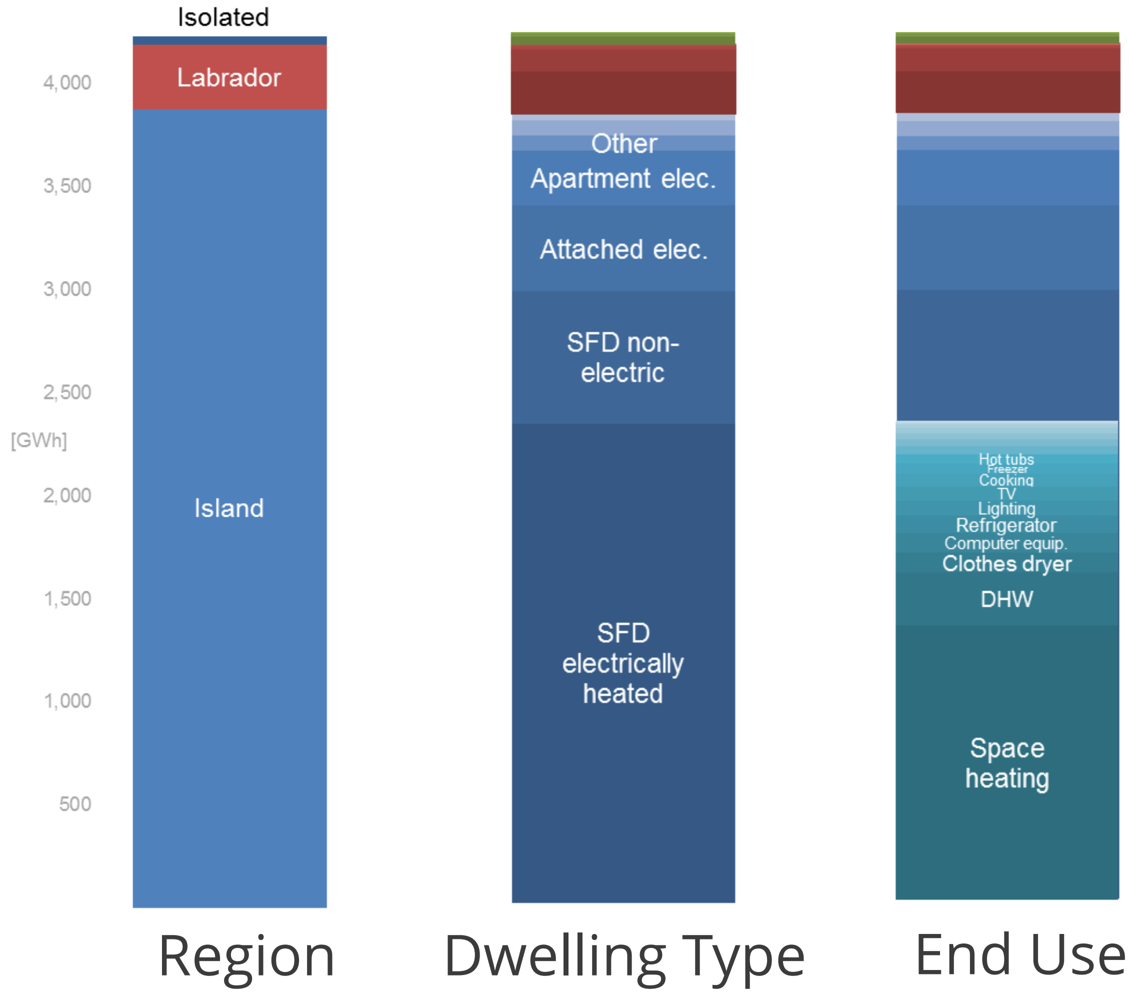


Total electricity sold to residential customers by region for 2014

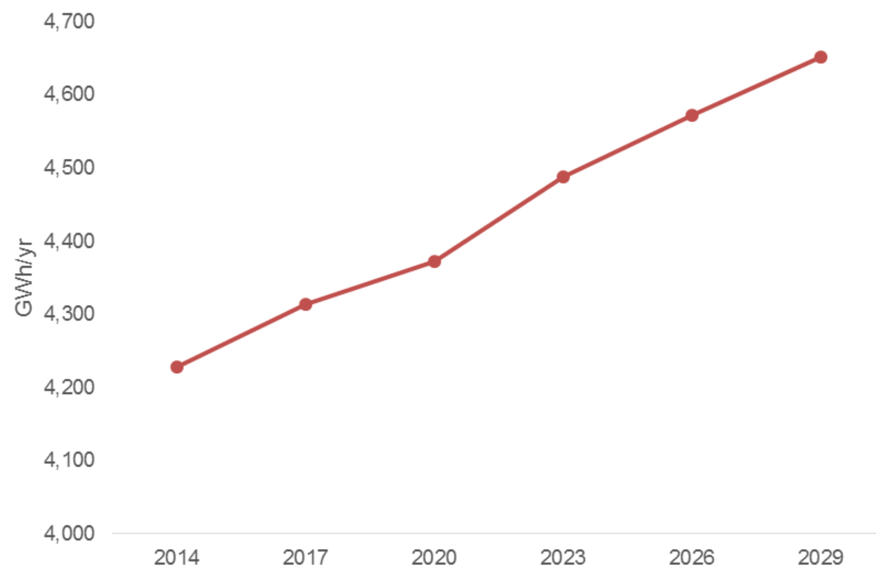
2014 Base Year



2014 Calibrated Base Year



Reference Case – The Foundation



- Growth forecasts for new construction (electrically heated and non-electrically heated) are applied out to the year 2029. This becomes the reference case.
- Efficiency measures can then be applied.

Screening the Technologies

- Compare cost of conserved electricity for over the energy efficiency technologies to economic thresholds of:

Year	Avoided Cost per kWh		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$0.108	$0.037	$0.21
2017	$0.125	$0.039	$0.23
2020	$0.050	$0.045	$0.26
2023	$0.059	$0.053	$0.29
2026	$0.068	$0.061	$0.34
2029	$0.076	$0.068	$0.37

Screening the Technologies

- Compare cost of electric peak reduction for the demand reduction technologies to economic thresholds of:

Year	Avoided Cost per kW		
	Island Interconnected	Labrador Interconnected	Isolated
2014	$50.911	$72.059	
2017	$65.116	$82.527	
2020	$101.821	$91.601	
2023	$115.126	$103.571	
2026	$124.930	$112.390	
2029	$124.907	$112.370	

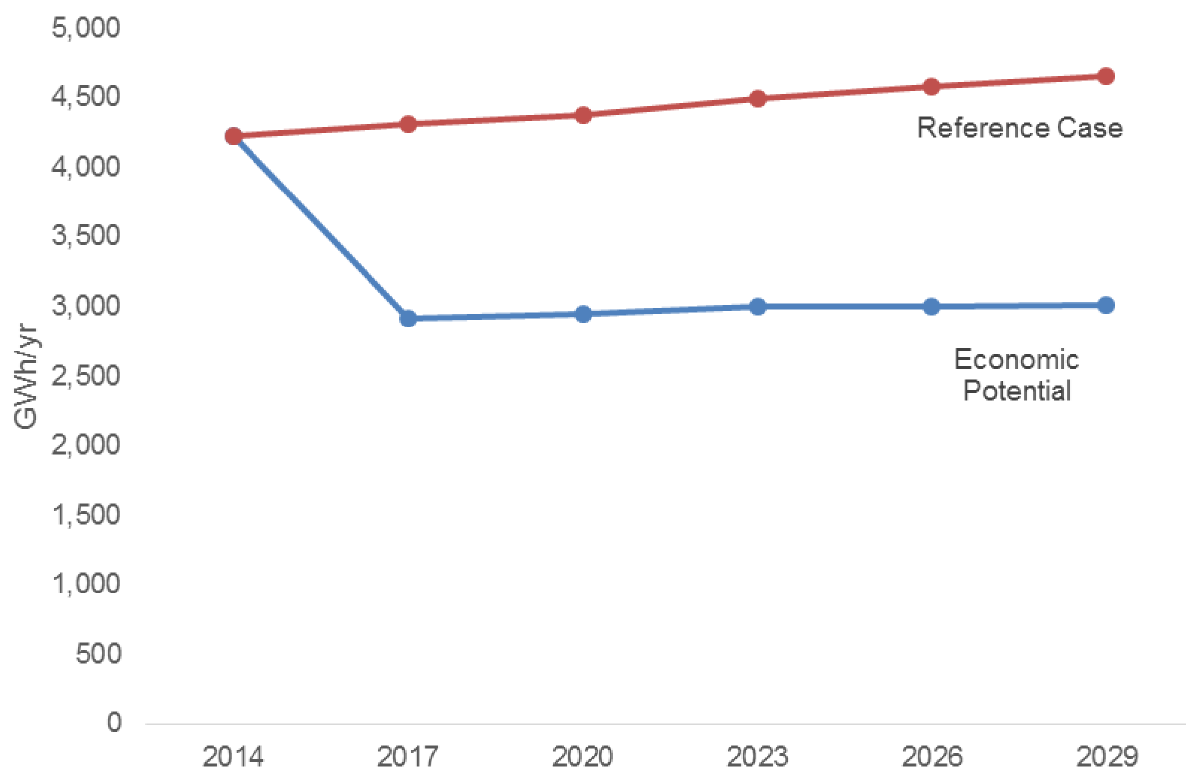
The Results – the Big Picture

- Nearly 70 out of 80 measures passed the screen in at least some dwelling types and regions
- Overall potential is 35% of projected 2029 consumption
- Interaction between internal electricity uses and the home heating system are high:
  - Reducing lighting by 100 kWh would increase electric heating by 60 kWh in the Island region, and by 70 kWh in the Labrador region
  - This makes measures that save internal electricity without reducing space heating less attractive economically
  - These measures also have no effect on peak demand in an electrically heated house, because their savings during the coldest hours of the year are offset by the baseboards working harder

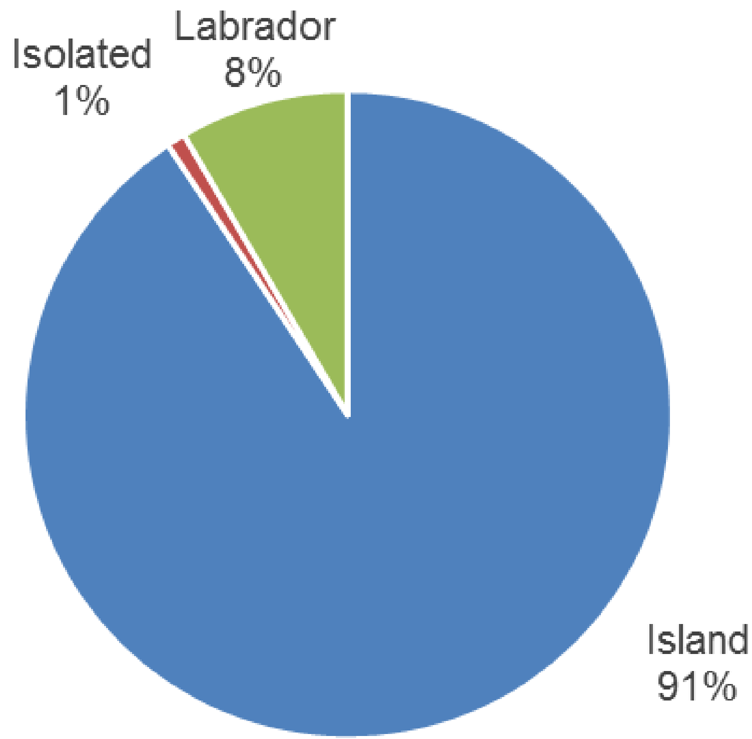
The Results – the Big Picture

- Most measures pass in Isolated, comparatively few in Labrador, and many drop out of contention in Island after the avoided costs decrease in 2018
- Heat pumps show considerable potential for energy savings (but no demand reductions)
- If the heating system is a heat pump, on average it becomes twice as efficient as electric resistance
  - 100 kWh lighting savings adds less than 40 kWh to heating
  - Lighting, appliance, and electronics paybacks would improve
- Changes expected in the NL electrical system: Muskrat Falls, Labrador-Island Link

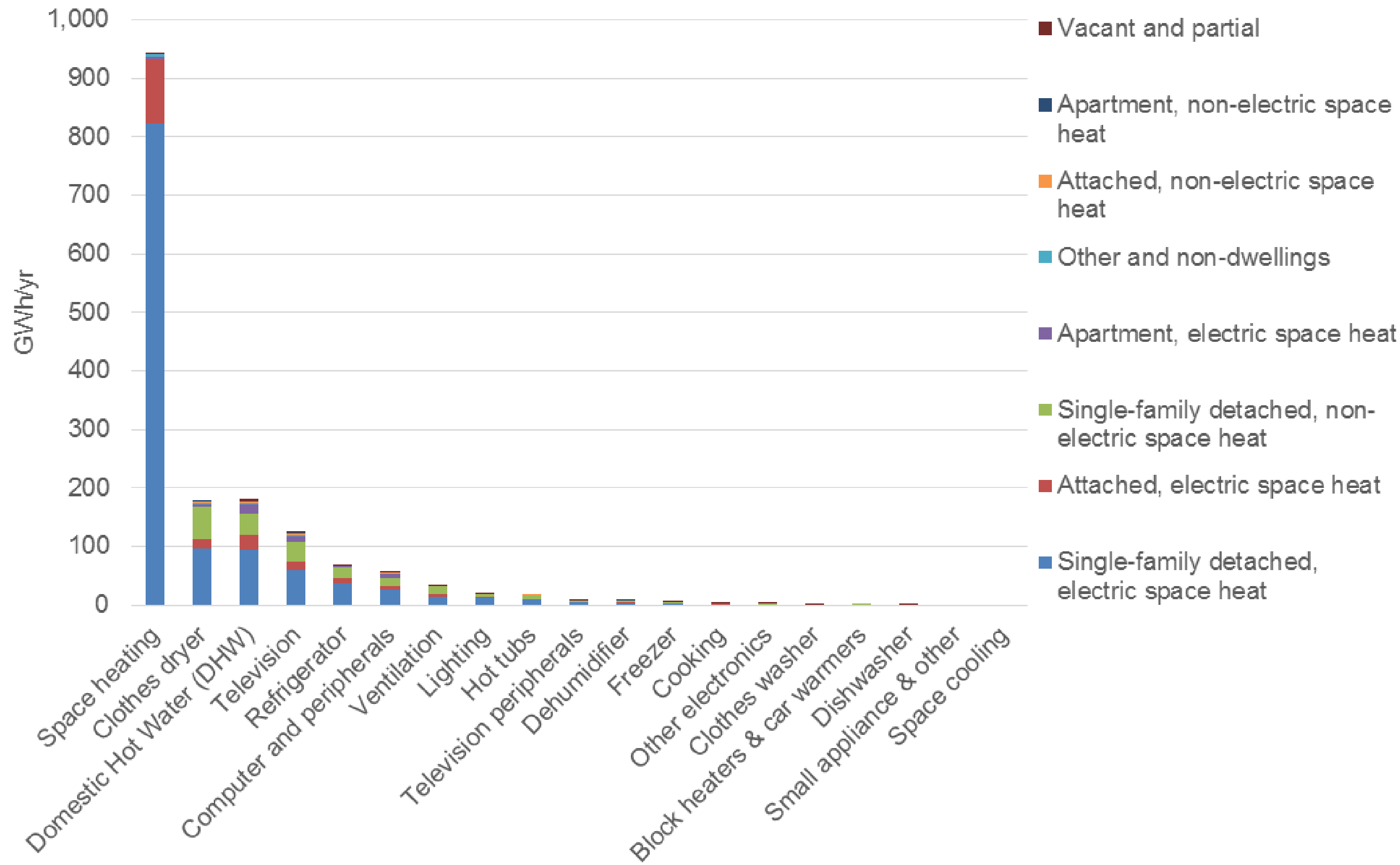
Overall results – 2 scenarios



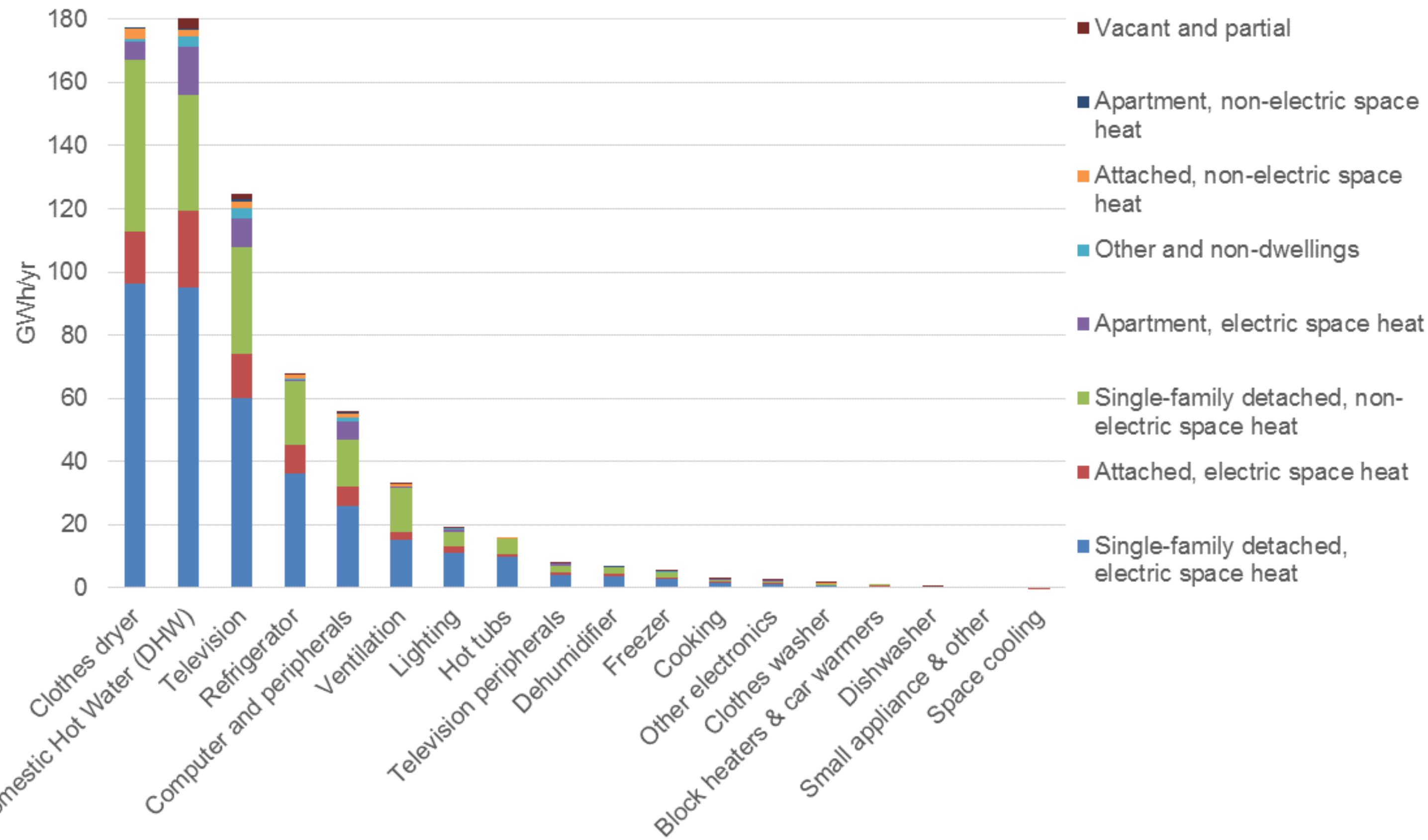
Overall Results-Distribution of Savings



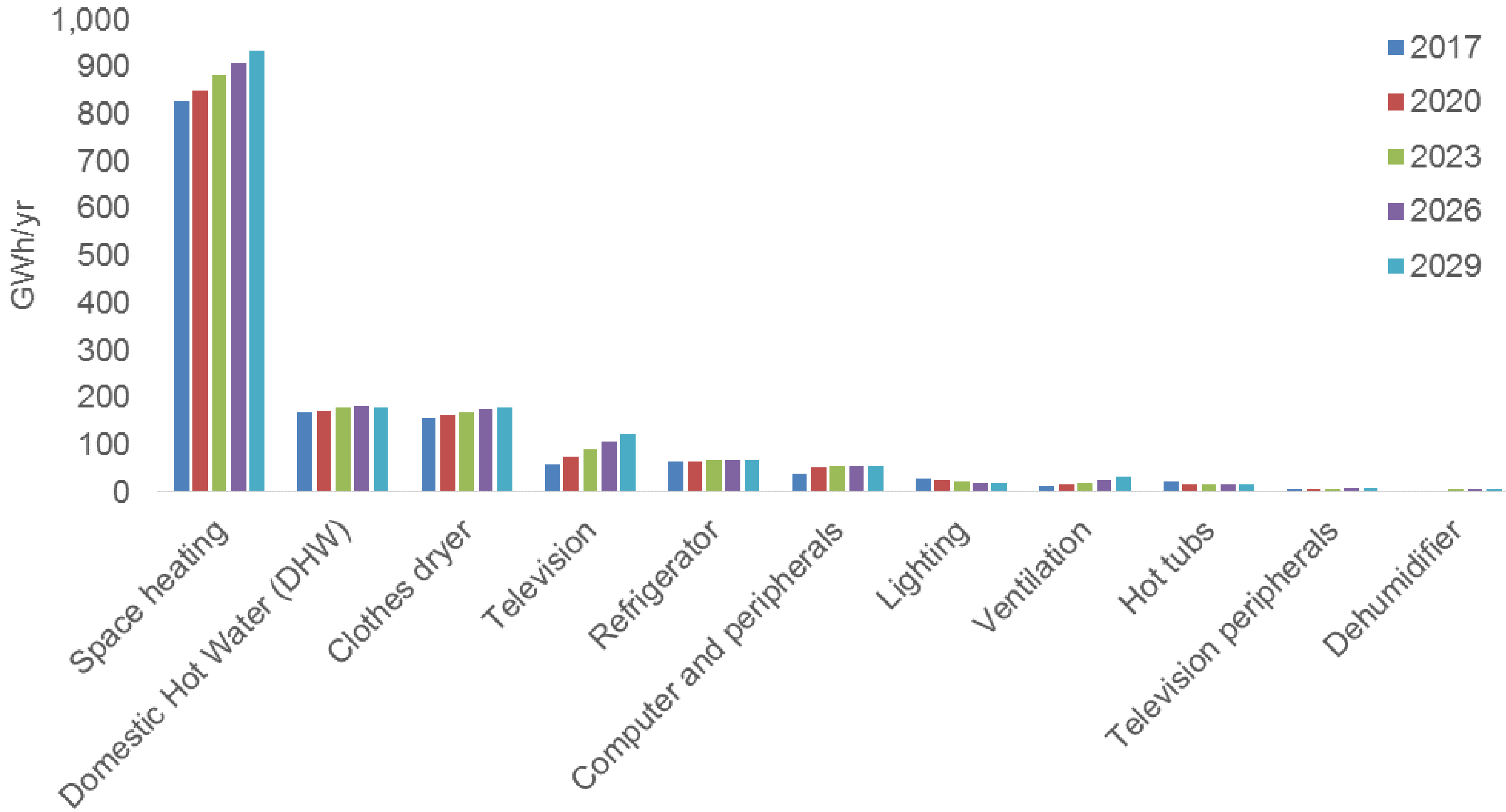
Results in 2029 – Economic Potential



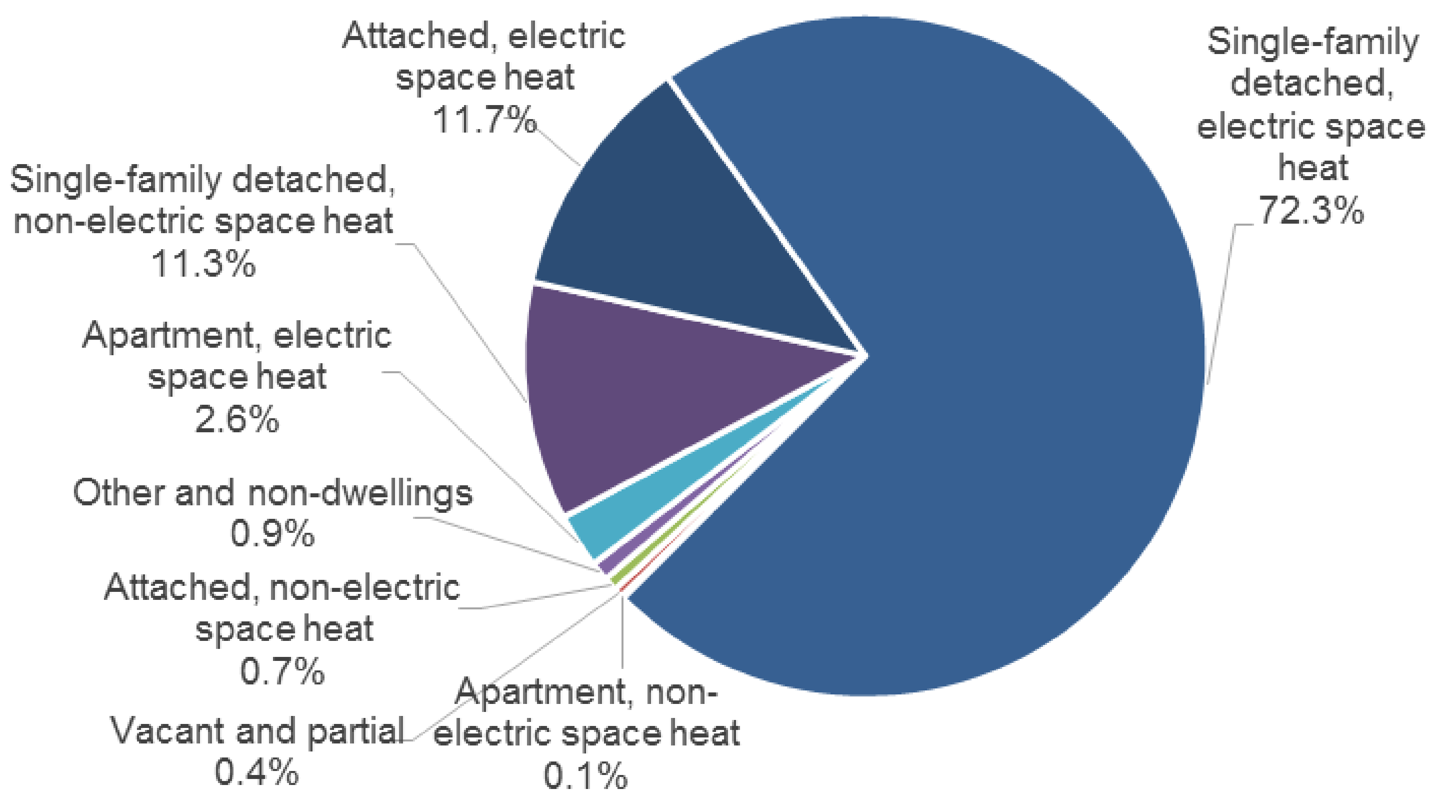
Results in 2029 – Economic Potential (Heating Removed)



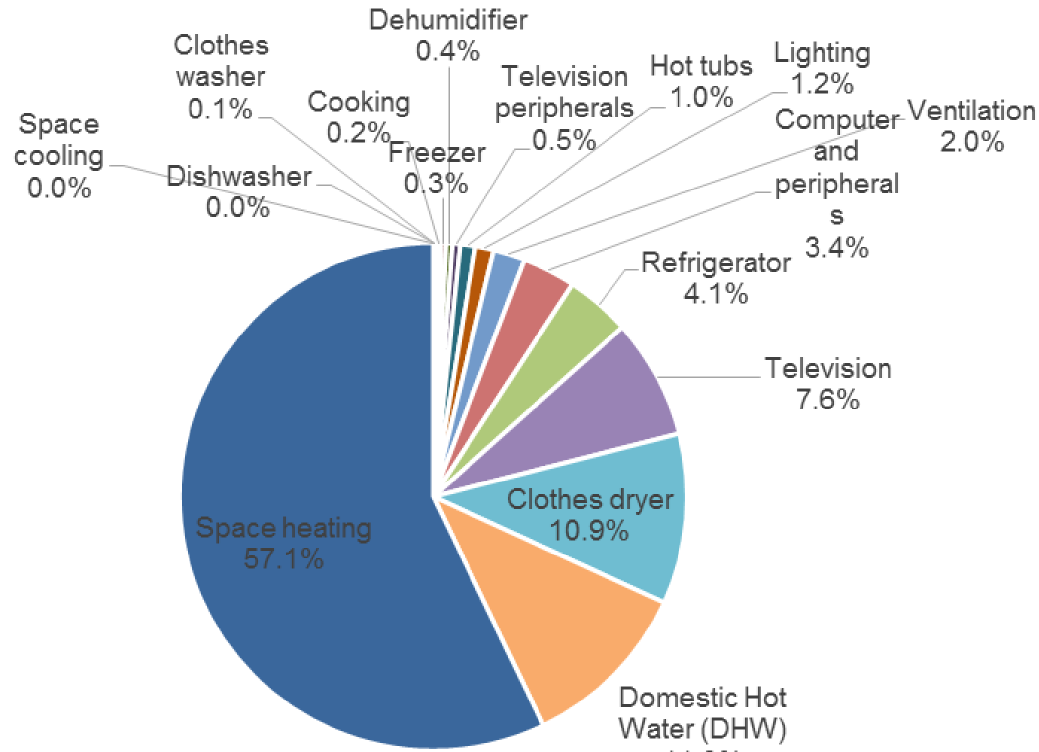
Economic Potential by End Use and Milestone Year



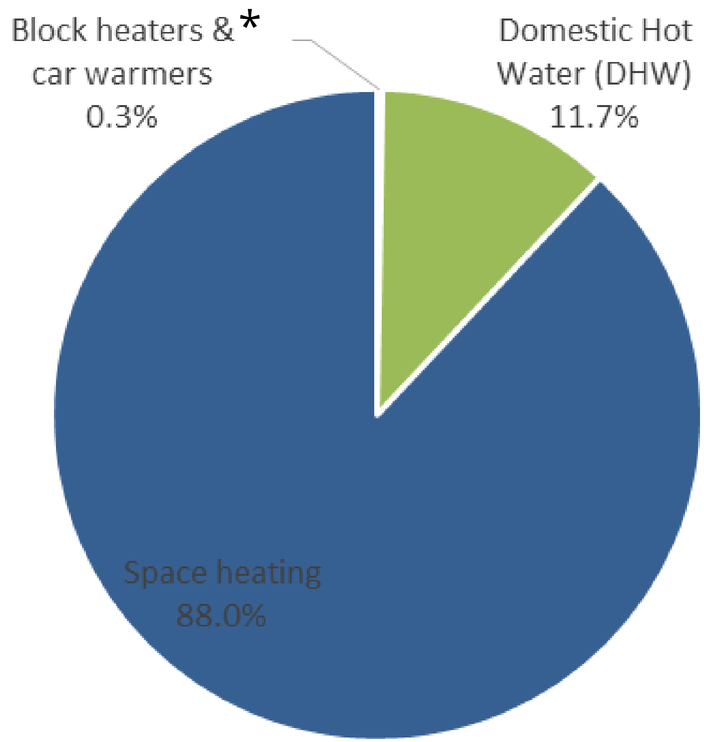
Economic Potential by Dwelling Type - 2029



Economic Potential by End Use - 2029

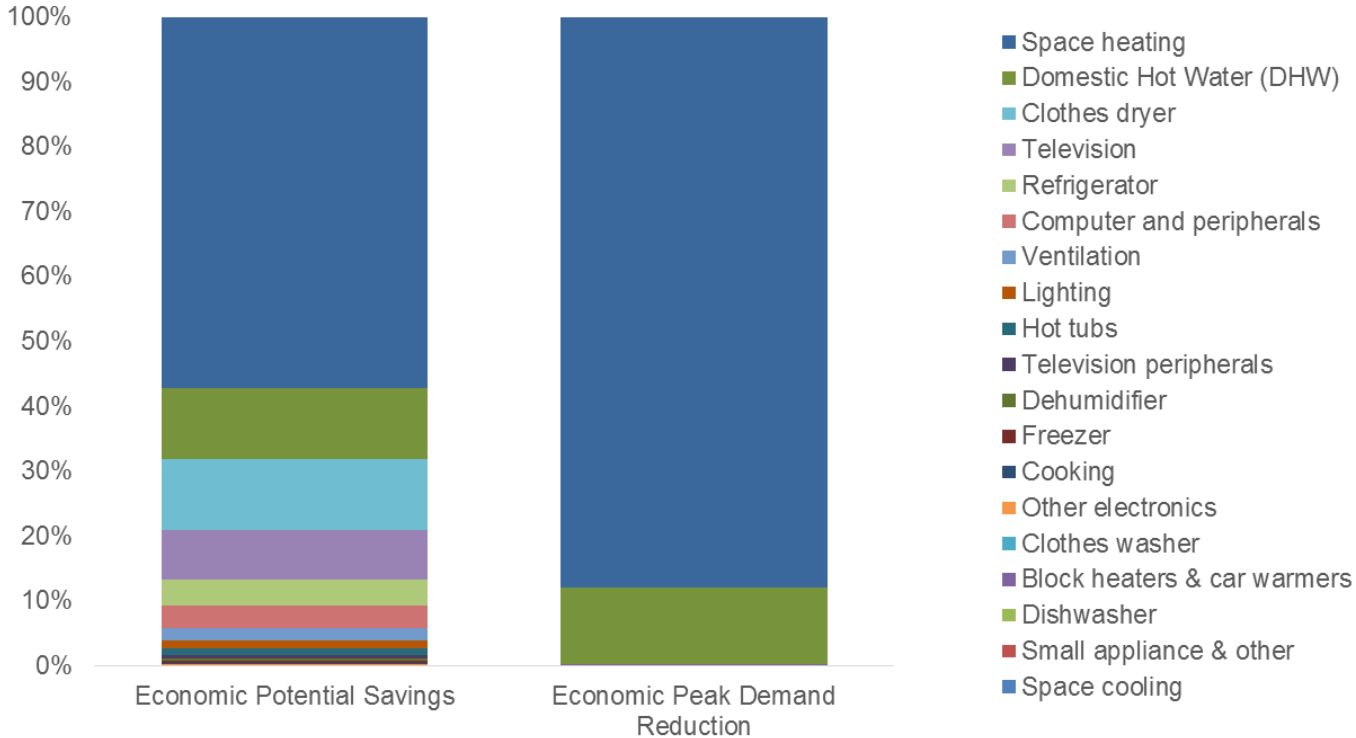


Peak Demand Reduction by End Use – 2029

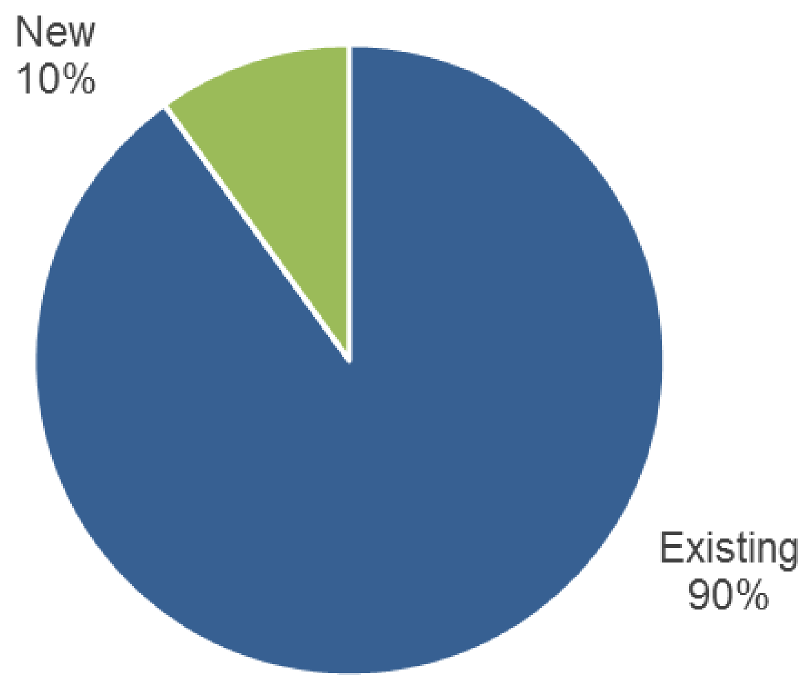


* Measure applies to Labrador only.

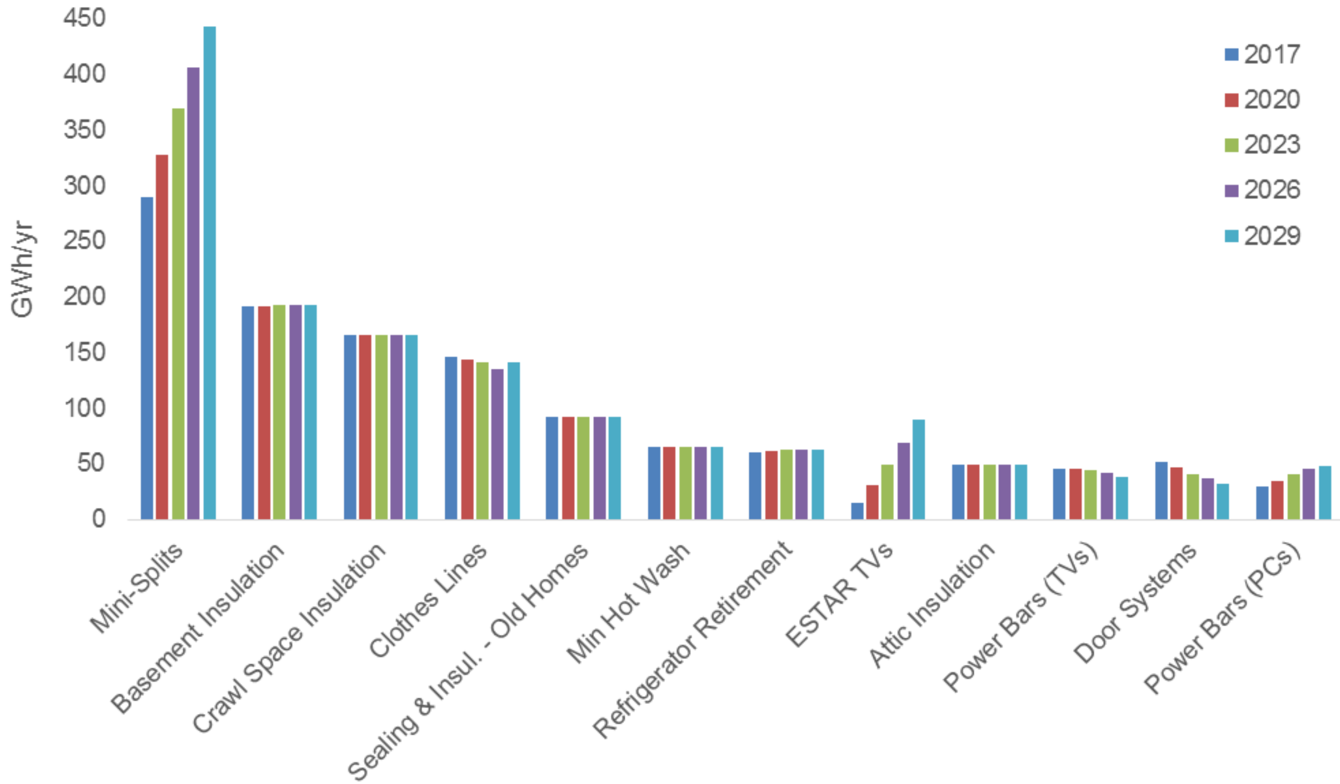
Comparison of Electric Energy & Peak Demand Savings



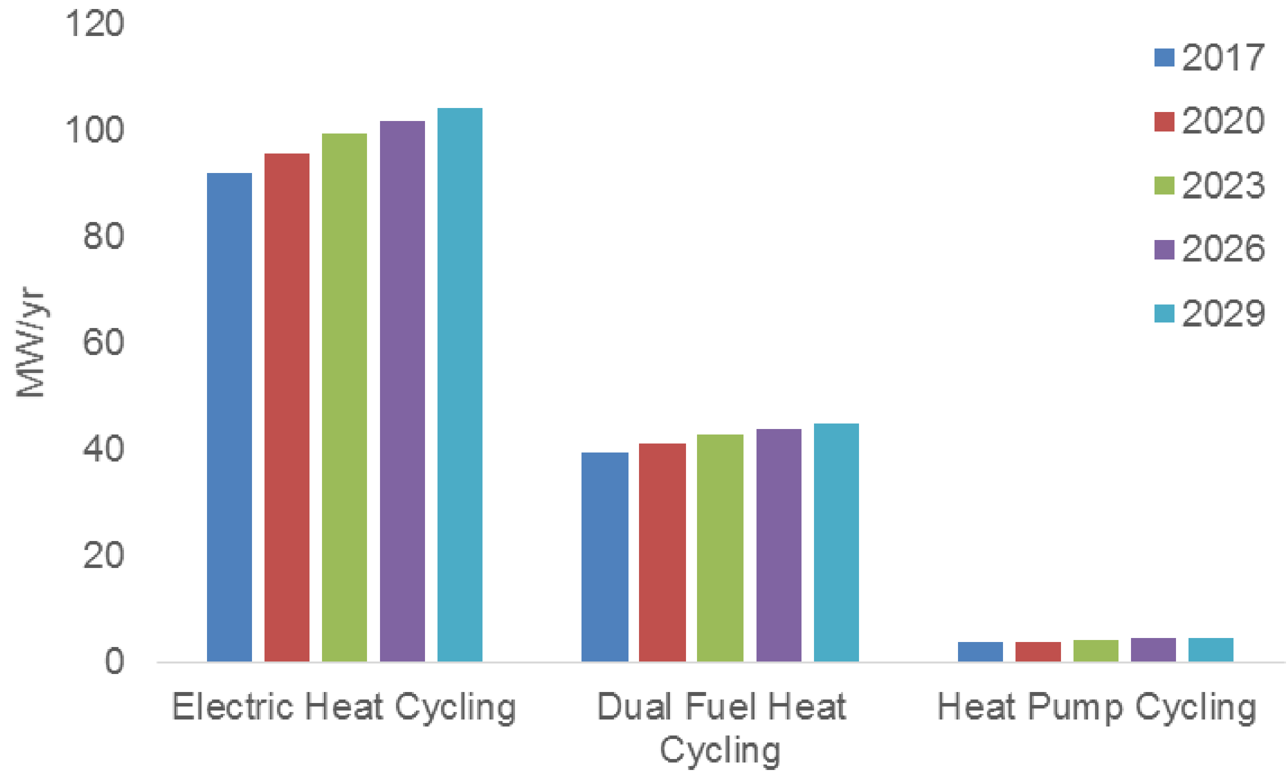
Economic Potential by Vintage - 2029



Economic Potential by Measure & Year



Peak Demand Reduction by Measure



3

Discussion of Residential Opportunities

Today's Discussion

High Level Market Characterization

- Barriers – Price, Availability, Awareness, Risk, etc
- Baseline – Affirmation of where we are starting from
- Market Structure – supply channels
- Main Actors – potential partners

High Level Strategy/ Program Design

- How do we make this opportunity happen?
- What would ideal strategy/program look like?
- Participation at the "upper" and "lower" levels?
- Applicability to other markets? Related technologies?

Today's Discussion

- Exchange of ideas and views
  - There are no wrong answers
  - Discussion is key!! Numbers will follow from it
- Today's Focus - selected opportunities
  - Subset of the opportunities identified in the study
  - Selected to cover a variety of different technologies and markets
  - Will extrapolate results to remaining sub-sectors and/or technologies

Choice of Measures to Discuss

- Represent a substantial portion of the economic potential
- Several different end uses
- Some for existing dwellings, some for new construction
- Different stages of market adoption
- **A set of conversations that are as different from each other as possible!**

Discussion Approach

- Proposed approach to each opportunity discussion
  - Introduction by ICF
  - Constraints, barriers & challenges
  - High level strategy
  - “Best Case” participation rates, 2029
  - “Lower Case” participation rates, 2029
  - Shape of adoption curve
  - Guidelines to consultants

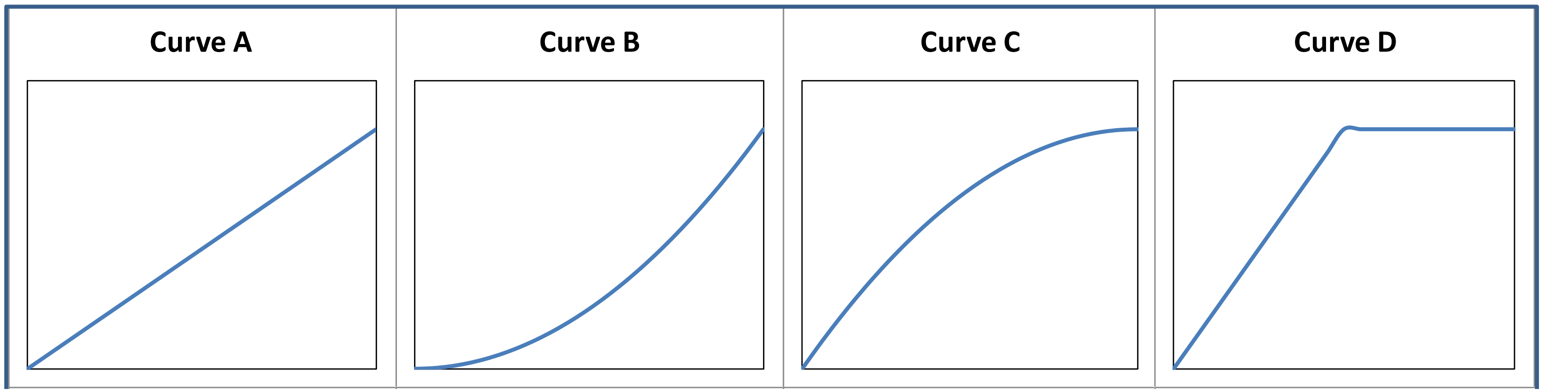
Achievable Potential - Definition

- The proportion of Economic Potential that can be realistically achieved
  - Includes consideration of customer perspective & market barriers
  - Recognizes that CDM programs can address some, but not all, market barriers
- Expressed as a range
  - Reflects the uncertainties of any forecast
  - Acknowledges that there are different levels of potential CDM program intervention
  - Recognizes that there are external factors that influence customer decisions

Achievable Potential – 2 Scenarios

- "Upper" = Very Best Possible Case
  - Theoretically = Economic potential minus "can't" or "won't" portion of market
  - Aggressive CDM program approach implied
  - Highly supportive context e.g. healthy economy, high level of public emphasis on climate change mitigation etc.
- "Lower" = Business as Usual
  - CDM program support is similar to, or modest increase over past years
  - Market interest/commitment to energy efficiency and environment remains approximately as current
  - Federal and provincial gov't EE and GHG efforts as current

Adoption Curves

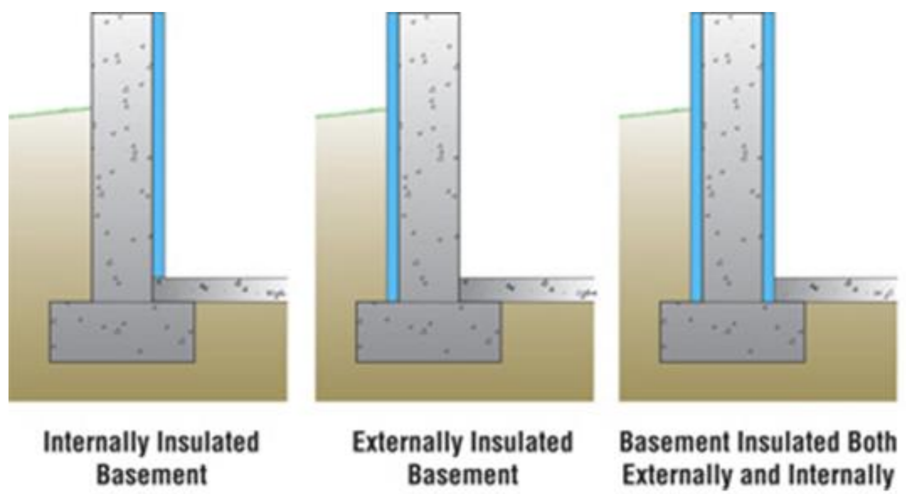


Opportunities for Today's Workshop

	Primary End Use	Percent of 2029 Economic Potential Savings
Basement Insulation	Space Heating	12%
Ductless Mini-Split Heat Pumps	Space Heating	27%
High-Performance New Construction	Space Heating	0.03%
Heat Cycling	Space Heating - Demand	88%
Electric Thermal Storgage	Space Heating - Demand	0%
Air Sealing	Space Heating	1.1%
Low-Flow Water Fixtures	Domestic Hot Water	4%
Behavioral Measures (Top 3)	Clothes Dryers	16%

Residential Opportunity 1:
Basement Insulation

Increasing the basement foundation wall insulation of existing homes to **R-18**.

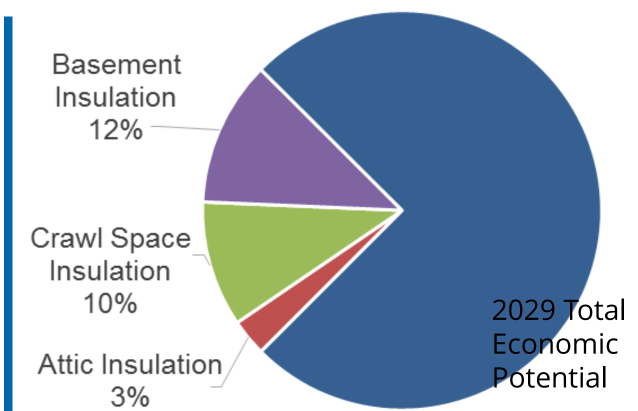


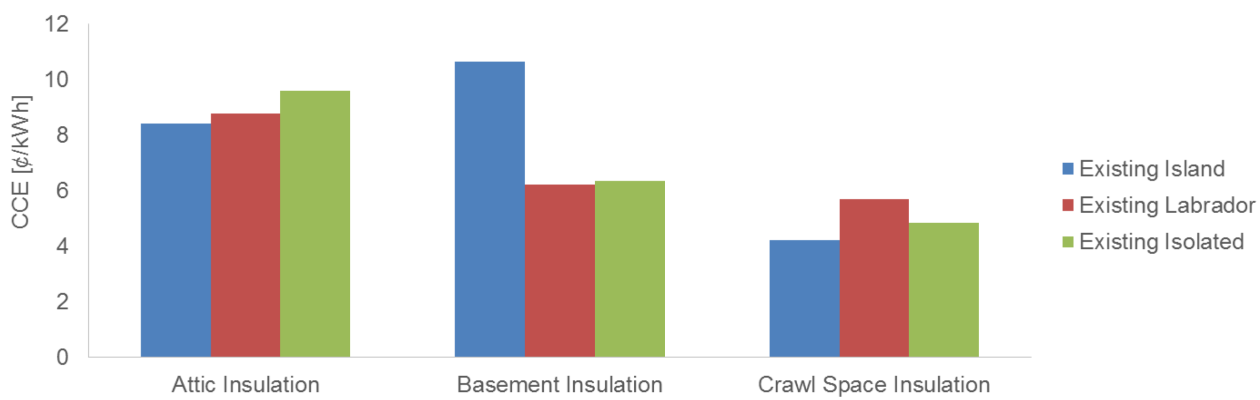
Residential Opportunity 1:

Basement Insulation

Comparison with Other Insulation Measures

	2029 Economic Potential Savings [GWh]	Passes Economic Test in Regions
Wall Insulation	0	None
Attic Insulation	49	All
Basement Insulation	193	All
Crawl Space Insulation	166	All





Residential Opportunity 1:

Basement Insulation

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost	$ 2,300
Basis	Full
Useful life	length of study
Savings:	
Space heating	25%
Space cooling	small increase in usage
Ventilation	8%

Residential Opportunity 1:

Basement Insulation

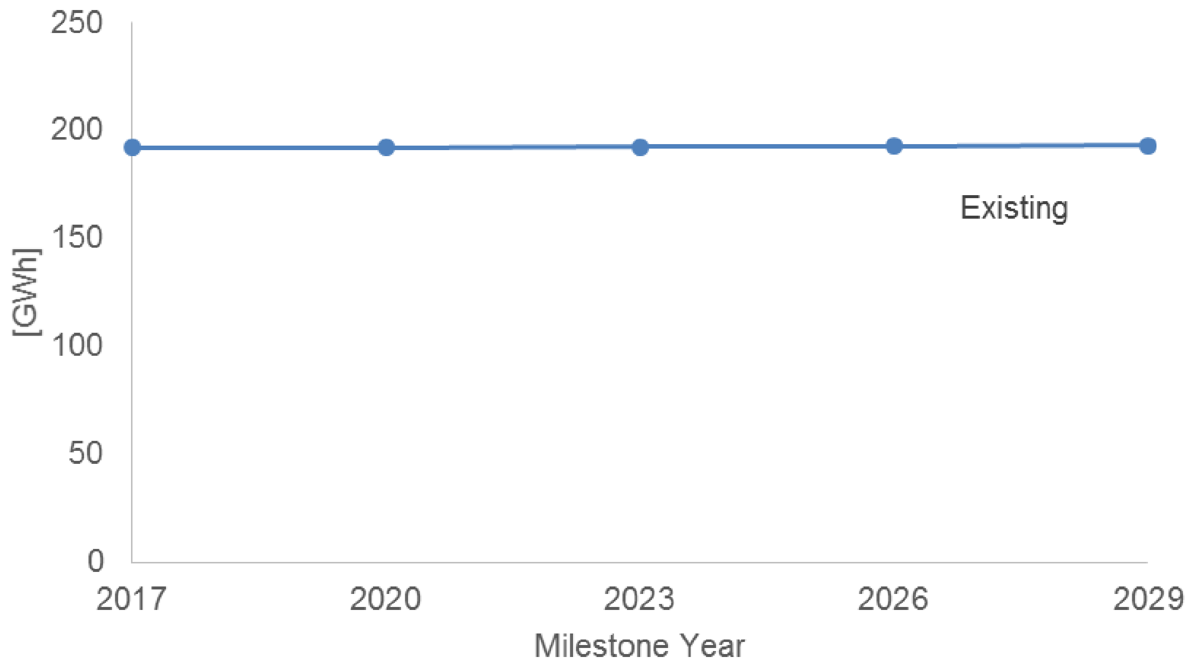
Economic Indicators

Simple Payback (SFD - Island)	5.7 years
Average CCE (¢/kWh):	
Island	11.5
Labrador	6.2
Isolated	10.1
Basis	Full cost
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	102,000
Principal region	Island Interconnected

Residential Opportunity 1:

Basement Insulation

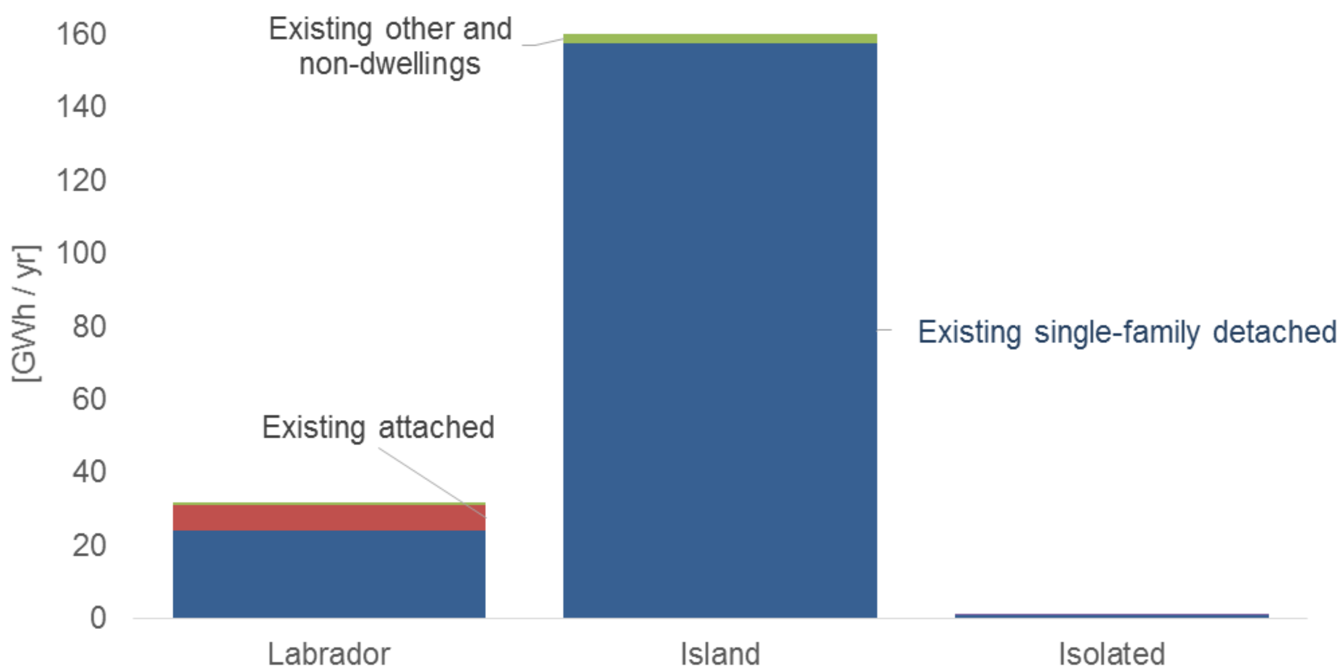
Growth of Economic Potential



Residential Opportunity 1:

Basement Insulation

2029 Economic Potential Breakdown



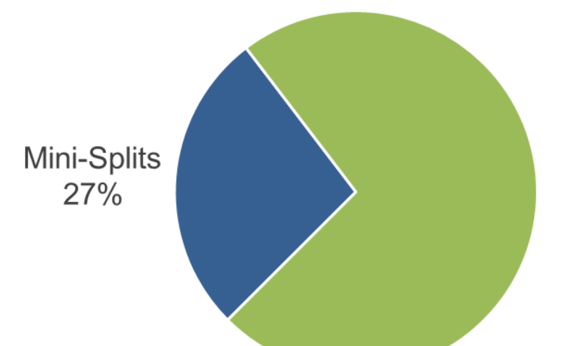
Residential Opportunity 2:

Ductless Mini-Split Systems

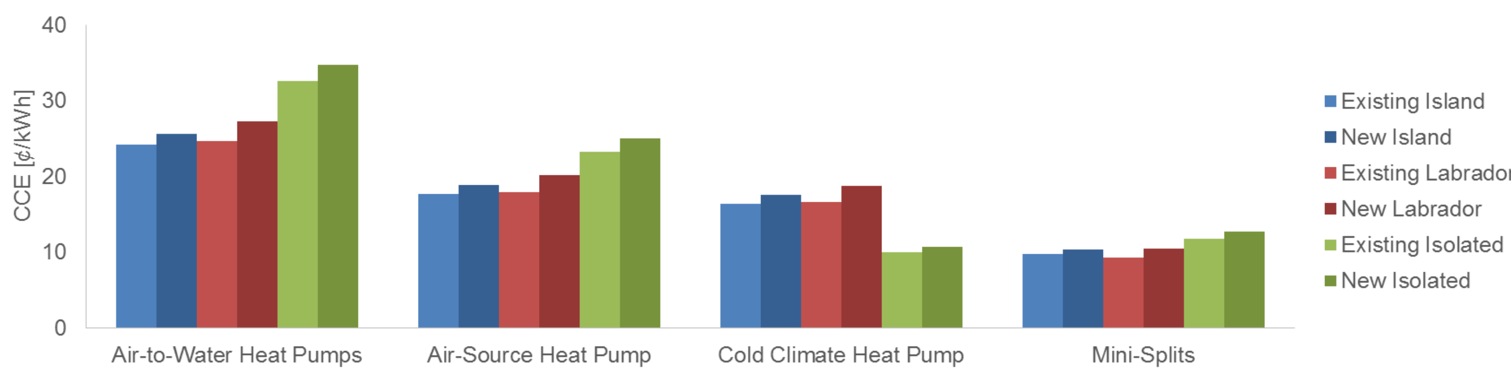
Upgrading a dwelling heated with **electric baseboards** to one with a **ductless mini-split heat pump system** that supplies heat to the most-used portion of the house (about 60% of the total floor area)

Residential Opportunity 2:
Ductless Mini-Split Systems
Comparison with Other Heating Measures

	2029 Economic Potential Savings [GWh]	Passes Economic Test in Regions
Air-to-Water Heat Pumps	0	None
Air-Source Heat Pump	0.178	Isolated only
Cold Climate Heat Pump	0.072	Isolated only
Mini-Splits	444	All



2029 Total Economic Potential



Residential Opportunity 2:

Ductless Mini-Split Systems

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost	$ 3,500
Basis	Full
Useful life	15 years
Savings:	
Space heating	35%
Space cooling	small increase in usage

Residential Opportunity 2:

Ductless Mini-Split Systems

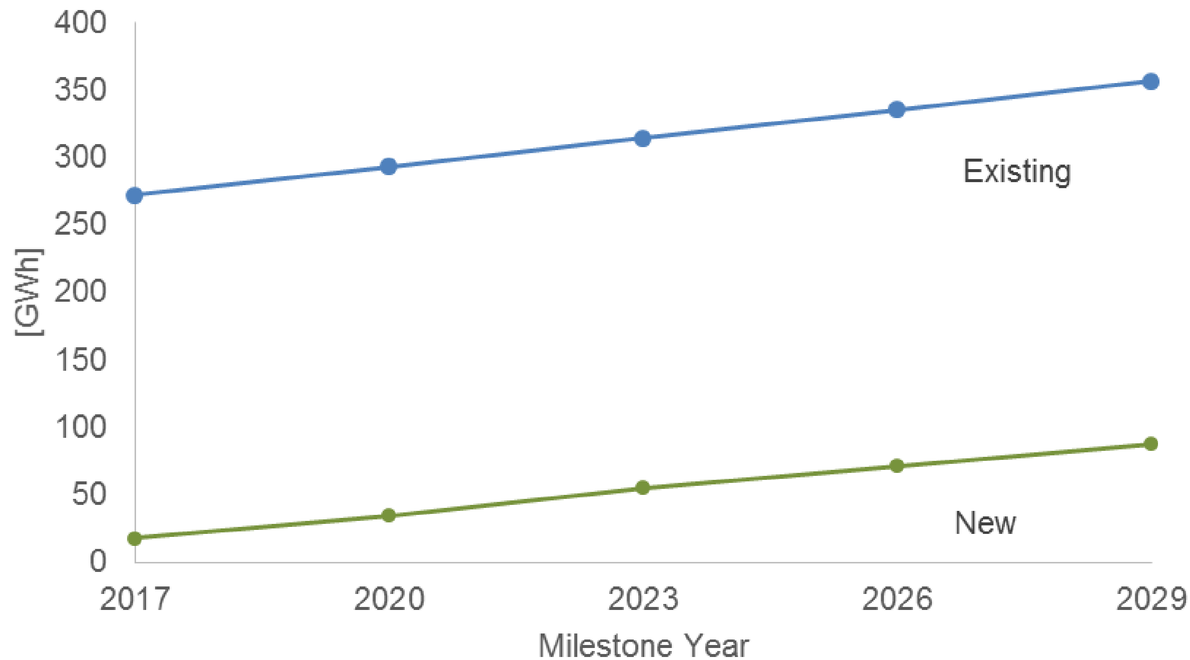
Economic Indicators

Simple Payback (SFD - Island)	6.4 years
Average CCE (¢/kWh):	
Island	9.8
Labrador	9.3
Isolated	11.8
Basis	Full cost*
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	130,000
Region	Island Interconnected
	* Labrador is incremental.

Residential Opportunity 2:

Ductless Mini-Split Systems

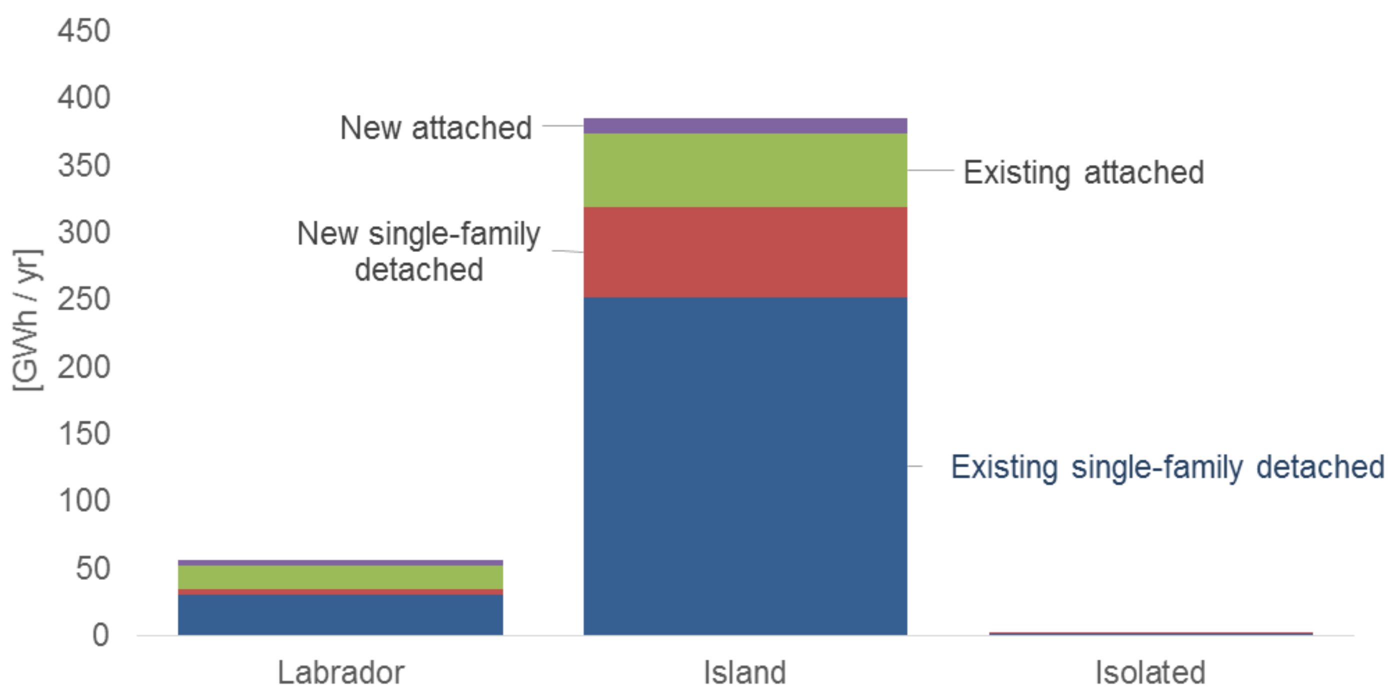
Growth of Economic Potential



Residential Opportunity 2:

Ductless Mini-Split Systems

2029 Economic Potential Breakdown



Residential Opportunity 3:

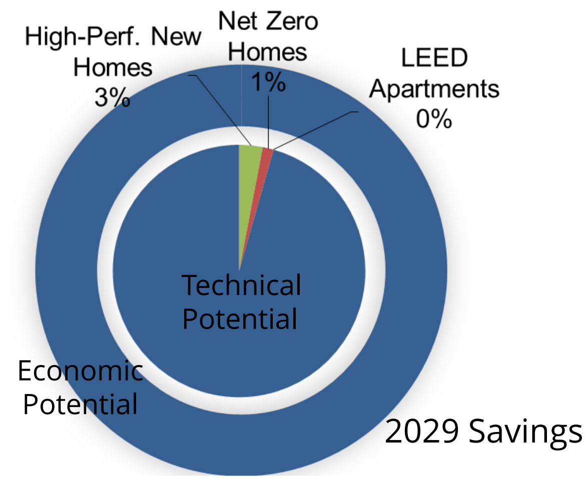
High-Performance New Construction

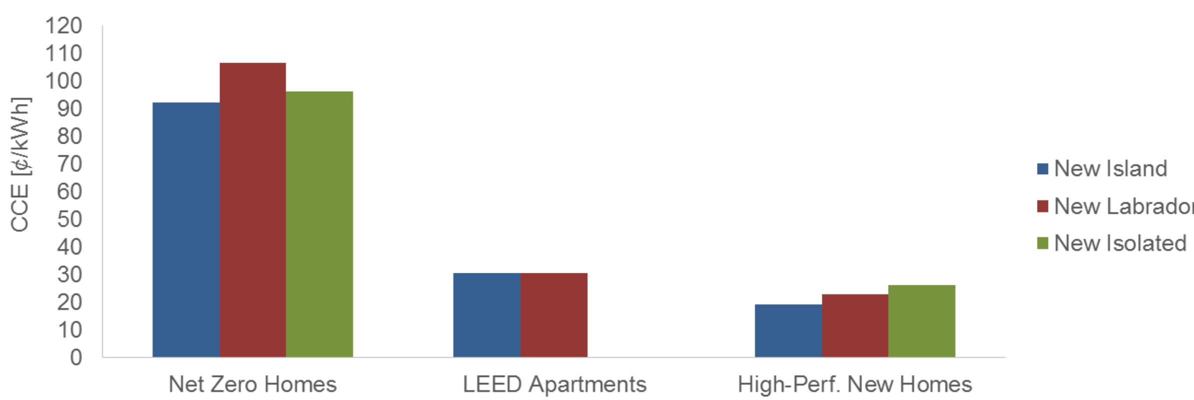
Building a new home to **EnerGuide for Houses (EGH) rating of 80**.

Measure includes **Energy Star**® and **R2000**, which requires a minimum air tightness level of 1.5 ACH@50Pa and installation of a heat recovery ventilator.

Residential Opportunity 3:
High-Performance New Construction
Comparison with Other New Construction Measures

	2029 Technical Potential Savings [MW]	2029 Economic Potential Savings [MW]	Passes Economic Test in Regions
Net Zero Homes	22797	0	None
LEED Apartments	3241	0	None
High-Perf. New Homes	49237	565	Isolated only





Residential Opportunity 3:

High-Performance New Construction

Assumptions

Focus Dwelling Type	Detached
Focus Region	Isolated (Diesel)
Typical Application:	
Cost	$ 5,800
Useful life	[length of study]
Savings:	
HVAC, lighting and DHW	17%

Residential Opportunity 3:

High-Performance New Construction

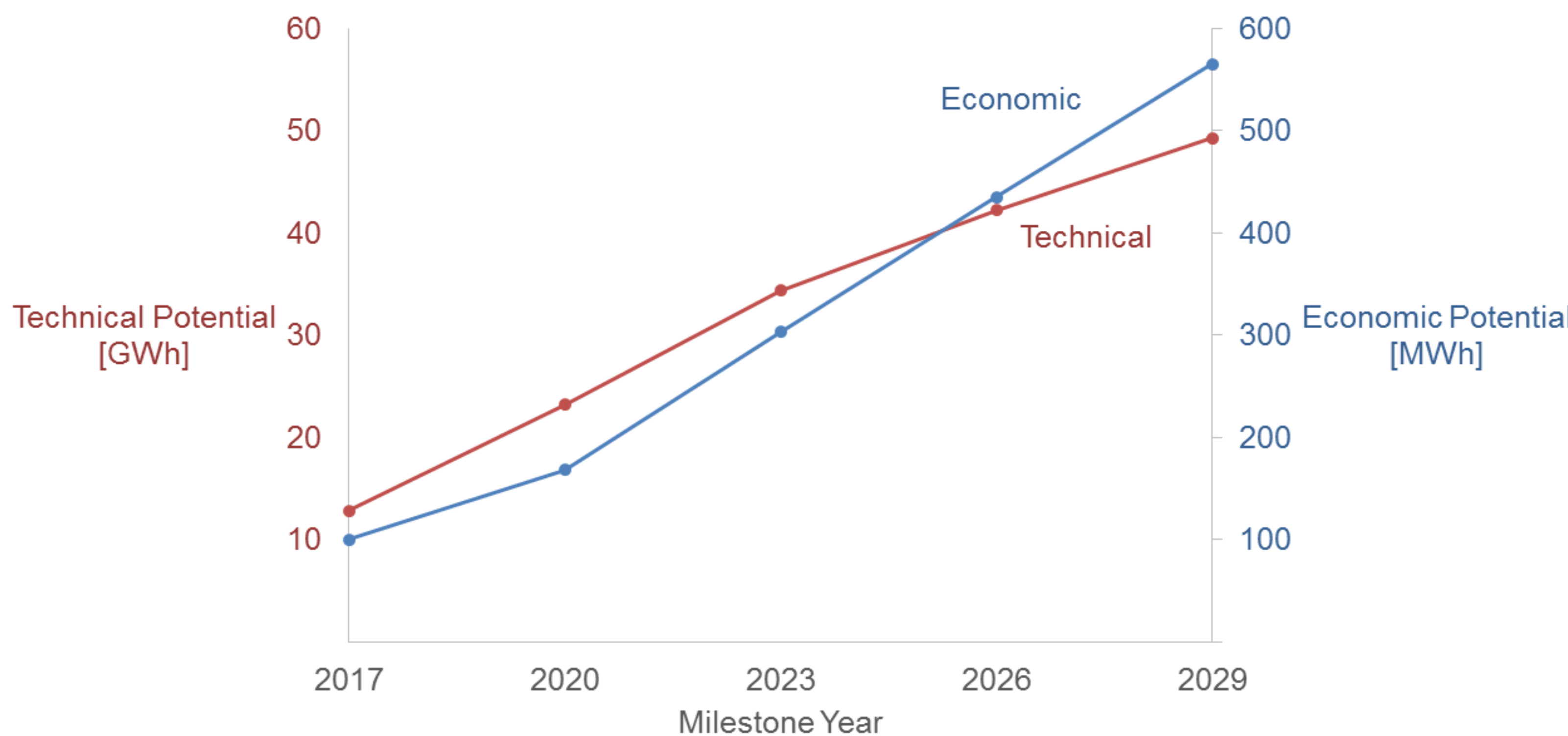
Economic Indicators

Simple Payback (SFD - Island)	17.2 years
Average CCE (¢/kWh):	
Island	24.0
Labrador	22.8
Isolated	46.0
Basis	Full cost
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	547
Principal region	Isolated (Diesel)

Residential Opportunity 3:

High-Performance New Construction

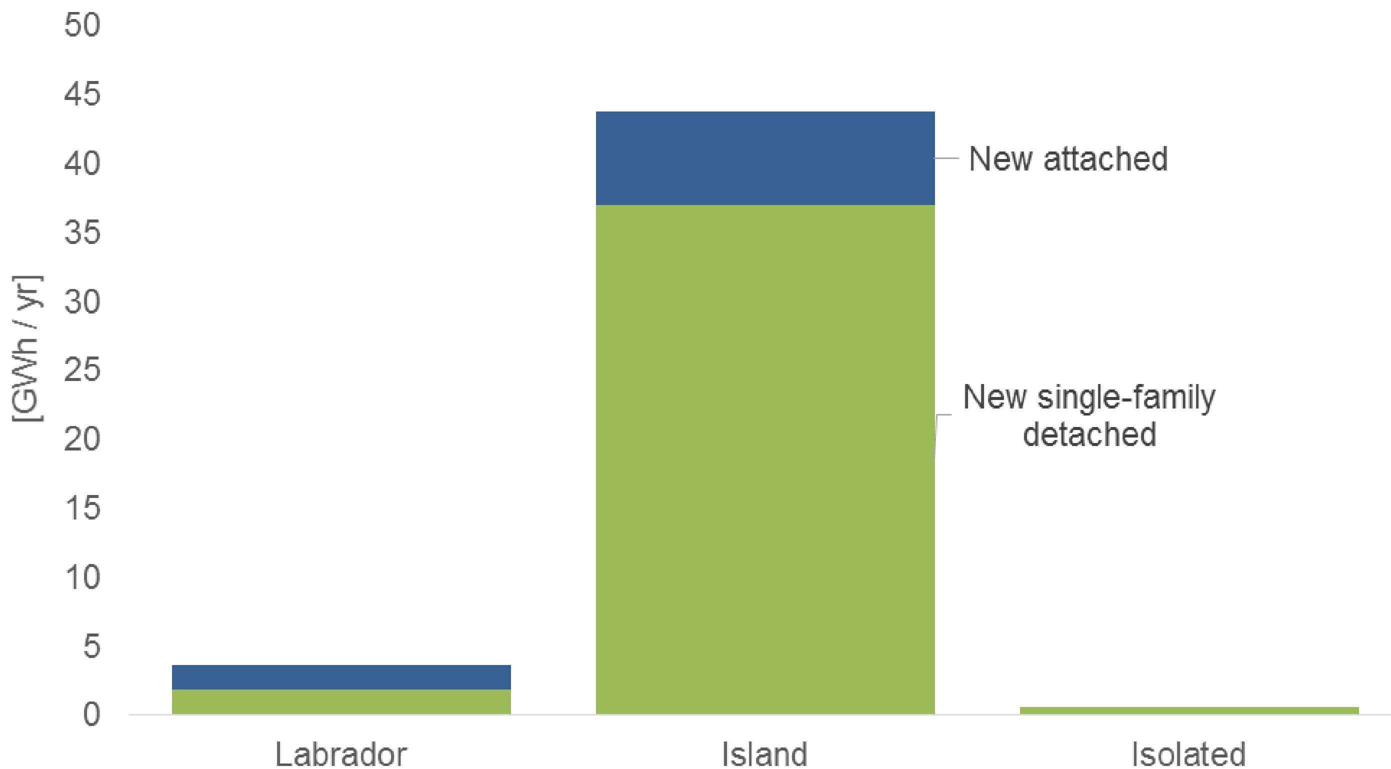
Growth of Technical and
Economic (Isolated only) Potential Savings



Residential Opportunity 3:

High-Performance New Construction

2029 Technical Potential Breakdown



Residential Opportunity 4:

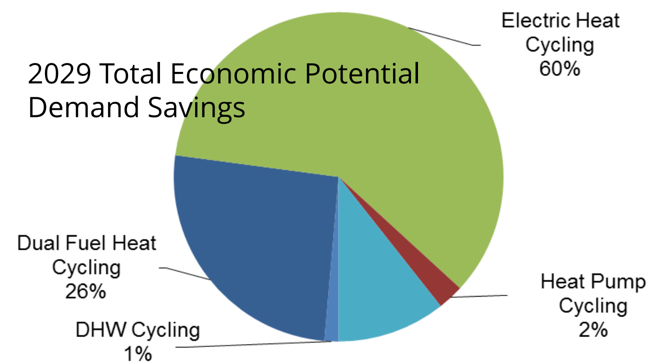
Heat Cycling

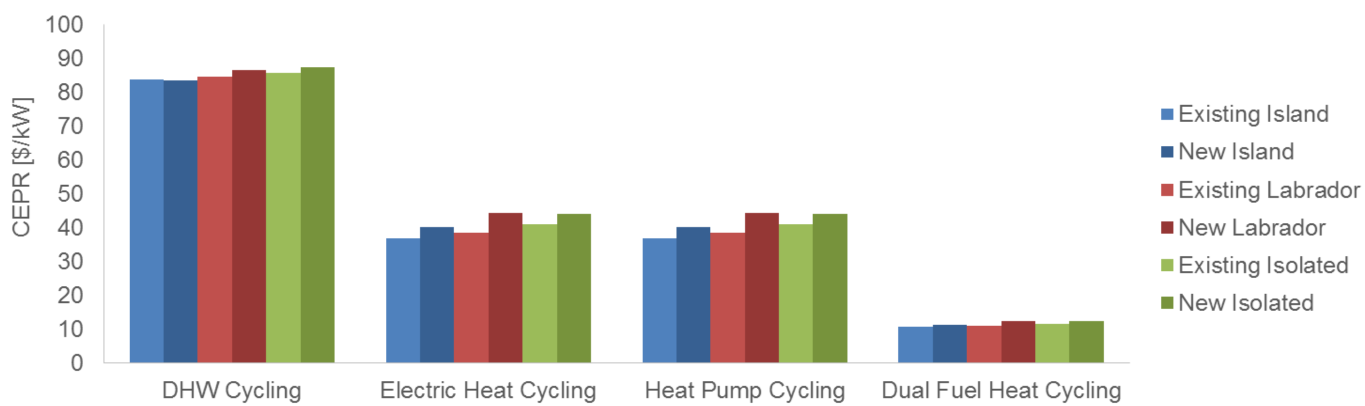
Adding a load management device on an electric baseboard, furnace or heat pump to **cycle the heater on and off** during times of peak demand. Homes have a secondary heat source for "Dual Fuel" cycling.

Residential Opportunity 4:
Heat Cycling
Comparison with Other Cycling Demand Measures

* Assumptions for DHW cycling measure have been updated since the workshop. Originally presented numbers are shown here.

	2029 Economic Potential Savings [MW]	Passes Economic Test in Regions
DHW Cycling	2.4	Isolated and Labrador
Electric Heat Cycling	104	All
Heat Pump Cycling	4.4	All
Dual Fuel Heat Cycling	45	All





Residential Opportunity 4:

Heat Cycling

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost	$ 200
Useful life	10 years
Savings: Heating	(tiers are program choice)
Duel Fuel	90%
Electric Heat	25%
Heat Pump	25%

Residential Opportunity 4:

Heat Cycling

Economic Indicators

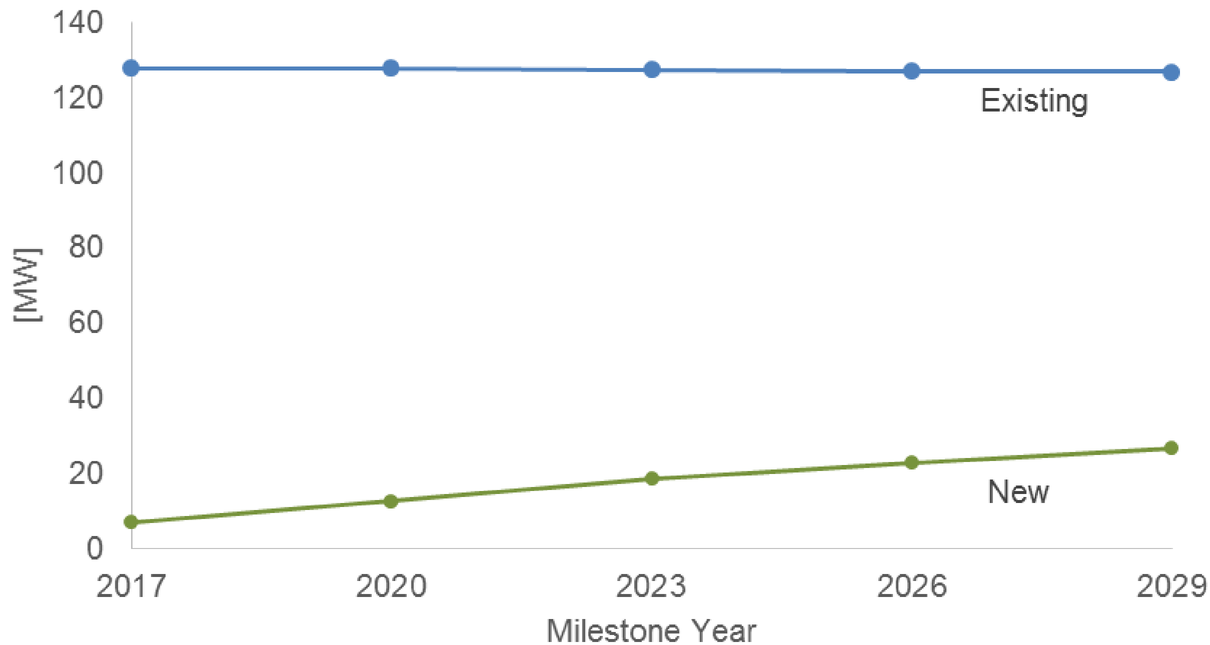
Simple Payback (SFD - Island)	N/A
Average CEPR ($/kW):	
Island	$ 43
Labrador	$ 39
Isolated	$ 72
Basis	Full cost
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029*	188,000
Principal region	Island Interconnected

* all heat cycling measures

Residential Opportunity 4:

Heat Cycling

Growth of Economic Potential Savings



Residential Opportunity 4:

Heat Cycling

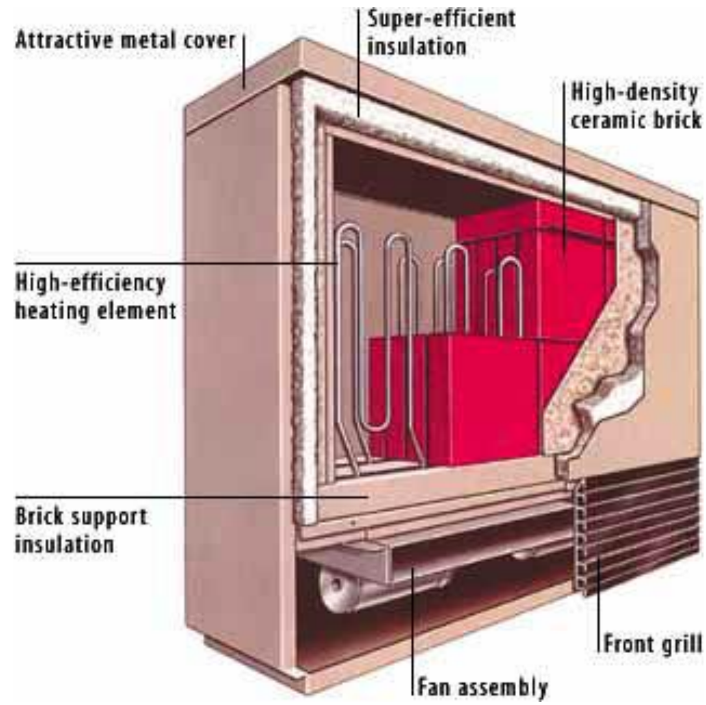
2029 Economic Potential Breakdown

Residential Opportunity 5:

Electric Thermal Storage

For homes with **central heating**, replacing an electric furnace with a unit with **thermal storage** capability.

For homes with **baseboard heating**, replacing baseboards or with **two unit heaters with thermal storage** in the principal living areas (approximately **60%** of total area).

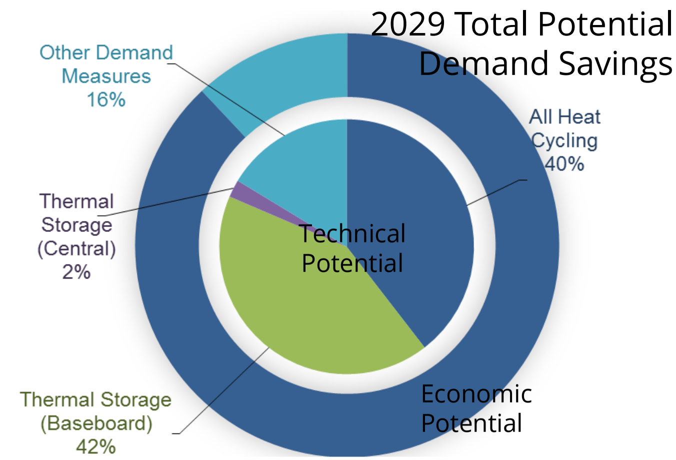


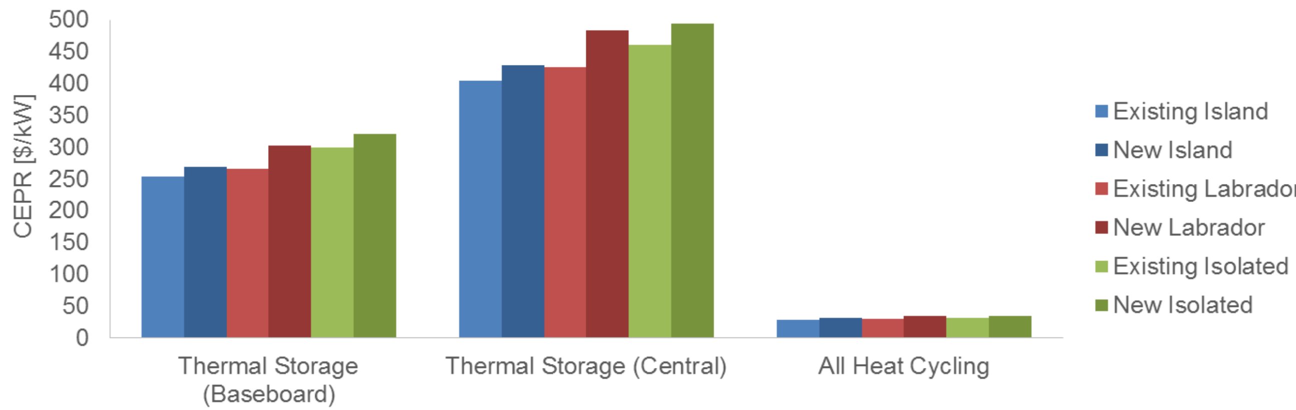
Residential Opportunity 5:

Electric Thermal Storage

Comparison with Other Heating Demand Measures

	2029 Technical Potential Savings [MW]	2029 Economic Potential Savings [MW]
Thermal Storage (Baseboard)	289	0
Thermal Storage (Central)	15	0
All Heat Cycling	272	153





Residential Opportunity 5:

Electric Thermal Storage

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost:	
Unit heaters (2)	$ 5,000
Central heating	$ 11,500
Useful life	15 years
Savings: Space heating	
Unit heaters (2)	56%
Central heating	85%

Residential Opportunity 5:

Electric Thermal Storage

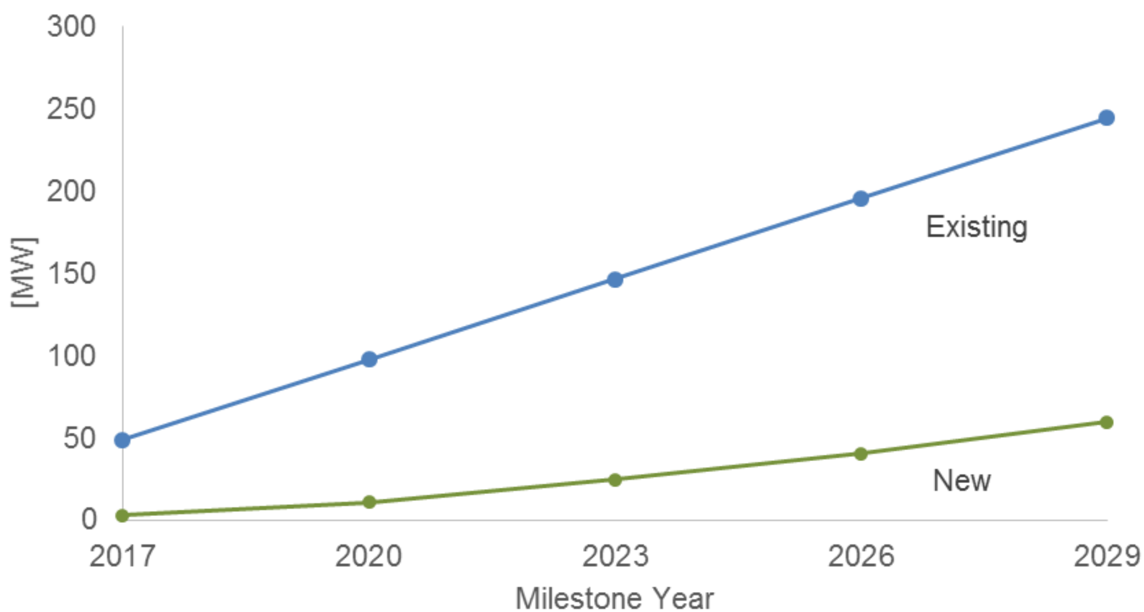
Economic Indicators

Simple Payback (SFD - Island)		N/A
Average CEPR ($/kW):		
Unit heaters (2)	$	285
Central heating	$	450
Basis		N/A
Eligibility Timeline		N/A
Eligible participants:		
Number of dwellings by 2029		0

Residential Opportunity 5:

Electric Thermal Storage

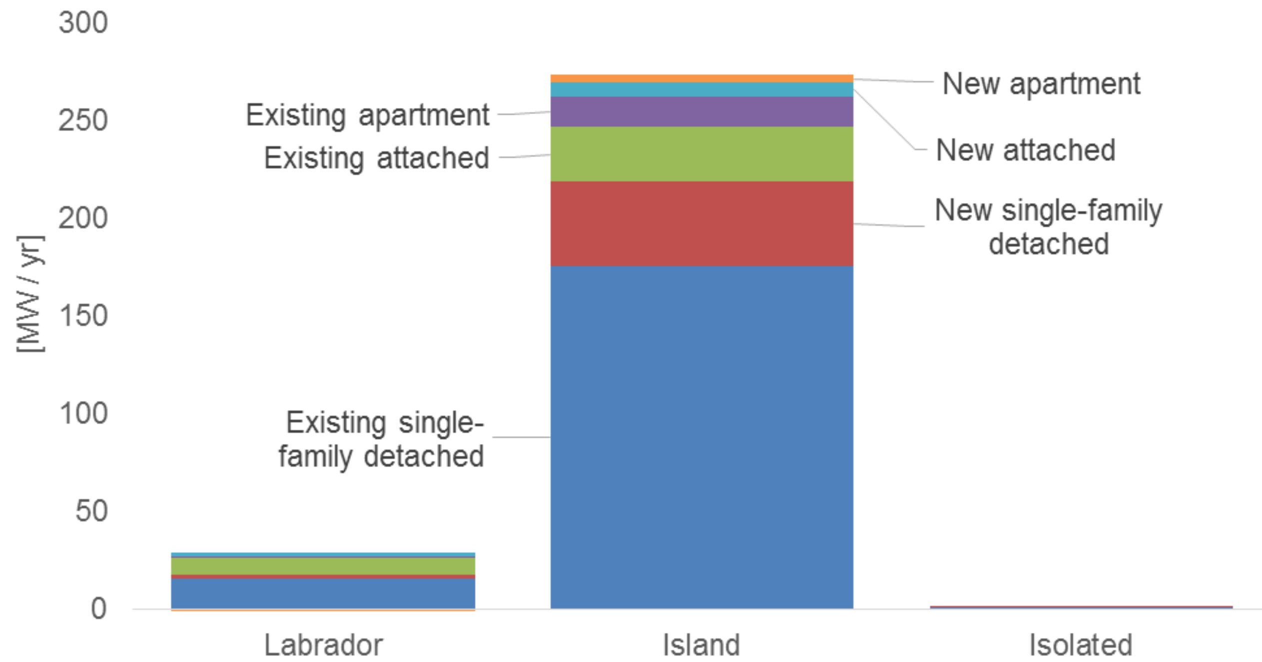
Growth of Technical Potential Savings



Residential Opportunity 5:

Electric Thermal Storage

2029 Technical Potential Breakdown



Residential Opportunity 6:

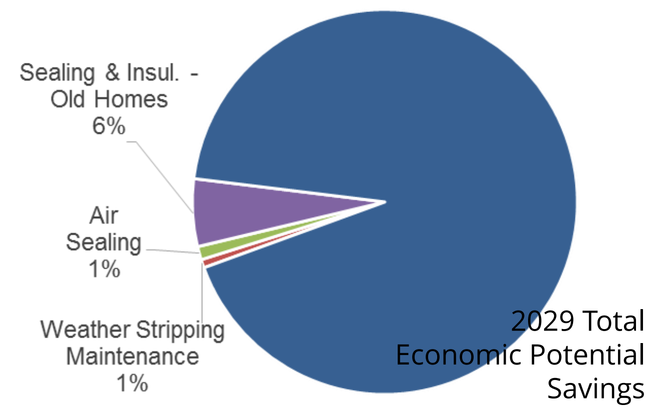
Air Sealing

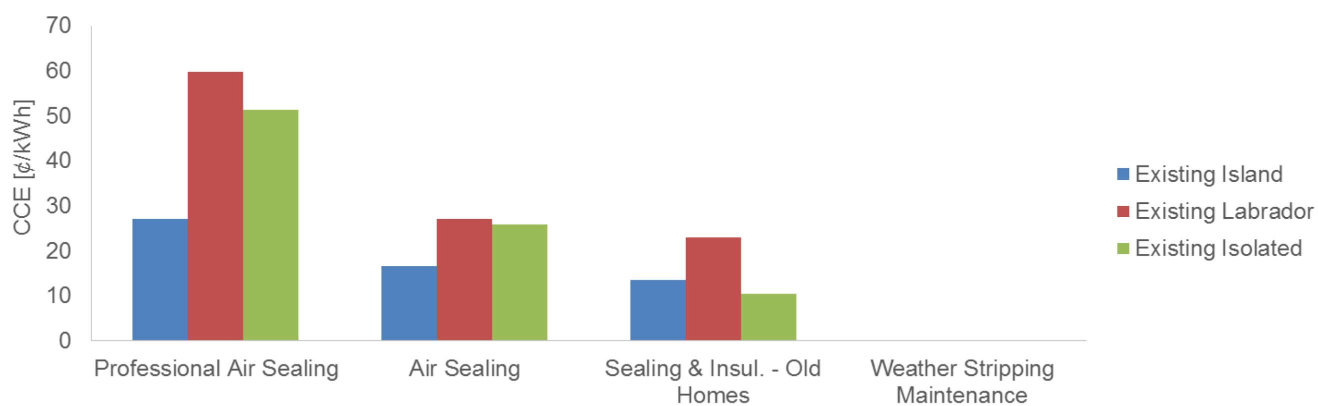
Homeowner air sealing: improving home air tightness by **15-20%**

Professional air sealing: improving home air tightness by **30%**

Residential Opportunity 6:
Air Sealing
Comparison Between Sealing Measures

	2029 Economic Potential Savings [GWh]	Passes Economic Test in Regions
Professional Air Sealing	0	None
Air Sealing	18.4	Island and Isolated only
Sealing & Insul. - Old Homes	92.8	Island and Isolated only
Weather Stripping Maintenance	11.5	All





Residential Opportunity 6:

Air Sealing

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost:	
Homeowner sealing	$ 200
Professional sealing	$ 1,800
Sealing & attic insulation	$ 3,000
Useful life:	
Homeowner sealing	15 years
Professional sealing	length of study
Savings: Heating & Ventilation	
Homeowner sealing	2.3%
Professional sealing	4.7%

Residential Opportunity 6:

Air Sealing

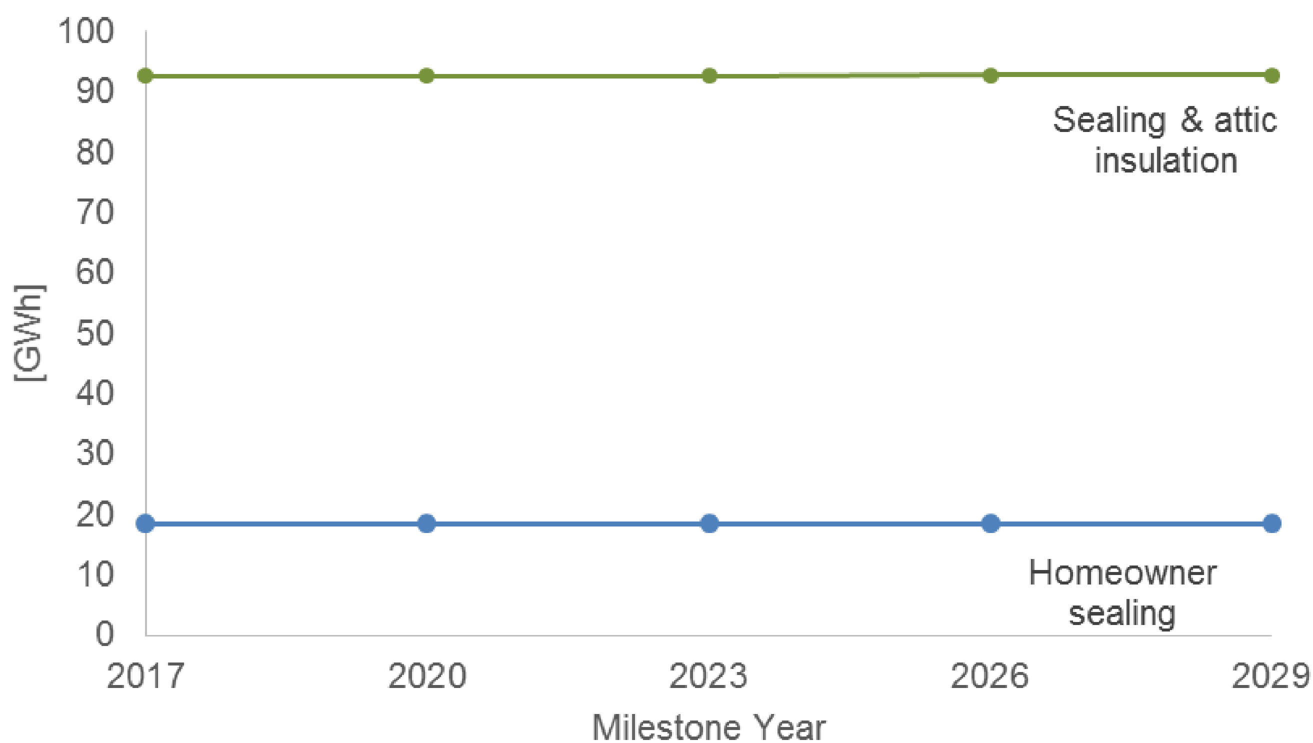
Homeowner Sealing Economic Indicators

Simple Payback (SFD - Island)	11 years
Average CCE (¢/kWh):	
Island	17
Labrador	27
Isolated	26
Basis	Full cost
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	113,855
Principal region	Island Interconnected

Residential Opportunity 6:

Air Sealing

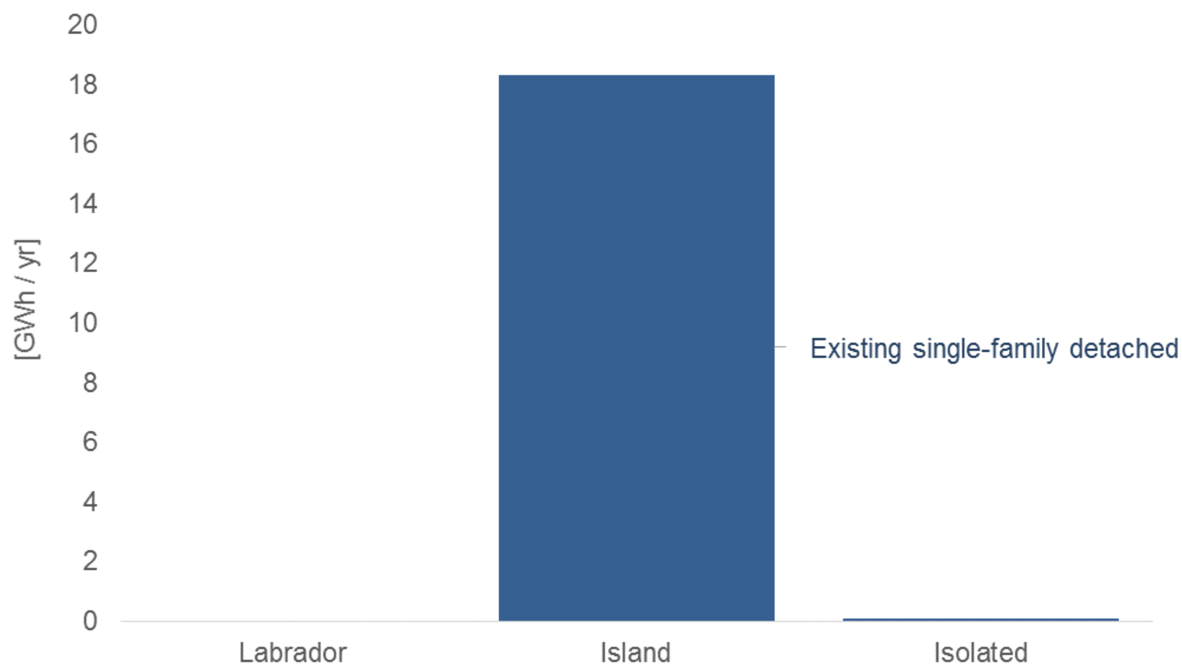
Growth of Economic Potential Savings



Residential Opportunity 6:

Air Sealing

Homeowner Sealing: 2029 Economic Potential Savings Breakdown



Residential Opportunity 7:

Low-Flow Water Fixtures

Installing a low-flow washroom **faucet** with a 1.5 GPM (5.7 LPM) flow rate.

Installing a 1.5 GPM (5.7 LPM) **aerator** on a kitchen faucet.

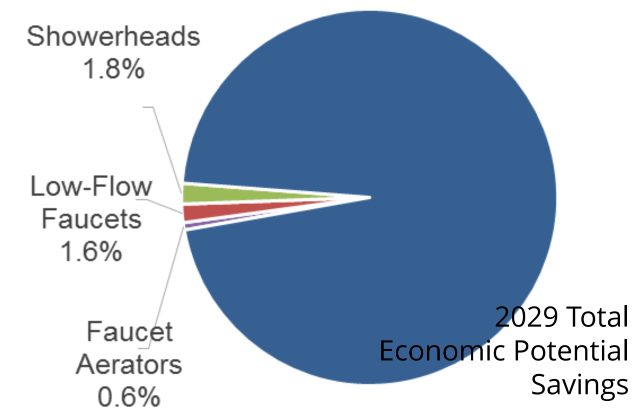
Installing an ultra low-flow **showerhead** with a 1.25 GPM (4.75 LPM) flow rate.

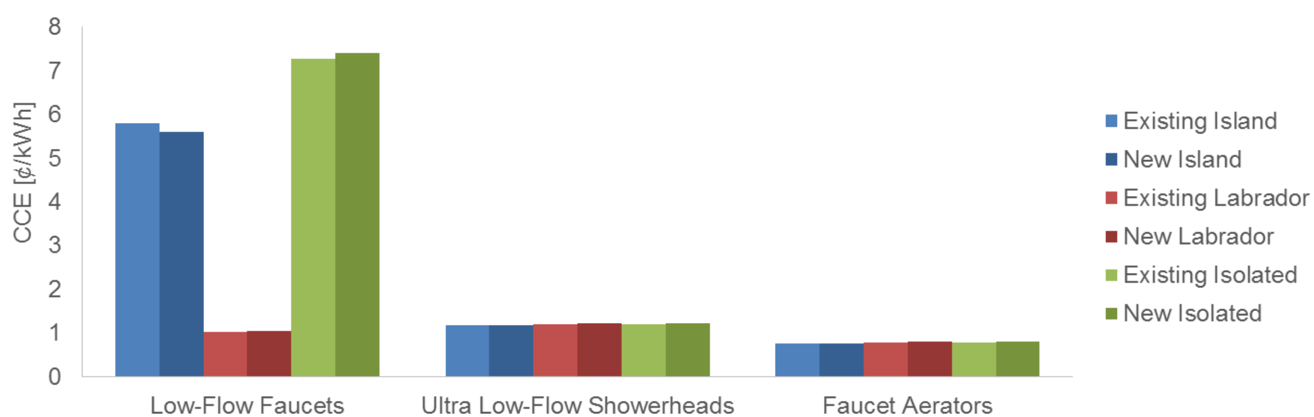
Residential Opportunity 7:

Low-Flow Water Fixtures

Comparison Between Low-Flow Measures

	2029 Economic Potential Savings [GWh]	Passes Economic Test in Regions
Low-Flow Faucets	25.9	All
Ultra Low-Flow Showerheads	29.0	Incremental in Labrador
Faucet Aerators	10.3	All





Residential Opportunity 7:

Low-Flow Water Fixtures

Assumptions

Focus Dwelling Type	All
Focus Region	All
Typical Application:	
Cost	
Showerheads	$ 29
Faucets	$ 45
Aerators	$ 7.50
Basis	Full/Incremental
Useful life	20 years
Savings: DHW	
Showerheads	10%
Faucets	6%
Aerators	6%

Residential Opportunity 7:

Low-Flow Water Fixtures

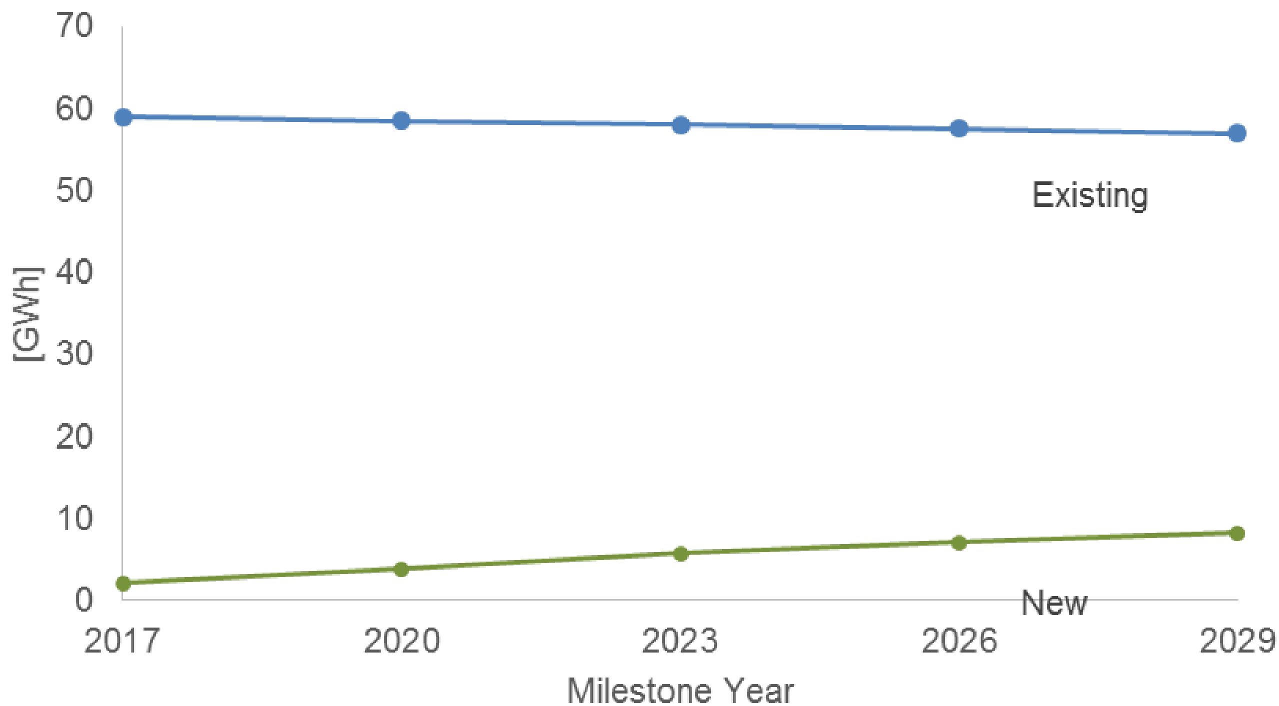
Economic Indicators

Simple Payback:	
Showerheads	1.3 years
Faucets	5.3 years
Aerators	7 months
Average CCE (¢/kWh):	
Showerheads	1.20
Faucets	4.69
Aerators	0.78
Basis	Full/Incremental
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	138,100
Principal region	Island and Isolated

Residential Opportunity 7:

Low-Flow Water Fixtures

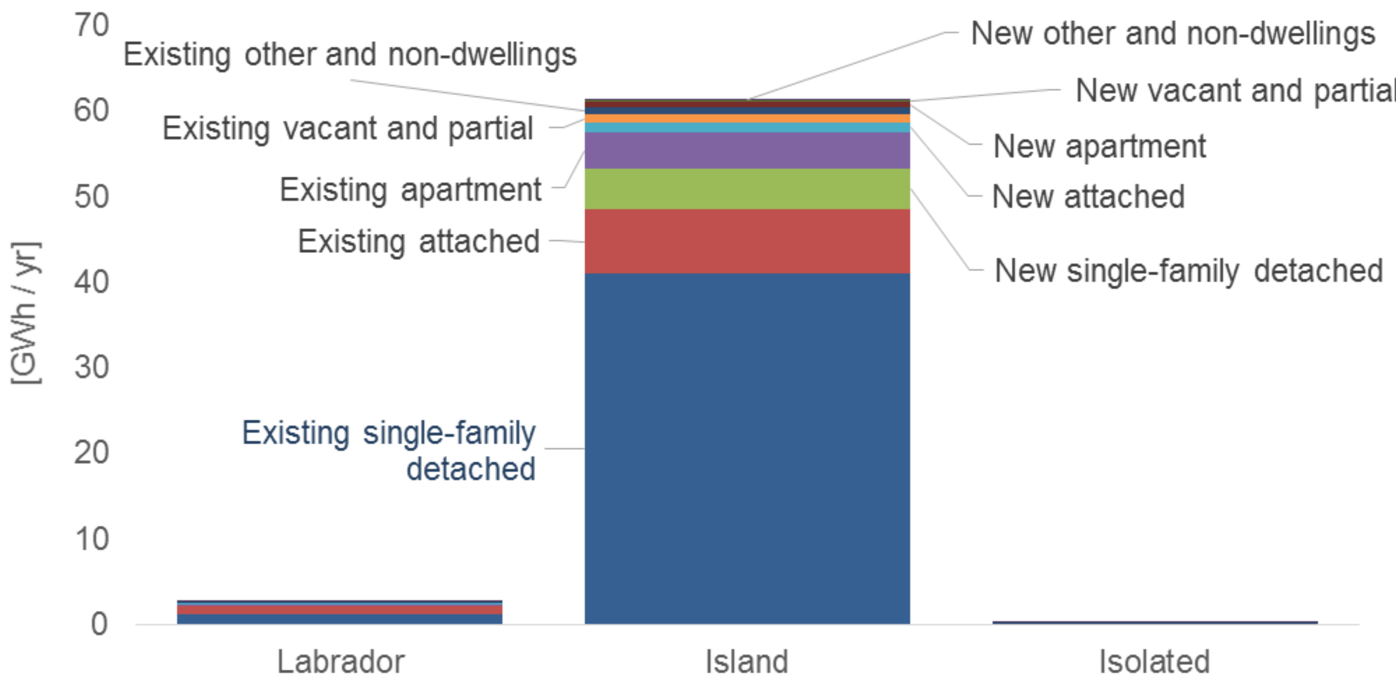
Growth of Economic Potential Savings



Residential Opportunity 7:

Low-Flow Water Fixtures

2029 Economic Potential Savings Breakdown



Residential Opportunity 8:

Behavioral Measures

Top three behavioral measures:

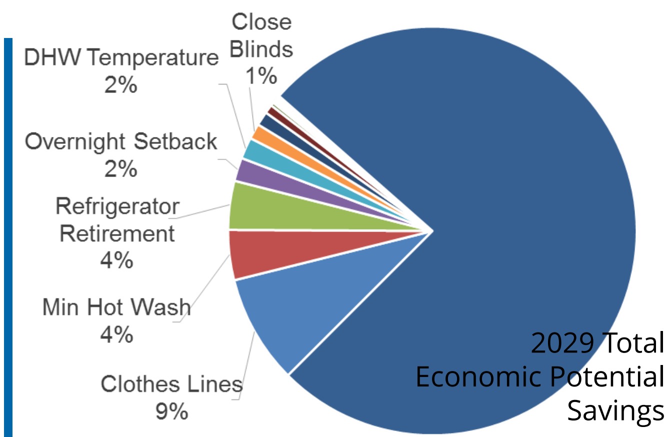
1. Clotheslines
2. Minimize hot and warm clothes wash
3. Second refrigerator retirement

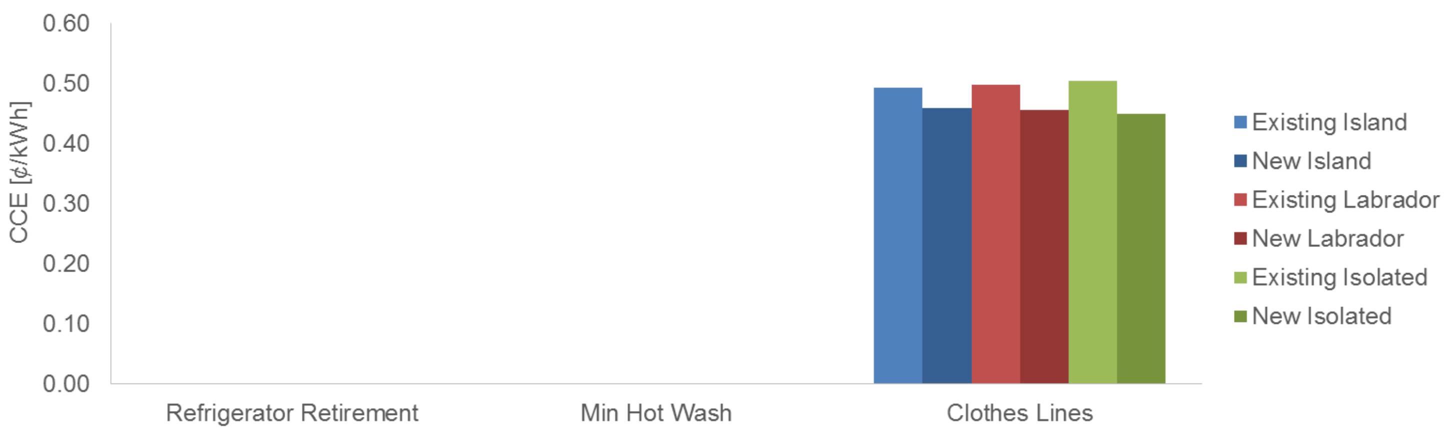
Residential Opportunity 8:

Behavioral Measures

Comparison Between Behavioral Measures

	2029 Economic Potential Savings [GWh]
Refrigerator Retirement	63.3
Min Hot Wash	64.9
Clothes Lines	140.9





Residential Opportunity 8:

Behavioral Measures

Assumptions (Combined)

Cost	(near) free
Useful life	1 year
Savings:	
Clothes dryer	61%
Refrigerator	30%
Domestic Hot Water (DHW)	16%
Other electronics	4.9%
Space heating	3.4%
Freezer	1.4%
Ventilation	1.3%
Television	1.3%
Lighting	0.1%

* Percentages of the pre-measure end use consumption.

Residential Opportunity 8:

Behavioral Measures

Eligible Participants

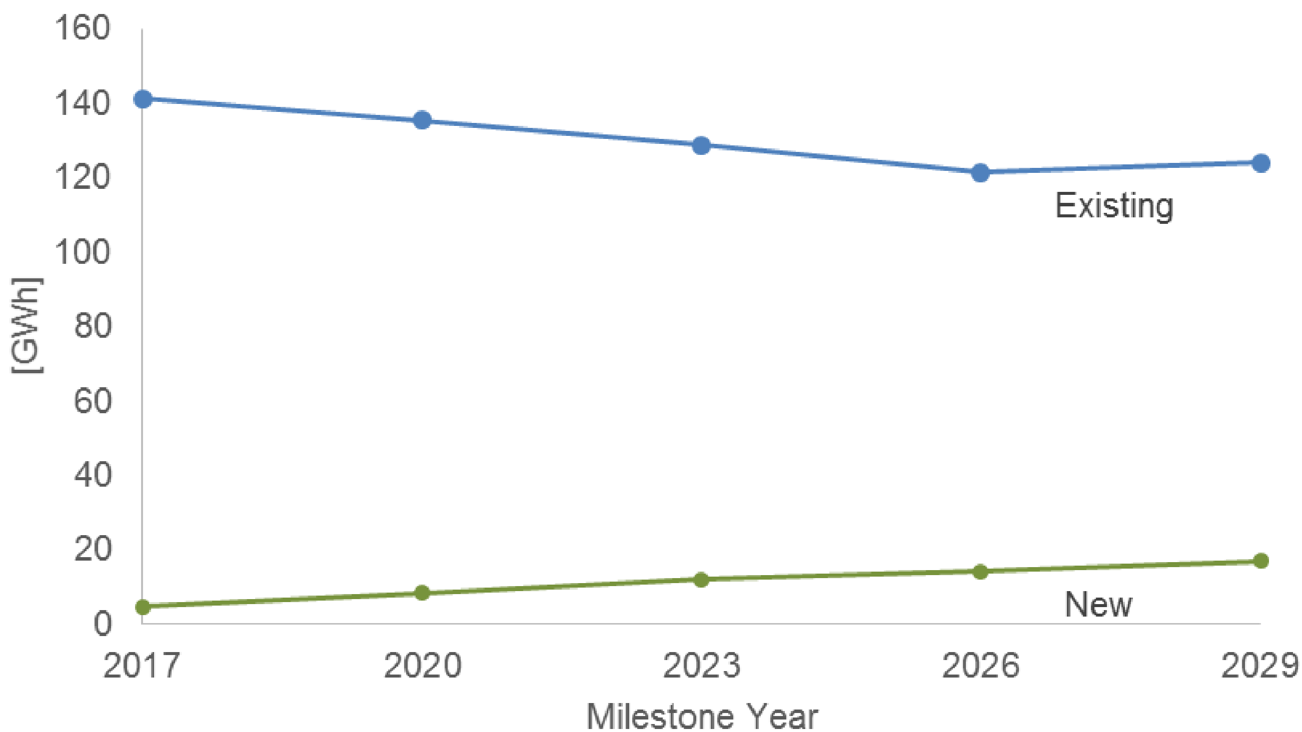
Eligible Dwellings by 2029:	
Clothes Lines	108,145
Minimum Hot Wash	86,874
Refrigerator Retirement	158,325

All types of dwellings, all regions.

Residential Opportunity 8:

Behavioral Measures: Clotheslines

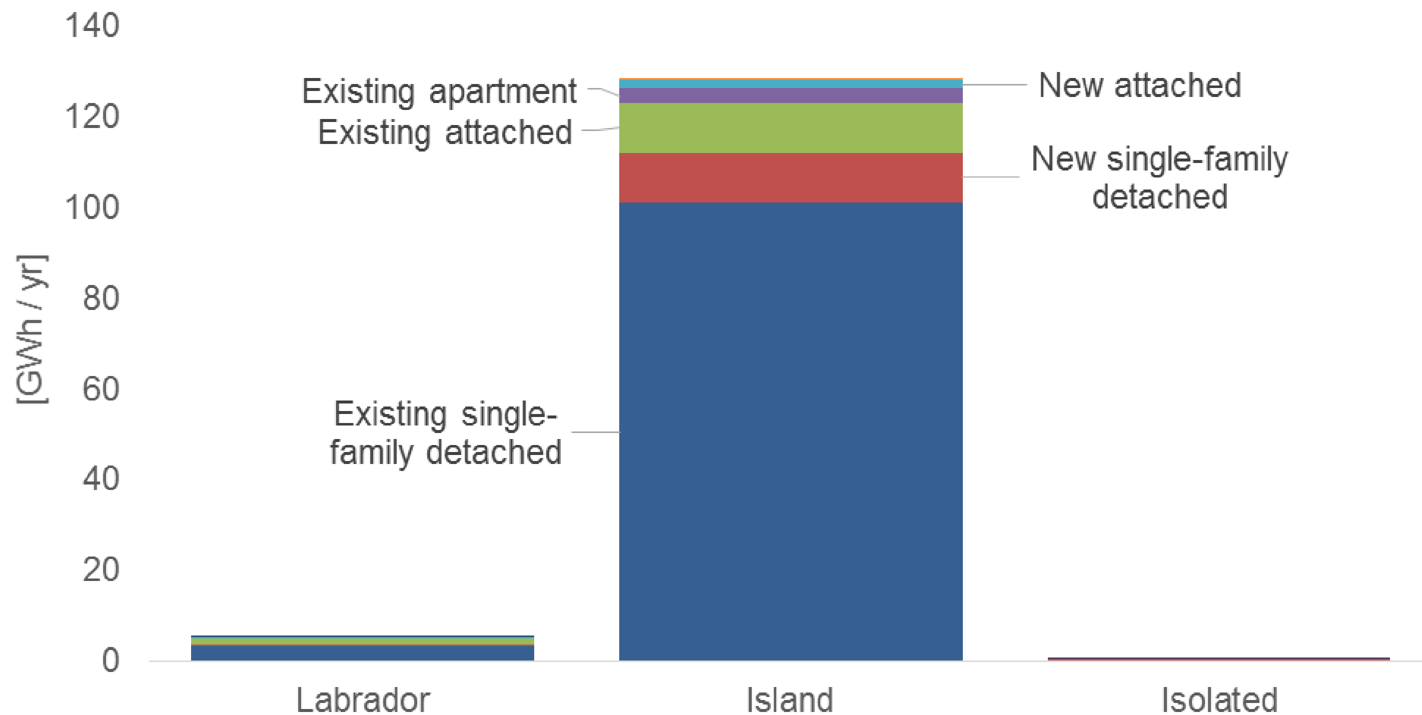
Growth of Economic Potential Savings



Residential Opportunity 8:

Behavioral Measures: Clotheslines

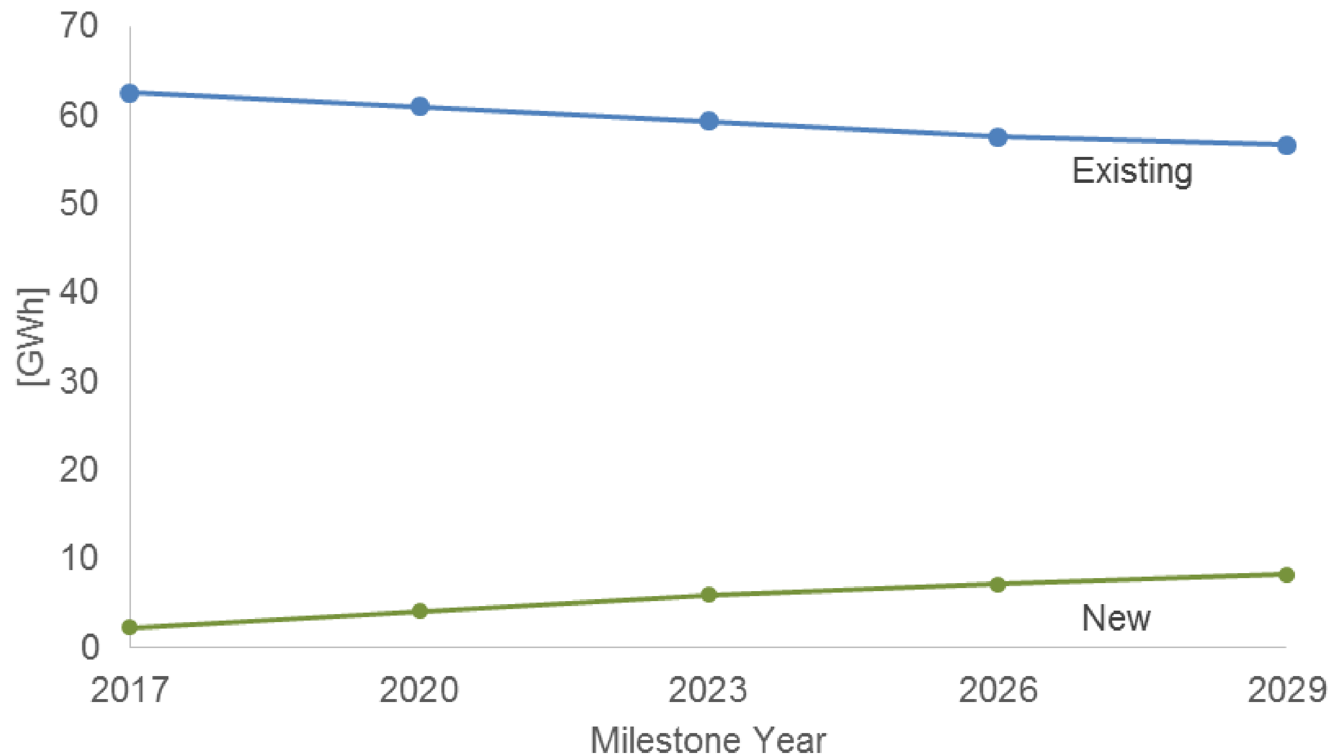
2029 Economic Potential Savings Breakdown



Residential Opportunity 8:

Behavioral Measures: Minimize Hot Washes

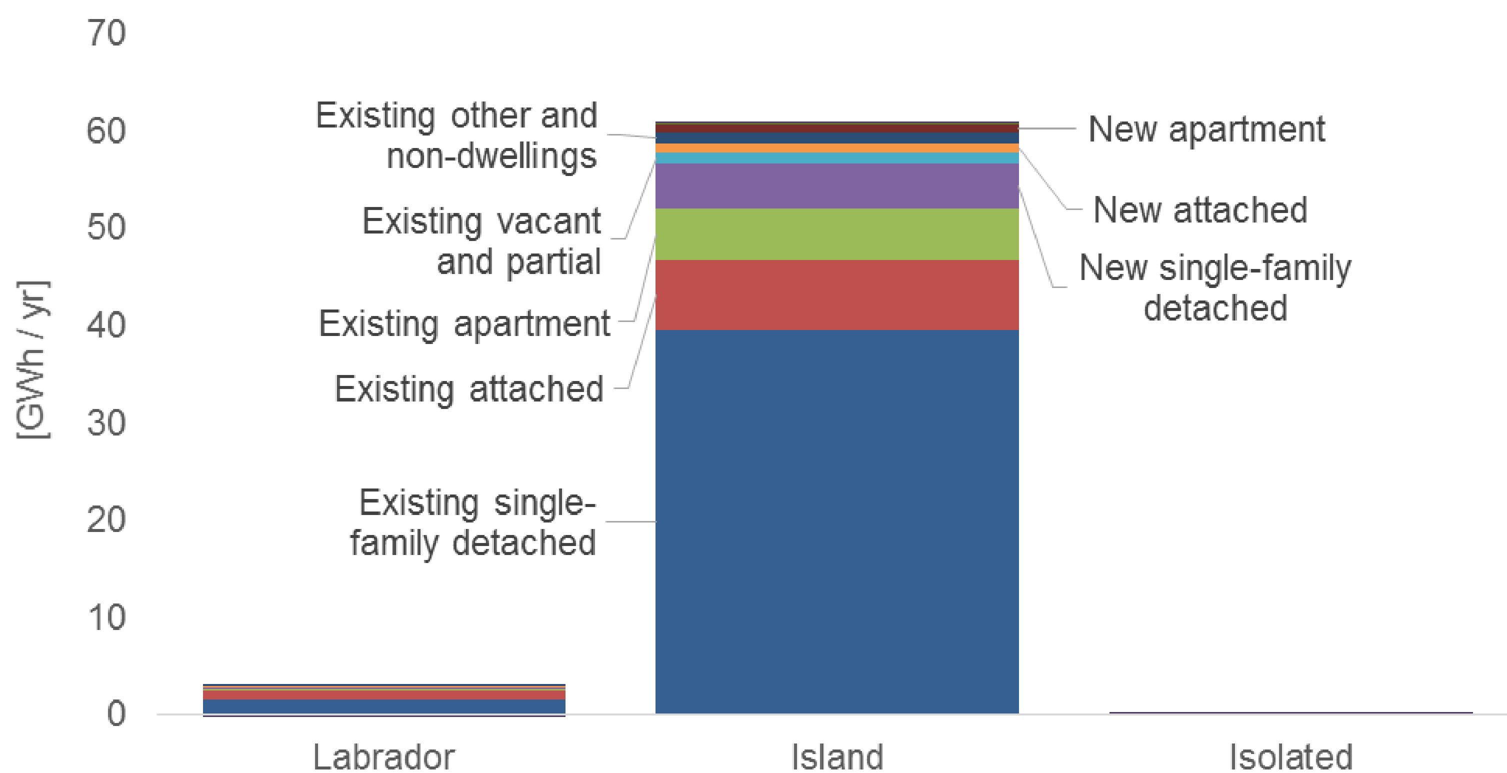
Growth of Economic Potential Savings



Residential Opportunity 8:

Behavioral Measures: Minimize Hot Washes

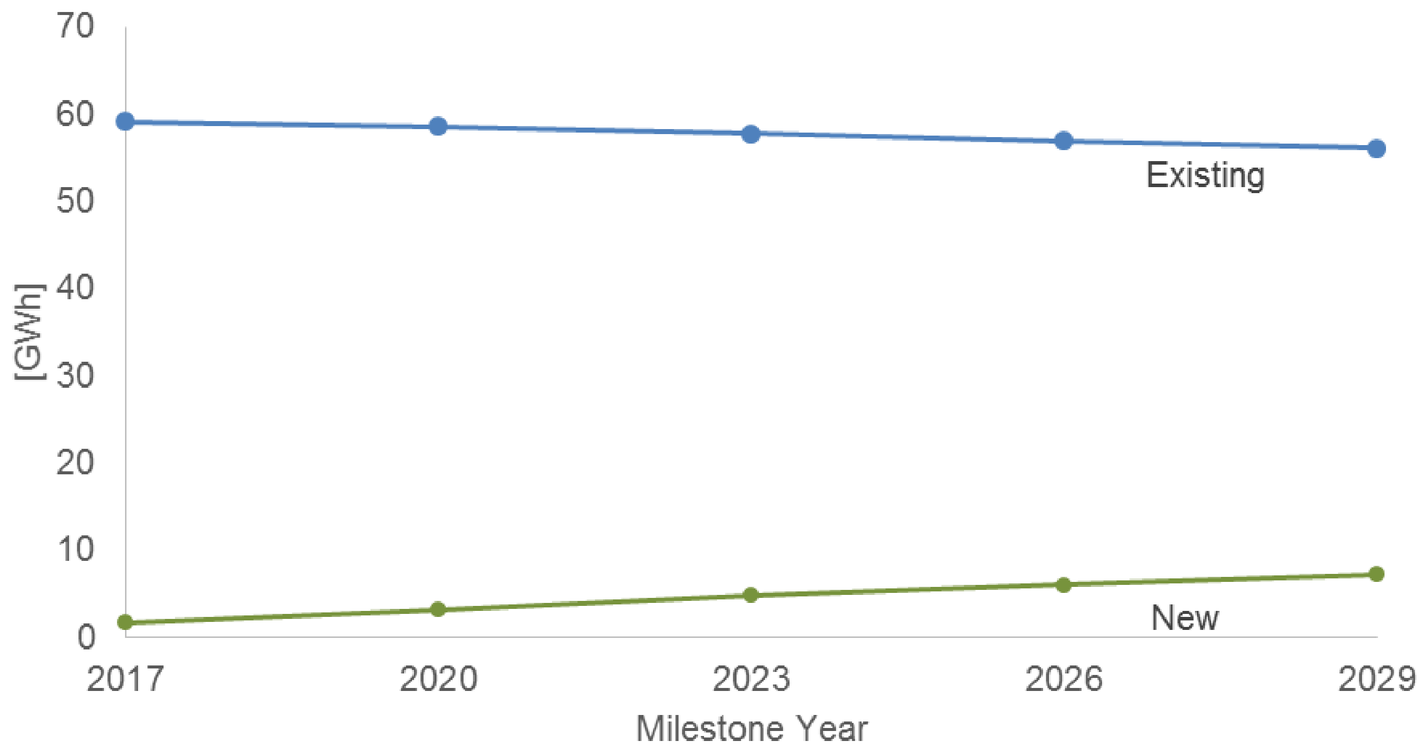
2029 Economic Potential Savings Breakdown



Residential Opportunity 8:

Behavioral Measures: Refrigerator Retirement

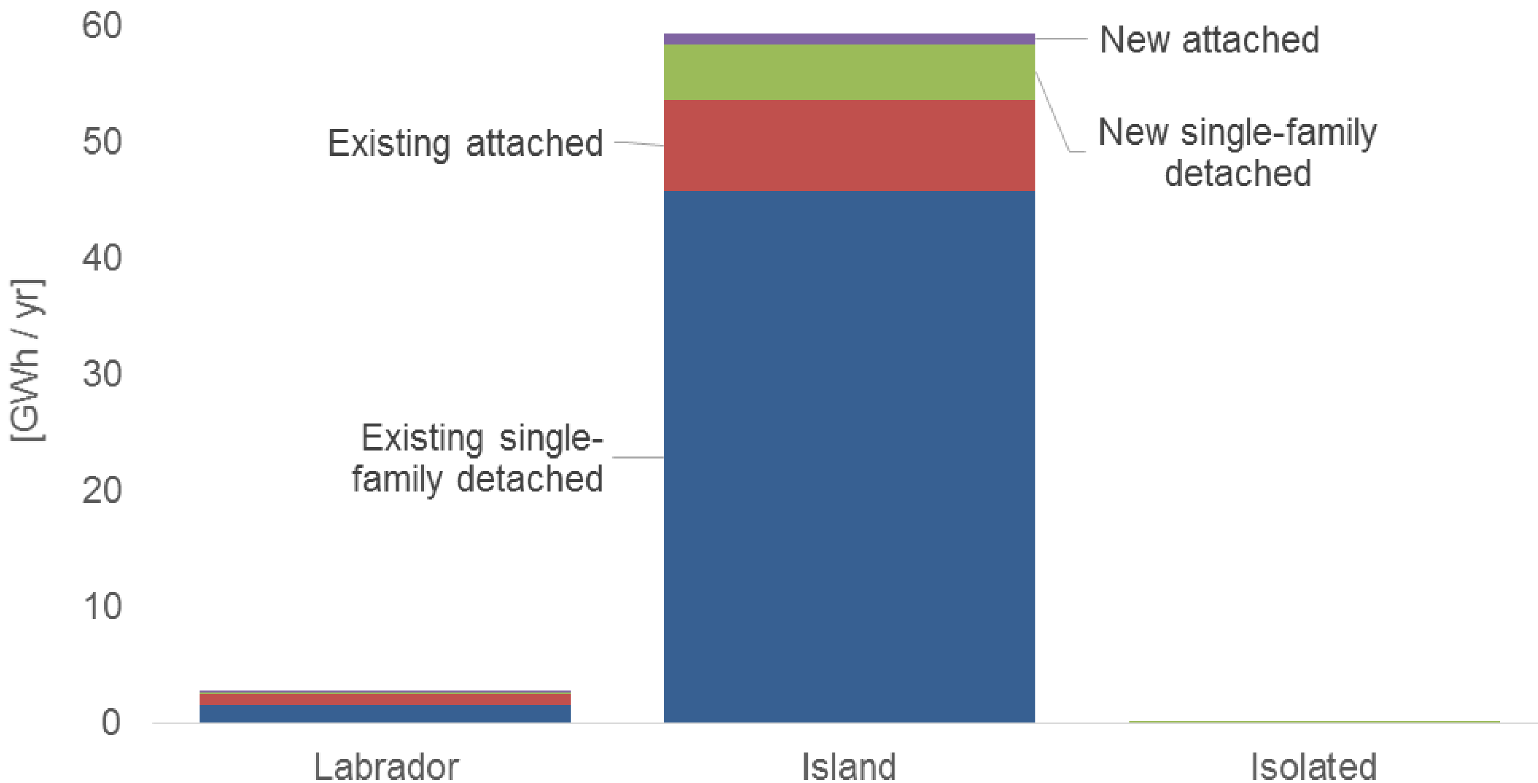
Growth of Economic Potential Savings



Residential Opportunity 8:

Behavioral Measures: Refrigerator Retirement

2029 Economic Potential Savings Breakdown



Residential Opportunity 9:

High-Efficiency Clothes Washers

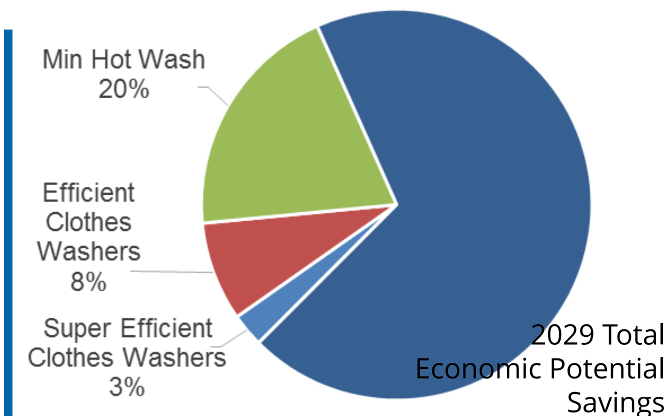
Installing a **CEE Tier III clothes washer**, which must meet targets for using less water and mechanical energy. Includes both top- and front-loading models.

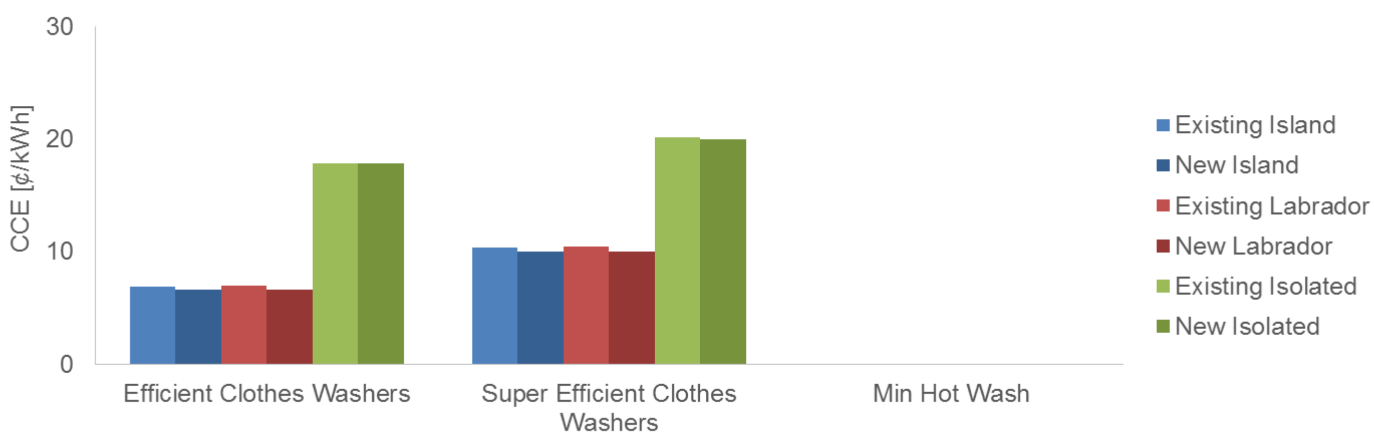
Residential Opportunity 9:

High-Efficiency Clothes Washers

Comparison Between Clothes Washing Measures

	2029 Economic Potential Savings [GWh]	Passes Economic Test in Regions
Efficient Clothes Washers	134	Full in some Isolated
Super Efficient Clothes Washers	45	Full in some Isolated
Min Hot Wash	325	All





Residential Opportunity 9:

High-Efficiency Clothes Washers

Assumptions

Focus Dwelling Type	Detached
Focus Region	Island Interconnected
Typical Application:	
Cost	$ 1,100
Basis	Incremental*
Useful life	12 years
Savings:	
Clothes Washers	48%
Clothes Dryers	48%
DHW	58%

* Full in some Isolated dwellings.

Residential Opportunity 9:

High-Efficiency Clothes Washers

Economic Indicators

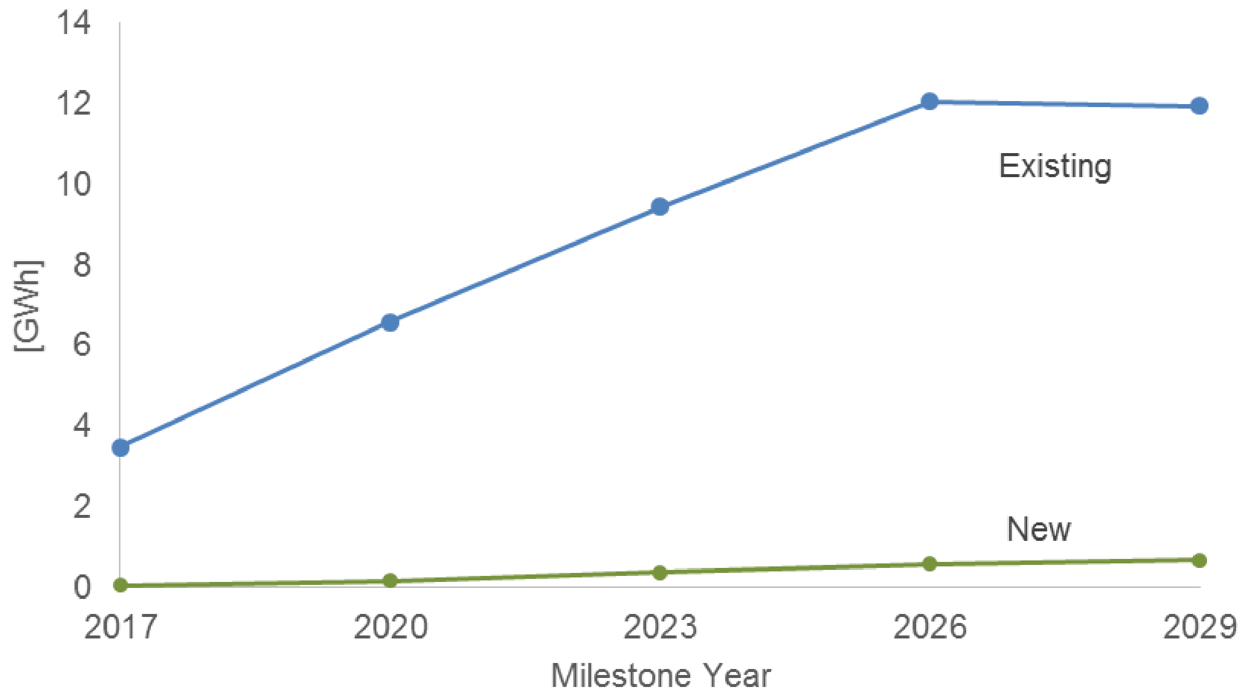
Simple Payback (SFD - Island)	6.6 years
Average CCE (¢/kWh):	
Island	12.0
Labrador	10.4
Isolated	21.7
Basis	Incremental*
Eligibility Timeline	Immediate
Eligible participants:	
Number of dwellings by 2029	175,542
Principal region	Island Interconnected

* Full in some Isolated dwellings.

Residential Opportunity 9:

High-Efficiency Clothes Washers

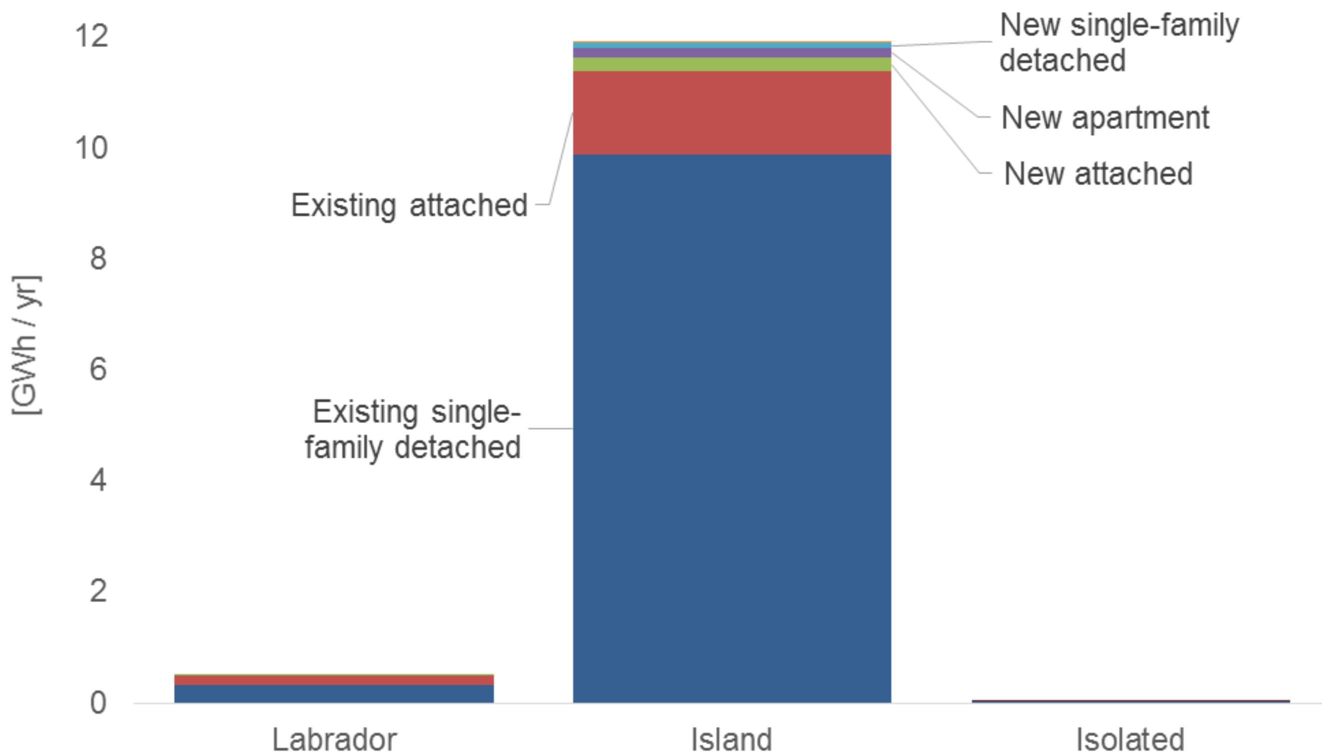
Growth of Economic Potential Savings



Residential Opportunity 9:

High-Efficiency Clothes Washers

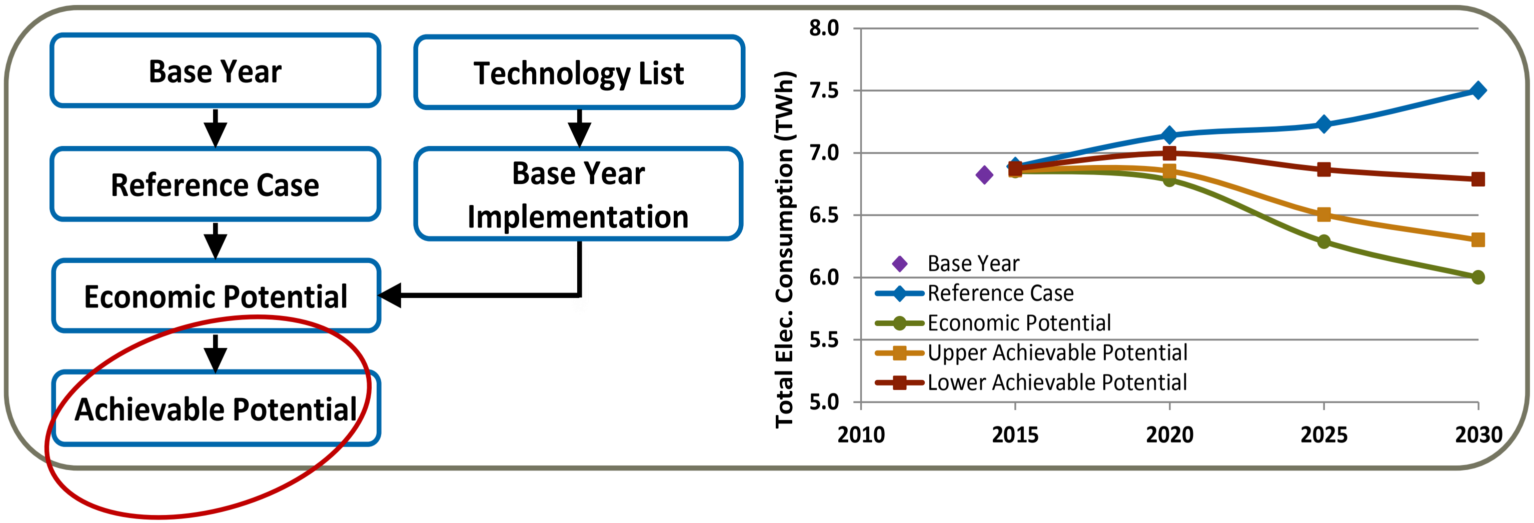
2029 Economic Potential Savings Breakdown



4

Wrap Up & Next Steps

Next Steps


Base Year
Reference Case
Economic Potential
Achievable Potential
Technology List
Base Year Implementation
Total Elec. Consumption (TWh)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
2010
2015
2020
2025
2030
Base Year
Reference Case
Economic Potential
Upper Achievable Potential
Lower Achievable Potential

Appendix H Background-Section 9: Achievable Workshop Measure Worksheets

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R1: Basement Insulation

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE (c/kWh)	5.9		
Simple Payback (years)	5.7		
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	88,583	88,583	
Dwellings Affected (Per Year)	29,528	5,906	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		25%	Past results: 5-10%; curve A
Aggressive Marketing		35%	Past results: 25-50%; curve B
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		22,146	
Aggressive Marketing		31,004	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments (up/down units)			lower; because the basement is all finished
Labrador			lower
Isolated			lower
Other Envelope Measures:			
Crawl Space Insulation			similar
Attic Insulation			higher
Wall Insulation			lower
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			high
Primary Incentive Target (User, Channel Member, Both)			
Sensitivity to Direct Program Support (High, Medium, Low)			high
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			

Notes:
- finished basements: cost much more than $2300
- cost is a barrier
- practicalities and logistics of the project
- in public housing, requires entering the units
- resources to deal with the project are a major barrier
- program paid $400-450 on a typical project
- a lot of do-it-yourselfers in NL: leads to deferring the project
- more access to contractors in Avalon; fewer contractors elsewhere, so people do their own work
- seniors would have difficulty accessing contractors; population outside the Avalon is aging
- technique of doing the work is a barrier: making sure the job is done correctly
- people don't really know what the savings would be: they think because no one is in the basement it doesn't matter whether it is insulated down there
- education is a huge part of the picture
- risks: trigger other upgrades; if some other components don't meet code, water damage, etc., then you get into a lot of other work
- doing the job wrong and damaging the house; this risk is larger outside the Avalon
- city inspector can protect you: a permit will protect the homeowner
- if people don't have a ventilation system, this measure might make moisture problems worse
- having an energy audit done on the house before any kind of upgrade can explain where the best potential is: people would do more insulation and air sealing
- out of Avalon, many people use wood for much of their heating
- people on fixed income often can't live in much of their house, because they can't afford to heat it
- seniors are very reluctant to deal with the disruption of the project; also hard to find someone to help them through it, particularly outside the Avalon
- testimonials have very big impact
- efficiency upgrades are the best bang for your dollar: what kind of RRSP can give you 18% on your money??
- not a lot of home energy performance contractors: there have been such contractors in other regions
- opportunity to do this measure when houses change hands, when the basement is empty
- key players: home inspectors (when the home changes hands)
- split incentive between landlord and renters: especially if the renters pay the electric bill
- strategies: energy audits paid for by utility, simplify the execution of the project for the consumer (could utilities have contractors that do the work?), awareness is the first step, then education, then cost, then execution
- RenoMark: nationally recognized certification for renovation companies, provided by CHBA (renomark.ca)
- a preferred contractor route is a huge undertaking
- everything should be translated back to a monthly payment; make the cost flow positive from day one
- 40% of basements are finished; 34% are partly finished
- 45% of houses were built before 1980
- 35% is probably the upper achievable

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R2: Ductless Mini-Split Systems

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE (¢/kWh)	7.8		
Simple Payback (years)	6.4		
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	89,981	101,761	
Dwellings Affected (Per Year)	29,994	6,784	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		30%	Past results: 17%; Curve B
Aggressive Marketing		60%	Past results: 50%; Curve B
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		30,528	
Aggressive Marketing		61,057	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments			lower
New Homes			higher
Labrador			lower
Isolated			lower
Other Heat Pump Measures:			
Air-source Heat Pumps			lower
Cold Climate Heat Pumps			lower
Air-to-Water Heat Pumps			lower
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			low: more about financing
Primary Incentive Target (User, Channel Member, Both)			
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			financing, access, education

Notes:
- within 15 years, mini-splits are going to be much more important in the reference case
- cost of $3500 might be too low: people are installing multi-units to provide heating in the bedrooms, too. More like $6-8000. Most are therefore higher cost
- knowledge is a barrier
- price is a barrier
- availability of qualified installers
- financing
- range in quality: education of people to buy a unit that performs well at low ambient temperatures below -5C
- not getting proper heat loss calculations on the house, because the electrician is doing the estimate
- unit doesn't suit the house: designed for US
- customer with a wood stove found electric bills went out, because the unit was in defrost mode all the time
- aesthetics are a barrier
- strategies for program design: need to offer financing
- that's why NS is getting lots of uptake. No rebates there, but there is financing
- servicing
- HRAI certification
- Should require licensed installation, just like with an HRV
- Worse situation outside the Avalon, particularly in the Northern Peninsula and Labrador
- 80% in St. John's; less outside the Avalon
- sell it based on comfort (including AC benefit)
- need to make sure they are done properly, to avoid negative publicity

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R3: High Performance New Homes

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE (¢/kWh)	17.7		
Simple Payback (years)	17.2		
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	4,454	18,138	
Dwellings Affected (Cumulative)	2,974	12,111	
Dwellings Affected (Per Year)	991	807	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		65%	Adoption curve A
Aggressive Marketing		80%	Adoption curve A
BAU Marketing		7,872	
Aggressive Marketing		9,689	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			same
Labrador			lower
Isolated			lower
Other New Construction Measures:			
Net Zero Homes			lower
LEED Apartments			lower
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			incentives would be valuable
Primary Incentive Target (User, Channel Member, Both)			
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			non-energy benefits; labelling; codes and standards

Notes:
- to bring the performance of the houses from 77 to 80
- seems like the base case is too low, assuming people build to code
- on average outside the city, houses are not built to code
- can we push them beyond 80
- NS EnergySTAR is an 83; can't get to 83 in NL without a heat pump
- to get 80, you need rigid insulation on the outside, you need good insulation in the basement and attic, you need an HRV. As soon as we get a heat pump in the mix, you get beyond 80
- cost is the major barrier
- knowledge for consumers to want it
- perceived resale value: prospective buyers can't see these improvements
- hard to find builders willing to "push the envelope" because they haven't done it before
- potential partners: builders, certification on R2000 and EnerGuide through the assocation; consumers purchasing higher-end homes are more knowledgeable about these programs and are demanding them
- utilities could partner with the industry associations and jointly promote it
- consumer sees very long payback: sell it based on comfort; how do you monetize the value of it on resale, if they aren't going to stay in the house for 20 years
- payback of 17 years is not right, City of St. John's says more like 6 years
- work with government on labeling; could be either level of government
- subsidize certification and include it in the program

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R4: Heat Cycling

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CEPR ($/kW)	26.5		
Simple Payback (years)	n/a		Typically utility would pay for cycling equipment
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	100,055	112,411	
Dwellings Affected (Per Year)	33,352	7,494	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		0%	Participation rates for AC and DHW only
Aggressive Marketing		2%	Curve A
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		0	
Aggressive Marketing		2,248	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			same
Apartments			same
New Homes			same
Labrador			same
Isolated			same
Other Cycling Measures:			
Dual Fuel Cycling			much higher
Heat Pump Cycling			same
DHW Cycling			much higher
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			massive
Primary Incentive Target (User, Channel Member, Both)			user
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			couple with t-stat

Notes:
- comfort is the big barrier
- loss of control
- the utility would have to pay
- might only work in dual fuel situation
- politically difficult
- based on kW avoided cost, the utility can only afford maybe $10/hr per baseboard
- rebound from installing portable heaters

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R5: Electric Thermal Storage

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CEPR ($/kW)	185.2		
Simple Payback (years)	n/a		Depends on how rates are structured
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	12,977	76,050	
Dwellings Affected (Per Year)	4,326	5,070	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		0%	Very dependent on rate structure
Aggressive Marketing		1%	Would need time of use rates
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		0	
Aggressive Marketing		761	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			same
Apartments			same
New Homes			same
Labrador			same
Isolated			same
Other Cycling Measures:			
Central Thermal Storage			lower
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			massive
Primary Incentive Target (User, Channel Member, Both)			
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			

Notes:
- aesthetic issue is becoming less of a problem
- cost is a huge barrier
- no benefit to the customer - utility would need to pay in some way
- or introduce time of use rates
- risk in high performance houses where there is a lag; they could come on in the summer when it is cold at night
- without benefit to the customer, it's not clear that the utility could get any participation without paying for the whole installation

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R6: Air Sealing

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE (¢/kWh)	12.4		
Simple Payback (years)	11.1		
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	113,487	113,487	
Dwellings Affected (Per Year)	37,829	7,566	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		20%	Past results: 3-10%; curve A
Aggressive Marketing		65%	Past results: 17-50%; curve A
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		22,697	
Aggressive Marketing		73,767	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments			lower
Labrador			same
Isolated			lower
Other Sealing Related Measures:			
Professional Air Sealing			lower; incentive probably couldn't be high enough
Air Sealing/Attic Insul. In Old Homes			lower
Weatherstripping Maintenance			same
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			not really about incentives
Primary Incentive Target (User, Channel Member, Both)			user
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			more need for education, maybe a kit, designated pı

Notes:
- an energy audit would help pinpoint the leakage areas
- otherwise the homeowner would be doing the "usual suspect" areas
- a lot of education to help homeowners know what to do and how to do it
- phyiscal ability to do the project
- confidence to do it yourself
- videos on the internet
- risks: injury, doing it wrong and getting no benefit (or making it worse)
- risk of making the house too tight if it doesn't have an HRV
- strategies: prepackage a kit and provide a video with it to tell people how to install them, and include a $20 rebate on top of it
- live demonstration with a blower door test would help give people a good idea of what to do
- energy audit might help to get a bundle of measures to pass
- could make a rebate on your mini-split contingent on getting an audit done, with a bundle of measures that go with that
- cost is not the main barrier
- awareness is a much bigger barrier
- the upper assumption is very contingent on the assumption of bundling

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R7: Low-Flow Water Fixtures

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE (¢/kWh)	1.1		(faucets = 6.4, aerators = 0.6)
Simple Payback (years)	1.0		(faucets = 6.1, aerators = 0.4)
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	76,734	84,179	
Dwellings Affected (Per Year)	25,578	5,612	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		5%	Past results: 70-80%; curve A
Aggressive Marketing		20%	Past results: 88-98%; curve A
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		4,209	
Aggressive Marketing		16,836	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments			lower
New homes			Higher: will be code within a few code cycles
Labrador			same
Isolated			lower
Other Sealing Related Measures:			
Faucets (washroom)			lower
Faucet Aerators (kitchen)			higher
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			not very
Primary Incentive Target (User, Channel Member, Both)			retailer
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			handing it out as a kit; or work with channel incentiv

Notes:
- not going to capture the people who want the rainwater showerheads and want to take out the flow restrictor
- standards are more restricted than they used to be. Not a lot of movement in the last five years
- not too many 1.25 showerheads available in the province at the moment
- some big box retailers are selling non-certified products
- Waterwise certification is 2.5 gpm and people are fooled
- no incentives not to use water in NL. Water usage is not metered.
- Gerald can't get the conditioner out of his hair when it's low flow
- lower flow causes the municipal pipes not to flow as well, but this is a bigger problem for the toilet
- perception from years ago that low-flow showerheads gave a poor shower; even though products have improved, that perception isn't completely gone
- most people don't switch until the showerhead breaks
- most faucets already have aerators
- people think "we don't pay for water" but people DO pay for hot water
- could you include these items in a kit (then does it end up in a drawer?)
- second program involved a direct install of the products in the kit
- gives you some control over the quality of the products
- if you have teenagers, a low-flow showerhead allows the last person up in the morning to still have a hot shower

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R8: Behaviour Measures

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE ($/kWh)	0.0		no capital cost
Simple Payback (years)	n/a		
ECONOMIC POTENTIAL (number of dwellings)			
Total Number of Dwellings	170,114	185,416	
Dwellings Affected (Cumulative)	79,471	86,619	(clothes line measure)
Dwellings Affected (Per Year)	26,490	5,775	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		0%	Nearly 30% already do this in NL.
Aggressive Marketing		10%	curve A
ACHIEVABLE POTENTIAL (number of dwellings)			
BAU Marketing		0	
Aggressive Marketing		8,662	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments			lower
New Homes			same
Labrador			same
Isolated			higher
Other Sealing Related Measures:			
Retire Second (old) Fridge		30-60%	Yukon retired over 500 in one year (17k customers)
Minimize Hot Water Wash	between clothes line and fri		43% maximum found in other studies
Others?			
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			
Primary Incentive Target (User, Channel Member, Both)			
Sensitivity to Direct Program Support (High, Medium, Low)			
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			

Notes:
- some subdivisions don't allow them
- covenants
- utilities don't want people attaching the other end of the clothesline to the utility pole
- umbrella style clothes lines are more space efficient
- indoor clothes lines use electric heat to dry the clothes, and you can get mold issues
- this is already a well-established cultural practice; not clear how many more people you'd get
- a lot of days in NL when the weather is not good for drying clothes
- no dryer sheet can replicate the smell of clothes hung on the line

- no incentive for clothes lines or minimizing hot water wash
- barriers to minimizing hot water wash? education; people are concerned about germs or dust mites
- people use hot water for bedsheets, but not so much for clothes
- NL water is very cold, so some hot water is always added even for the cold water wash.
- bundle the cold water wash with other water measures

- retirement of second fridge: NO!
- this program usually offers a way of getting a fridge out of your house and properly disposing of it
- very effective program in Yukon, BC, and Ontario
- utilities would like to work with the retailers, to get the retailers to talk about the program to haul away the old fridges
- there are some local service districts that have expertise to remove the refrigerant; Eastern Waste Management, for example
- take the fridge and give them a showerhead and a clothes line
- probably need an incentive for the fridge, but the main benefit is the help removing it
- appliance dealers might be able to participate in the program by doing the pickup
- can the "recycle culture" among the youth promote this in the next generation

NL ACHIEVABLE POTENTIAL WORKSHOP - RESIDENTIAL SECTOR

R9: High Efficiency Clothes Washers

	NL		COMMENTS
	Island Interconnected		
	2017	2029	
MEASURE INFORMATION			
CCE ($/kWh)	9.3		Energy Star is 6.2 $/kWh
Simple Payback (years)	6.6		Energy Star is 4.4 years
ECONOMIC POTENTIAL (number of washers)			
Total Number of Dwellings	170,114	185,416	
Washers Affected (Cumulative)	124,696	174,832	
Washers Affected (Per Year)	41,565	11,655	
PARTICIPATION RATES (%)			
BAU (Business As Usual)		10%	Past results: 50-65%; curve A
Aggressive Marketing		20%	Past results: 70-98%; curve A
ACHIEVABLE POTENTIAL (number of washers)			
BAU Marketing		17,483	
Aggressive Marketing		34,966	
PARTICIPATION RATES (relative to discussion scenario)			
Attached Homes			lower
Apartments			lower
New Homes			higher
Labrador			lower
Isolated			lower
Other Appliance Technologies:			
ENERGY STAR Refrigerators			lower
ENERGY STAR Freezers			slightly lower
ENERGY STAR Dishwashers			higher
OTHER PARAMETERS			
Sensitivity to Incentives (High, Medium, Low)			high sensitivity to incentives
Primary Incentive Target (User, Channel Member, Both)			both
Sensitivity to Direct Program Support (High, Medium, Low)			medium to high
Most Critical Program Support Type(s) (e.g. Trade Ally Training, Certification, Technical Workshops, etc.)			working with retailers

Notes:
- CEE Tier III is unfamiliar
- Retailers need to educate the customer about which models qualify
- cost is an issue
- utility have not referenced Energy Star or CEE; instead they offer a rebate on "qualifying models"
- there is a lot of product availability in the market - that may mean the rebate is too large - retailer in the room didn't think it was too large
- some retailers have really run with the program; others have been much more reluctant
- engaged retailers very much needed
- rebate is currently for the customer, not the dealer
- good retailers see it as a way to increase sales; others don't see that
- about 20% of the core appliance line qualifies
- people are looking for features and price, but the rebate does help convince people to choose the more efficient model
- our incremental cost might be too large
- the energy efficient washers tend to be better models overall
- education about the cost of a wash
- participation in the current program is still building
- the washer is one of the best performing products in the program

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CONSERVATION AND DEMAND MANAGEMENT (CDM) POTENTIAL

NEWFOUNDLAND and LABRADOR

Commercial Sector

–Final Report–

Prepared for:

Newfoundland & Labrador Hydro and Newfoundland Power

Prepared by:

Marbek Resource Consultants Ltd.

In association with:

**CBCL Ltd.
and
Applied Energy Group**

January 18, 2008

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EXECUTIVE SUMMARY

❑ Background and Objectives

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province's future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report meets, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five-year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

❑ Scope and Organization

This study covers a 20-year study period from 2006 to 2026 and addresses the Residential, Commercial and Industrial sectors as well as street lighting. The study results combine customers from both NLH and NP and are presented for two service regions: Island and Isolated and the Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island and Isolated service region due to their relatively small size and electricity usage. Given pending load constraints, the study emphasizes the Island and Isolated service region.

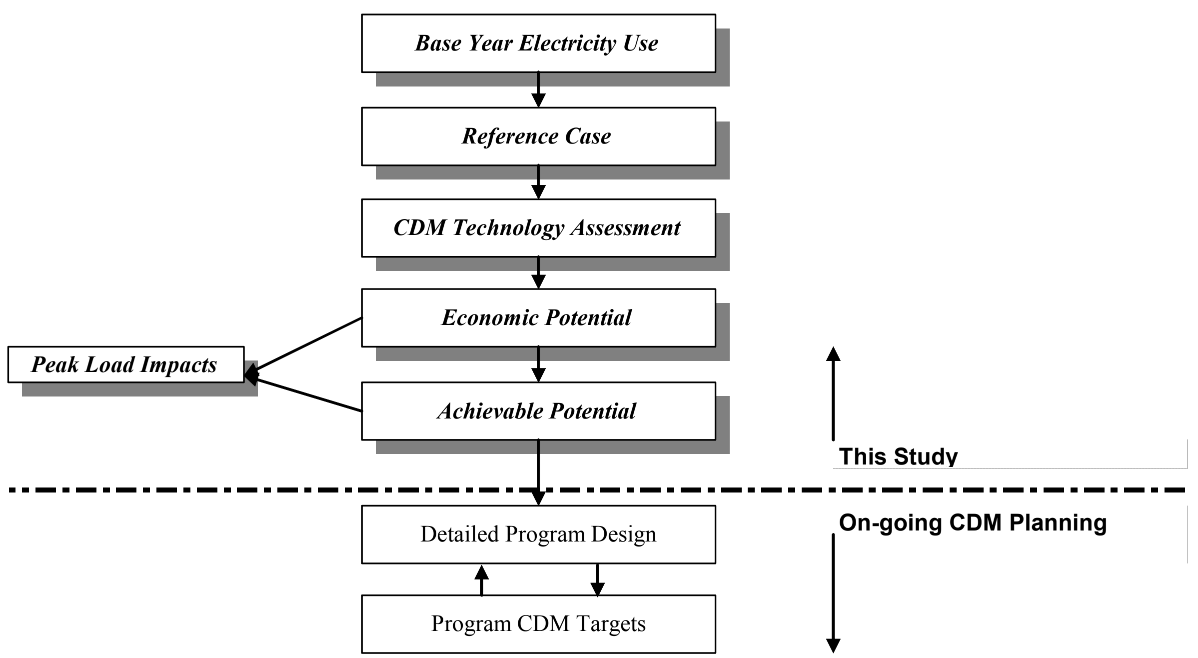
The study reviews all commercially viable electrical efficiency technologies or measures. In addition, the study also reviews selected peak load reduction and fuel switching measures.

- **Approach**

The detailed end-use analysis of electrical efficiency opportunities in the Commercial sector employed two linked modelling platforms: **CEEAM** (Commercial Electricity and Emissions Analysis Model), a Marbek in-house simulation model developed in conjunction with Natural Resources Canada (NRCan) for modelling electricity use in commercial/institutional building stock, and **CSEEM** (Commercial Sector Energy End-use Model), an in-house spreadsheet-based macro model. Peak load savings were modelled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

The major steps involved in the analysis are shown in Exhibit ES1 and are discussed in greater detail in Chapter 1. As illustrated in Exhibit ES1, the results of this study, and in particular the estimation of Achievable Potential,[1] support the on-going work of the Utilities; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific targets or with program design.

Exhibit ES1: Study Approach - Major Analytical Steps



[1] The proportion of savings identified that could realistically be achieved within the study period without consideration for budgetary constraints.

❑ Overall Study Findings[2]

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the stock of commercial buildings and customer willingness to implement new CDM measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgement of the consultant team, Utilities' personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

The study findings confirm the existence of significant potential cost-effective opportunities for CDM in Newfoundland and Labrador's Commercial sector. Electricity savings from efficiency improvements within the Island and Isolated service region would provide between 387 and 261 GWh/yr. of electricity savings by 2026 in, respectively, the Upper and Lower Achievable scenarios. The most significant Achievable Savings opportunities were in the actions that addressed lighting, HVAC fans and pumps and space heating.

The study also assessed the peak load reductions that would result from the electricity savings (noted above). Electricity savings would provide peak load reductions of approximately 54 to 35 MW during the Utilities' typical Winter Peak Day[3] by 2026 in, respectively, the Upper and Lower Achievable scenarios.

❑ Summary of Electricity Savings

A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by the study is presented in Exhibits ES2 and ES3, by milestone year, and discussed briefly in the paragraphs below.

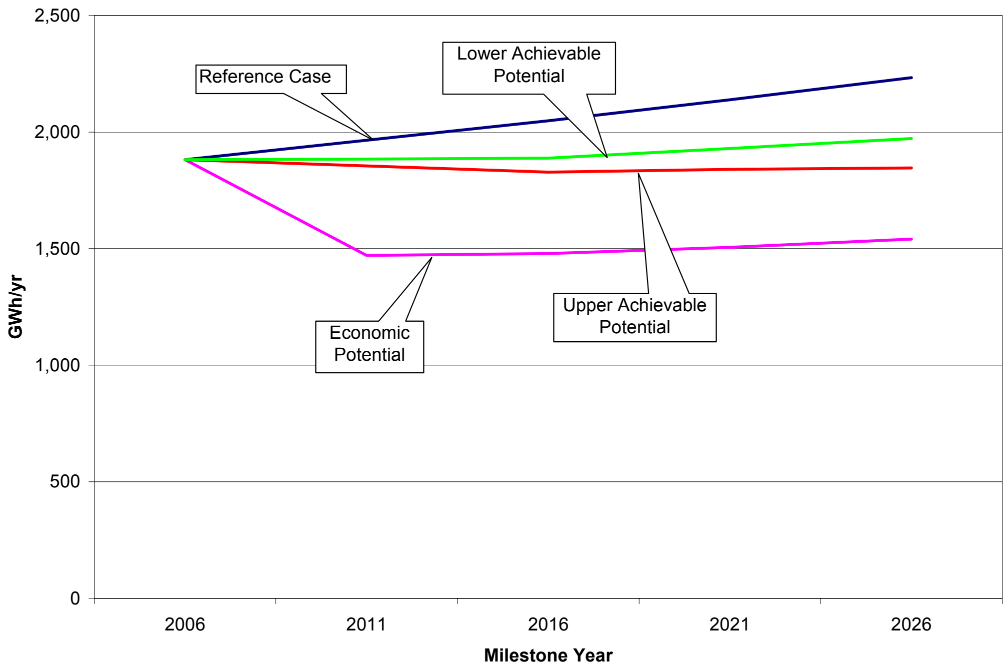
Exhibit ES2: Summary of Forecast Results for the Island and Isolated Service Region – Annual Electricity Consumption, Commercial Sector (GWh/yr.)

Annual Consumption (GWh/yr.) Commercial Sector						*Potential Annual Savings (GWh/yr.)*		
Milestone Year	*Base Year*	*Reference Case*	*Economic*	*Achievable*		*Economic*	*Achievable*	
				Upper	*Lower*		*Upper*	*Lower*
2006	1,881	1,881	1,881	1,881	1,881			
2011		1,965	1,471	1,855	1,884	494	110	80
2016		2,048	1,479	1,828	1,888	569	220	160
2021		2,138	1,506	1,840	1,930	632	298	209
2026		2,233	1,541	1,846	1,972	693	387	261

*Results are measured at the customer's point-of-use and do not include line losses.

[2] Consistent with the study scope, the results presented in this Executive Summary address the Island and Isolated service region. The main report provides a similar breakdown for the Labrador Interconnected service region.
[3] Winter Peak Day is defined as the week day hours from 7 am to 12 pm and 4 pm to 8 pm on the four coldest days in the December to March period; totals 36 hours.

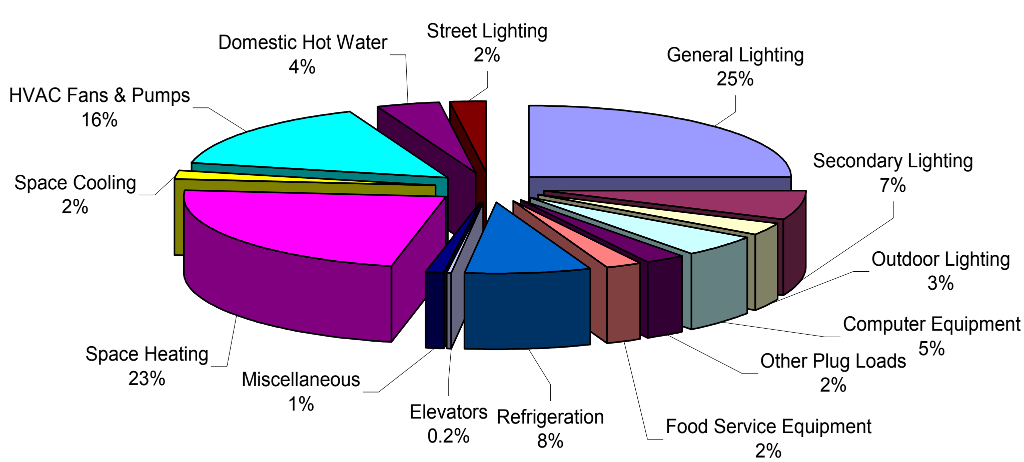
Exhibit ES3: Graphic of Forecast Results for the Island and Isolated Service Region – Annual Electricity Consumption, Commercial Sector (GWh/yr.)



Base Year Electricity Use

In the Base Year of 2006, the Commercial sector in the Island and Isolated service region consumed about 1,881 GWh. Exhibit ES4 shows that space lighting (general and secondary lighting) accounts for about 32% of total commercial electricity use, space heating accounts for about 23%, followed by HVAC fans and pumps (16%) and refrigeration (8%).

Exhibit ES4: Base Year Electricity Use by End Use in the Island and Isolated Service Region, Commercial Sector



Totals may not add to 100% due to rounding.

In the Island and Isolated Service Region, the Small Commercial sub sector accounts for the largest share of the total electricity consumption at 28%, followed by Office at 17%, Other Buildings at 8% and Food Retail at 7%.

Reference Case

In the absence of new Utility initiatives, the study estimates that electricity consumption in the Commercial sector will grow from 1,881 GWh/yr. in 2006 to about 2,233 GWh/yr. by 2026 in the Island and Isolated service region. This represents an overall growth of about 19% in the period and compares very closely with NLH's load forecast, which also included consideration of the impacts of "natural conservation."

Economic Potential Forecast

Under the conditions of the Economic Potential Forecast,[4] the study estimated that electricity consumption in the Commercial sector would fall to about 1,541 GWh/yr. by 2026 in the Island and Isolated service region. Annual savings relative to the Reference Case are 693 GWh/yr., or about 31%.

Achievable Potential

The Achievable Potential is the proportion of the economic electricity savings (as noted above) that could realistically be achieved within the study period. In the Commercial sector within the Island and Isolated service region, the Achievable Potential for electricity savings was estimated to be 387 GWh/yr. and 261 GWh/yr. by 2026 in, respectively, the Upper and Lower scenarios.

Consistent with the results in the Economic Potential Forecast, the most significant achievable savings opportunities were in the actions that addressed lighting, HVAC fans and pumps and space heating.

- **Peak Load Savings**

The electricity savings noted above also result in a reduction in capacity requirements (MW), which can be of particular value to the Utilities during periods of high electricity demand. The study defined the Newfoundland and Labrador system peak period as:

> *The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.*

The resulting peak load reductions are presented in Exhibit ES5. The Commercial sector peak load savings was estimated to be 54 MW and 35 MW by 2026 in, respectively, the Upper and Lower scenarios. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case.

[4] The level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against future avoided electricity costs.

Exhibit ES5: Peak Load Savings from Electricity Savings in the Island and Isolated Service Region, Commercial Sector

Milestone Year	Energy Savings (GWh/yr.)		Peak Load Reduction (MW)	
	Upper Achievable	Lower Achievable	Upper Achievable	Lower Achievable
2011	110	80	16	11
2016	220	160	31	23
2021	298	209	41	29
2026	387	261	53	34

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APPENDICES

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1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province's future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report is prepared to meet, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

1.2 STUDY SCOPE

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses three sectors: Residential, Commercial and Industrial as well as street lighting. It was agreed that the primary focus is on the Residential and Commercial sectors; the Industrial sector will be treated at a "high level."

- **Geographical Coverage**: The study addresses the customers of both utilities. Due to differences in cost and rate structures, the Utilities' customers are organized into two service regions, which in this report are referred to as the Island and Isolated and Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island and Isolated service region due to their relatively small size and electricity usage.

- **Study Period**: This study covers a 20-year period. The Base Year is the calendar year 2006, with milestone periods at five-year increments: 2011, 2016, 2021 and 2026. The Base Year of 2006 was selected as this was the most recent calendar year for which complete customer data were available.

- **Technologies:** The study addresses conservation and demand management (CDM) measures. Although CDM refers to a broad range of potential measures (see Section 1.3, Definitions), for the purposes of this study, it was agreed that the primary focus is on energy-efficiency measures. This includes measures that reduce electricity use as well as the associated capacity impact on a winter peak period. The study also provides a high-level treatment of selected demand management measures, such as direct control of space heating loads, etc.[5]

1.2.1 Data Caveat

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the stock of commercial buildings and customer willingness to implement new CDM measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgement of the consultant team, Utilities' personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.3 DEFINITIONS

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

A brief description of some of the most important terms and their application within this study is included below. The reader is also referred to the Terms Used in Building Profiles, found in Section 8 of this report.

[5] The information provided is based on the detailed analysis that Marbek is currently undertaking in other jurisdictions.

Base Year Electricity Use

The Base Year is the starting point for the analysis. It provides a detailed description of "where" and "how" electrical energy is currently used in the existing Commercial sector building stock. Building electricity use simulations were undertaken for the major sub sector types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2006.

Reference Case Electricity Use (includes Natural Conservation)

The Reference Case Electricity Use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2006) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of "economic" and "achievable" electricity savings potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the sub sectors, estimation of the expected growth in building stock and finally an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case is calibrated to the NLH Long Term Planning (PLF) Review Forecast, Summer/Fall 2006.

Conservation and Demand Management (CDM) Measures

CDM refers to a broad range of potential measures that can include energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and self-generation/co-generation (displace load off of grid).

As noted in Section 1.2, it was agreed that the primary focus is on energy-efficiency measures. This includes measures that reduce electricity use as well as the associated capacity impact on a winter peak period.

The Cost of Conserved Energy (CCE)

The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Economic Potential Electricity Forecast

The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the future avoided cost of electricity in the Newfoundland and Labrador Hydro service area (for this study, the value was set at $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the

Labrador Interconnected service region).[6] All the energy-efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the preceding avoided costs of new electricity supply were incorporated into the Economic Potential Forecast.

Achievable Potential The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as "Lower" and "Upper."

1.4 APPROACH

To meet the objectives outlined above, the study was conducted within an iterative process that involved a number of well-defined steps. At the completion of each step, the client reviewed the results and, as applicable, revisions were identified and incorporated into the interim results. The study then progressed to the next step. A summary of the steps is presented below.

Step 1: **Develop Base Year Electricity Calibration Using Actual Utility Billing Data**

- Compile and analyze available data on Newfoundland and Labrador's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.

Step 2: **Develop Reference Case Electricity Use**

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with NLH load forecast for the study period.

Step 3: **Identify and Assess Energy-efficiency Measures**

- Develop list of energy-efficiency upgrade measures.
- Compile detailed cost and performance data for each measure.

[6] Sensitivity analysis was also conducted using avoided cost values expected to prevail if the Lower Churchill/DC Link project is completed.

- Identify the baseline technologies employed in the Reference Case, develop energy-efficiency upgrade options and associated electricity savings for each option, and determine the CCE for each upgrade option.

Step 4: **Estimate Economic Electricity Savings Potential**

- Compile utility economic data on the forecast cost of new electricity generation; costs of $0.0980kWh and $0.0432/kWh were selected as the economic screens for, respectively, the Island and Isolated and Labrador Interconnected service regions.
- Identify the combinations of energy-efficiency upgrade options and building types where the cost of saving one kilowatt of electricity is equal to, or less than, the cost of new electricity generation.
- Apply the economically attractive electrical efficiency measures from Step 3 within the energy use simulation model developed previously for the Reference Case.
- Determine annual electricity consumption in each building type and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: **Estimate Achievable Potential Electricity Savings**

- "Bundle" the electricity and peak load reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a "high-level" implementation framework, including measure description, cost and savings profile, target sub sectors, potential delivery allies, barriers and possible synergies.
- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a full day workshop involving the client, the consultant team and technical experts to reach general agreement on "upper" and "lower" range of Achievable Potential.

Step 6: **Estimate Peak Load Impacts of Electricity Savings**

- The electricity (electric energy) savings (GWh) calculated in the preceding steps were converted to peak load (electric demand) savings (MW).[7]
- The study defined the Newfoundland and Labrador system peak period as the morning period from 7 am to noon and the evening period from 4 to 8 pm on the four coldest days of the year during the December to March period; this is a total of 36 hours per year.
- The conversion of electricity savings to hourly demand drew on a library of specific sub sector and end use electricity load shapes. Using the load shape data, the following steps were applied:

[7] Peak load savings were modeled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

- Annual electricity savings for each combination of sub sector and end use were disaggregated *by month*
- Monthly electricity savings were then further disaggregated *by day type* (weekday, weekend day and peak day)
- Finally, each day type was disaggregated *by hour*.

1.5 ANALYTICAL MODELS

The analysis of the Commercial sector employed two linked modelling platforms:

- CEEAM (Commercial Electricity and Emissions Analysis Model), an in-house, simulation model developed in conjunction with Natural Resources Canada (NRCan) for modelling electricity use in commercial/institutional building stock.

- CSEEM (Commercial Sector Electricity End-use Model), an in-house spreadsheet-based macro model.

CEEAM was used to develop commercial electricity end-use intensities (EUIs) for each of the commercial and institutional building archetypes. CEEAM has been successfully employed in numerous domestic and international CDM work. Domestically, this includes assignments for BC Hydro, Terasen Gas, Manitoba Hydro, the Ontario Power Authority (OPA), Consumers Gas and NRCan, including the extensive national climate change analysis conducted for the Federal Buildings Table. CEEAM is a robust modelling platform and its results have been verified against actual end-use metered data for commercial buildings in the cities of Ottawa and Toronto and against DOE-2.1E.

CEEAM was developed specifically for applications such as this study. One of its particular strengths is the capability to simulate electricity performance not only in a given building but also in an entire stock of similar buildings (e.g., all Large Offices). In particular, it is capable of tracking the penetration of multiple technologies and combinations that are not possible in other simulation software, such as DOE-2.

CEEAM simulates the electricity consumption and peak load for all electricity end uses present in a given commercial building segment. CEEAM calculates energy use and emissions by end use and reports them in $kWh/m^2/yr.$ and kg eCO_2/m^2. Because CEEAM is a full modelling program, it calculates both building heating and cooling loads (internal and transmission). It therefore accounts for interactive effects such as the increase in heating electricity use and decrease in cooling electricity use from lighting retrofits. CEEAM also uses equipment part load performance curves to accurately model the seasonal efficiency of heating and cooling plants.

The commercial EUIs derived by CEEAM provide inputs into Marbek's in-house CSEEM. CSEEM consists of two modules:

- A General Parameters module that contains general sector data (e.g., floor space, growth rates, etc.)

- A Building Profile module that contains the EUI data for each of the selected building sub sectors.

CSEEM combines the data from each of the modules and provides total electricity use by service region, building sub sector and end use. CSEEM also enables the analyst to estimate the demand impacts of the electrical efficiency measures introduced in the Economic Potential Forecast.

1.6 STUDY ORGANIZATION AND REPORTS

The study was organized and conducted by sector using a common methodology, as outlined above. The results for each sector are presented in individual reports as well as in a summary report. They are entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Commercial Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Industrial Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential, Commercial and Industrial Sectors, Summary Report*

The study also prepared a brief CDM program evaluation report, which is entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Program Evaluation Guidelines*.

This report presents the Commercial sector results; it is organized as follows:

- Section 2 presents a profile of Commercial sector Base Year Electricity Use in Newfoundland and Labrador, including a discussion of the major steps involved and the data sources employed.

- Section 3 presents a profile of Commercial sector Reference Case Electricity Use in Newfoundland and Labrador for the study period 2006 to 2026, including a discussion of the major steps involved.

- Section 4 identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Commercial sector.

- Section 5 presents the Commercial sector Economic Potential Electricity Forecast for the study period 2006 to 2026.

- Section 6 presents the estimated Upper and Lower Achievable Potential for electricity savings for the study period 2006 to 2026.
- Section 7 presents conclusions and next steps.
- Section 8 presents a listing of major references.
- Section 9 provides an explanation of terms used in the building profiles.

2. BASE YEAR (2006) ELECTRICITY USE

2.1 INTRODUCTION

This section provides a profile of Base Year (2006) electricity use in Newfoundland and Labrador's Commercial[8] sector. The discussion is organized into the following subsections:

- Segmentation of Commercial Sector
- Definition of End Uses
- End-use Saturation and Fuel Share Data
- Detailed Building and Equipment Specifications
- Floor Area Calculations
- Summary of Model Results.

2.2 SEGMENTATION OF COMMERCIAL SECTOR

The first major task in developing the Base Year calibration involved the segmentation of the commercial building stock into specific sub sectors. The choice of specific building sub sectors is driven by both data availability and the need to facilitate the subsequent analysis and modelling of potential electrical efficiency improvements.

To facilitate the subsequent modelling and analysis of energy-efficiency opportunities, the selected building sub sectors need to be reasonably similar in terms of major design and operating considerations, such as building size, mechanical and electrical systems, annual operating hours, etc.

A summary of the Commercial sub sectors that are used in this study is provided in Exhibit 2.1.

Exhibit 2.1: Commercial Sub Sectors

- Office
- Non-food Retail
- Food Retail
- Accommodations (Hotels & Motels)
- Health Care (Hospitals & Nursing Homes)
- Schools (Elementary and Secondary)
- Universities and Colleges
- Warehouse/Wholesale
- Small Commercial (all customers in sector below approx. 50 kW)
- Isolated C/I Buildings
- Other Buildings
- Other Institutional
- Non-Buildings

[8] Throughout this report, use of the word "commercial" includes both commercial and institutional buildings unless otherwise noted.

The types of buildings included in most of the sub sectors shown in Exhibit 2.1 are self-explanatory. However, additional explanation is provided for four of the sub sectors:

- **Isolated C/I Buildings**. This sub sector includes buildings such as restaurants, schools, variety stores, medical clinics and multi-purpose garages and sheds that are located in isolated communities served by local diesel-powered systems.

- **Other Buildings**. This sub sector represents buildings that do not fit into the specific sub sectors shown in Exhibit 2.1 including churches, theatres, community centres, transportation buildings and recreation complexes.

- **Other Institutional**. This sub sector includes buildings such as barracks, mess halls, hangers and warehouses located at Canadian Forces Base Goose Bay.

- **Non-Buildings.** This sub sector includes facilities such as micro wave repeater stations and telephone exchanges. Although these facilities are housed within a “building,” the majority of their electricity use is consumed by the unique equipment that it houses. This sub sector will be tracked throughout the study but will not be subjected to detailed analysis.

2.3 DEFINITION OF END USES

Electricity use within each of the sub sectors noted above is further defined on the basis of specific end uses. In this study, an end use is defined as, “the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy.” A summary of the major Commercial sector end uses used in this study is provided in Exhibit 2.2 together with a brief description of each.

Exhibit 2.2: Commercial Sector End Uses

End-Use	Description/Comments
General Lighting	Lighting in main areas of a building, e.g., classrooms in a school
Secondary Lighting	Lighting in secondary areas of a building, e.g., corridors/lobbies in a school
Outdoor Lighting	Lighting used for parking lots and exterior building illumination
Computer Equipment	Computers, monitors, printers, fax machines, copiers and servers
Other Plug Loads	Other plug loads excluding computer equipment
Food Service Equipment	Food preparation equipment including ranges, broilers, ovens, etc.
Refrigeration	Fridges, freezers, coolers, and display cases
Elevator	Passenger and freight elevators
Miscellaneous Equipment	Air compressors, sump pumps, clothes washers, etc.
Space Heating	Electric boilers, unit heaters, baseboard heaters
Space Cooling	Air-conditioning compressors
HVAC Fans & Pumps	Fans, pumps, cooling tower fans, etc.
Domestic Hot Water	Electric water heaters
Street Lighting	Roadway lighting

2.4 END-USE SATURATION AND FUEL SHARE DATA

The next step in the analysis involved an estimation of the electric fuel share for both space heating and domestic hot water,[9] and an estimation of saturation for space cooling.[10] Various information sources were used to derive these estimates, including analysis of utility sales data, and consultations with NLH/NP and local technical advisors.

Exhibits 2.3 and 2.4 present the estimated fuel shares and saturations for each sub sector and service region.

Exhibit 2.3: Electric Fuel Share by Sub Sector and Service Region, (%)

Sub Sector	Island and Isolated		Labrador Interconnected	
	Space Heating	Domestic Hot Water	Space Heating	Domestic Hot Water
Office	79%	90%	100%	100%
Non-food Retail	62%	90%	100%	100%
Food Retail	67%	70%	100%	100%
Health Care	23%	30%	90%	100%
Schools	74%	80%	75%	100%
Accommodations	74%	80%	100%	100%
University/College	11%	50%	100%	100%
Warehouse/Wholesale	56%	80%	100%	100%
Small Commercial	63%	83%	98%	100%
Other Buildings	52%	62%	98%	98%
Isolated Buildings	15%	10%		
Other Institutional			30%	30%

Exhibit 2.4: Space Cooling Saturation by Sub Sector and Service Region, (%)

Sub Sector	Island and Isolated	Labrador Interconnected
Office	80%	50%
Non-food Retail	70%	25%
Food Retail	60%	15%
Health Care	75%	35%
Schools	0%	0%
Accommodations	50%	50%
University/College	10%	25%
Warehouse/Wholesale	5%	0%
Small Commercial	31%	26%
Other Buildings	18%	9%
Isolated Buildings	0%	
Other Institutional		21%

[9] Space heating fuel share refers to the percentage of the total floor space that is electrically heated; similarly, DHW fuel share refers to the percentage of the total floor space that is served by electric domestic hot water.
[10] Space cooling saturation refers to the percentage of the total floor space that is air conditioned.

2.5 DETAILED BUILDING AND EQUIPMENT SPECIFICATIONS

The next major task involved the development of detailed technical data on building specifications, mechanical and electrical equipment, operating practices and electricity use for each sub sector and end use identified above.

To facilitate the subsequent analysis of the potential impacts of energy-efficiency measures, the detailed data on building, equipment and operating practices were compiled using Marbek's commercial/institutional building energy use simulation model (CEEAM). Detailed building profiles were created for the stock of buildings within each sub sector, using weather data from Environment Canada.

Development of the detailed building profiles relied on an analysis of existing data sources. They included:

- Site visits
- Consultations with local technical advisors
- Building information and utility consumption provided by various organizations
- Professional experience of the study team personnel.

Exhibit 2.5 presents a sample summary building profile. Detailed profiles for each existing building sub sector are provided in Appendix A.

Exhibit 2.5: Sample Summary Building Profile

Building Type:	Office	**Location:**	Island and Isolated

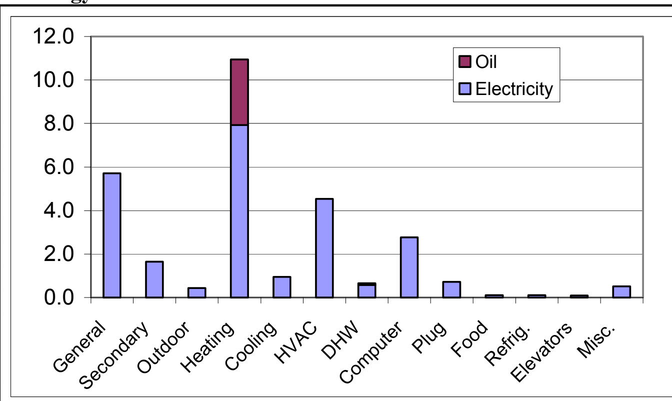
The building characteristics used to define the Office archetype are as follows:
- Average gross floor area of 40,000 ft²
- Average footprint of 13,333 ft² (approx. 115 ft x 115 ft)
- Average height of 3 storeys.

Technical Profile of Major Building Systems

Building Envelope:							
Roof U Value	0.12 Btu/hr.ft² .°F						
Wall U Value	0.09 Btu/hr.ft² .°F						
Window U Value	0.70 Btu/hr.ft² .°F						
Shading Coefficient (SC)	0.58						
Window to Wall Ratio (WWR)	0.36						
General Lighting:	550 Lux		1.5 W/ft²				
System Types	INC	CFL	T12	T8	MH	HPS	
	0%	0%	70%	30%	0%	0%	
Secondary Lighting:	350 Lux		3.1 W/ft²				
System Types	INC	CFL	T12	T8	MH	HPS	
	50%	45%	0%	0%	5%	0%	
Outdoor Lighting:			0.1 W/ft²				
System Types	FLUOR	INC	HID	Other			
	26%	19%	54%	1%			
Overall LPD			1.8 W/ft²				
Fans:							
System Types	CAV	VAV					
	75%	25%					
System Air Flow	0.71 CFM/ft²						
Fan Power	0.57 W/ft²						
Space Heating:							
System Types	AS HP	WS HP	Resistance	Oil			
	0%	0%	79%	21%			
Peak Heating Load	19 Btu/hr.ft²						
Space Cooling							
System Types	Centrifugal	Centri HE	Recip Open	DX			
	20%	0%	0%	80%			
Peak Cooling Load	27 Btu/hr.ft²		448 ft²/Ton				
Pumps:							
Circulating Pumps	0.1 W/ft²						
Condenser Pumps	0.1 W/ft²						

Energy Profile

End Use	**Elec** kWh/ft².yr	**Oil** kWh/ft².yr
GENERAL LIGHTING	5.7	
SECONDARY LIGHTING	1.7	
OUTDOOR LIGHTING	0.4	
SPACE HEATING	7.9	3.0
SPACE COOLING	1.0	
HVAC FANS & PUMPS	4.5	
DOMESTIC HOT WATER	0.6	0.1
COMPUTER EQUIPMENT	2.8	
OTHER PLUG LOADS	0.7	
FOOD SERVICE EQUIPMENT	0.1	
REFRIGERATION	0.1	
ELEVATORS	0.1	
MISCELLANEOUS	0.5	
Total	**26.1**	**3.1**



2.6 FLOOR AREA CALCULATIONS

Floor area is used to drive changes in Newfoundland and Labrador's commercial building stock over the study period, including changes to equipment and electricity use. For the purposes of this study, floor space was derived by dividing the actual sales data for each building sub sector by the applicable fuel share and saturation-weighted, whole-building electricity use intensity (EUI). Exhibit 2.6 shows the resulting estimates of floor area within each building sub sector in the Island and Isolated and Labrador Interconnected service regions.

Exhibit 2.6: Floor Area by Sub Sector and Service Region, (ft^2)

Sub Sector	Island and Isolated	Labrador Interconnected	Total
Office	12,178,467	316,584	12,495,051
Non-food Retail	4,326,634	911,653	5,238,286
Food Retail	2,356,898	173,358	2,530,256
Health Care	3,790,192	670,349	4,460,542
Schools	9,509,360	631,026	10,140,387
Accommodations	4,694,717	155,325	4,850,042
University/College	7,374,889	198,785	7,573,675
Warehouse/Wholesale	3,780,305	431,856	4,212,161
Small Commercial	23,464,658	1,368,078	24,832,736
Other Buildings	9,528,256	1,025,539	10,553,794
Isolated Buildings	1,919,228		1,919,228
Other Institutional		2,488,528	2,488,528
Total	**82,923,605**	**8,371,081**	**91,294,686**

Note: Any differences in totals are due to rounding.

For the Island and Isolated service region, the total floor area of the modelled sub sectors is approximately 83 million square feet. The largest sub sector is Small Commercial, which accounts for 28%[11] of the total floor area, followed by Office at 15%, Other Buildings at 11% and Schools at 11%.

For the Labrador Interconnected service region, the total floor area of the modelled sub sectors is approximately 8.4 million square feet. The largest sub sector is Other Institutional, which accounts for 30% of the total floor area, followed by Small Commercial at 16%, Other Buildings at 12% and Non-food Retail at 11%.

2.7 SUMMARY OF MODEL RESULTS

This section presents the results of the analysis of electricity consumption for the Base Year 2006. Electricity consumption is measured at the customer's point-of-use and does not include line losses.

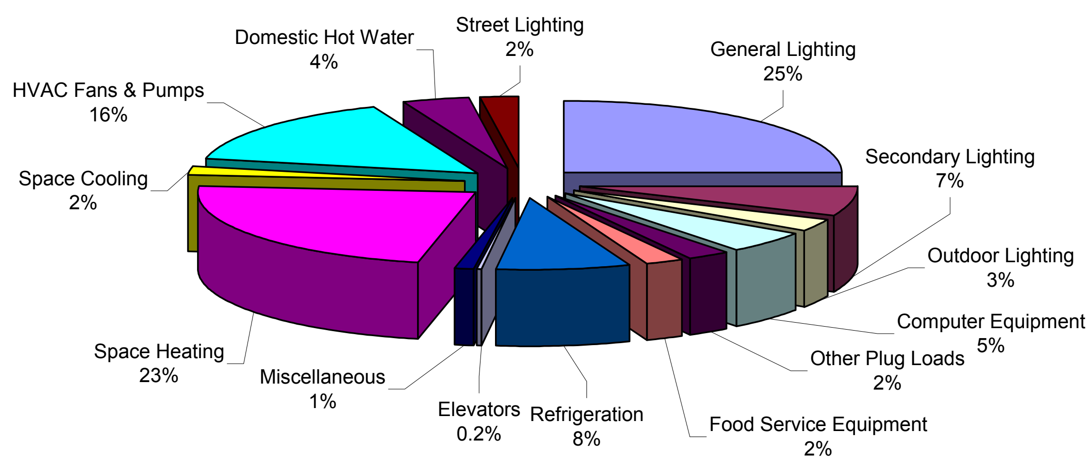
[11] Retail stores located in malls with individual metering that use less than 50 kW are included in the Small Commercial sub sector.

Exhibits 2.7 and 2.8 present the electricity consumption for, respectively, the Island and Isolated and Labrador Interconnected service regions by building sub sector and end use. Note: the Non-Buildings sub sector was not modelled and, therefore, the electricity consumption is carried as a total for the sub sector.

Exhibit 2.7: Base Year Annual Electricity Consumption for the Island and Isolated Service Region by Sub Sector and End Use, (GWh/yr.)[12]

Sub Sector	Electricity Consumption by End Use (GWh/yr)														
	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneous	Space Heating	Space Cooling	HVAC Fans & Pumps	Domestic Hot Water	Street Lighting	Total
Office	69.5	20.1	5.3	33.8	8.7	1.3	1.3	1.2	6.3	96.6	11.6	55.2	7.1		317.9
Non-food Retail	50.4	4.6	3.8	3.9	2.8	1.1	1.0	0.0	1.1	23.1	4.1	22.6	1.9		120.3
Food Retail	21.2	3.1	3.1	2.1	2.0	3.7	73.0	0.0	0.6	8.0	1.2	10.6	2.1		130.7
Health	4.3	21.2	3.3	4.2	6.6	7.8	1.5	0.8	1.0	17.6	2.8	26.0	3.8		100.9
Schools	28.9	8.5	4.2	6.1	1.0	1.0	0.7	0.0	0.7	52.8	0.0	5.9	3.7		113.6
Accommodations	13.1	14.9	2.1	2.6	2.3	6.1	3.6	0.5	1.2	27.8	1.5	10.8	25.2		111.6
University/College	40.3	6.2	3.2	10.5	4.8	2.9	3.8	0.7	1.9	6.2	0.9	36.1	2.4		119.9
Warehouse/Wholesale	18.8	2.8	1.7	1.7	3.1	0.4	5.9	0.0	1.0	12.9	0.1	3.6	1.5		53.4
Small Commercial	150.0	28.5	13.2	25.4	11.5	9.8	43.2	0.5	5.2	134.3	8.4	84.2	20.0		534.1
Other Buildings	49.3	8.6	5.1	2.7	1.0	3.4	3.0	0.0	2.0	38.2	1.4	25.4	2.8		142.9
Non-Buildings															81.6
Isolated Buildings	6.1	1.4	0.7	0.9	0.6	0.4	3.0	0.0	0.0	0.5	0.0	1.0	0.1		14.8
Street Lighting														39.4	39.4
Total	**452**	**120**	**46**	**94**	**45**	**38**	**140**	**4**	**21**	**418**	**32**	**282**	**71**	**39**	**1,881**

Note: Any differences in totals are due to rounding.



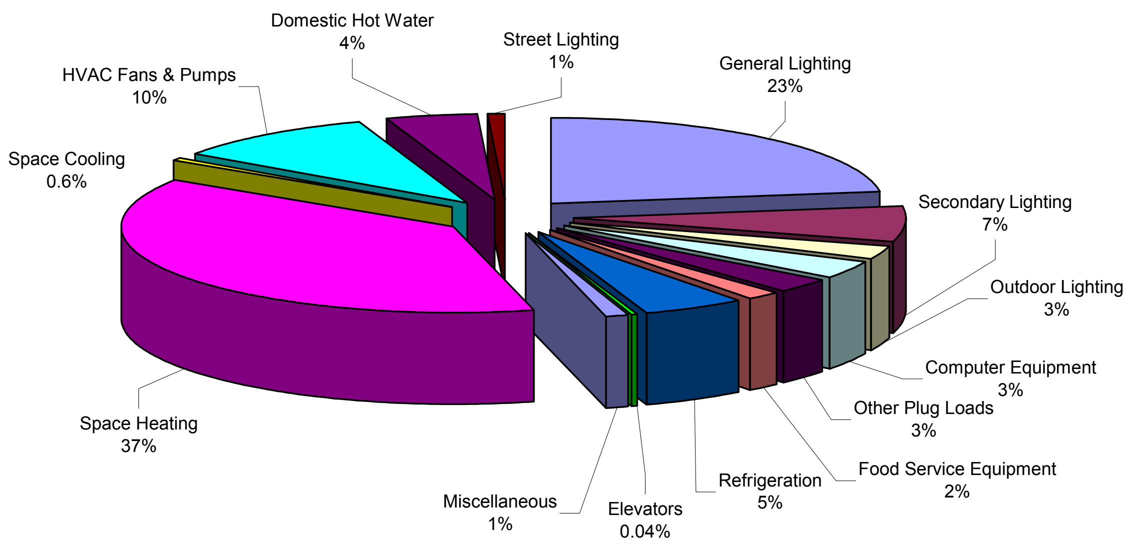
Totals may not add to 100% due to rounding.

[12] The pie chart presents percentage of electricity consumption by end use for buildings only; the sub sector Non-Buildings is included in the total load, but not included in the above pie chart.

Exhibit 2.8: Base Year Annual Electricity Consumption for Labrador Interconnected Service Region by Sub Sector and End Use, (GWh/yr.)[13]

Sub Sector	Electricity Consumption by End Use (GWh/yr)														
	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneous	Space Heating	Space Cooling	HVAC Fans & Pumps	Domestic Hot Water	Street Lighting	Total
Office	1.8	0.5	0.1	0.9	0.2	0.0	0.0	0.0	0.2	4.0	0.12	0.7	0.2		8.9
Non-food Retail	9.8	0.9	0.8	0.8	0.6	0.2	0.2	0.0	0.2	10.7	0.24	2.3	0.4		27.2
Food Retail	1.4	0.2	0.2	0.2	0.1	0.3	4.5	0.0	0.0	2.6	0.02	0.4	0.2		10.1
Health	0.8	3.8	0.6	0.7	1.2	1.4	0.3	0.1	0.2	6.8	0.09	2.1	2.2		20.2
Schools	2.2	0.6	0.3	0.4	0.1	0.1	0.0	0.0	0.0	5.1	0.00	0.8	0.3		9.9
Accommodations	0.4	0.5	0.1	0.1	0.1	0.1	0.1	0.0	0.0	1.8	0.04	0.3	1.0		4.6
University/College	1.1	0.2	0.1	0.3	0.1	0.1	0.1	0.0	0.2	2.4	0.04	0.6	0.1		5.3
Warehouse/Wholesale	2.1	0.3	0.2	0.2	0.4	0.0	0.7	0.0	0.1	4.6	0.00	0.6	0.2		9.4
Small Commercial	8.5	1.6	0.8	1.4	0.7	0.5	2.2	0.0	0.3	16.1	0.31	2.6	1.4		36.3
Other Buildings	5.2	0.9	0.5	0.3	0.1	0.4	0.3	0.0	0.2	11.4	0.05	2.2	0.5		22.1
Non-Buildings															7.2
Other Institutional	10.7	3.8	1.2	1.0	1.7	0.5	1.5	0.0	0.7	8.4	0.18	6.9	2.0		38.7
Street Lighting														1.6	1.6
Total	44.0	13.4	4.9	6.2	5.3	3.5	9.8	0.1	2.2	73.9	1.1	19.5	8.7	1.6	201.4

Note: Any differences in totals are due to rounding.



Totals may not add to 100% due to rounding.

[13] The pie chart presents percentage of electricity consumption by end use for buildings only; the sub sector Non-Buildings is included in the total load, but not included in the above pie chart.

Highlights of the results shown in Exhibits 2.7 and 2.8 are as follows:

Base Year Electricity Use by Sub Sector

- In the Island and Isolated Service Region, the Small Commercial sub sector accounts for the largest share of the total electricity consumption at 28%, followed by Office at 17%, Other Buildings at 8% and Food Retail at 7%.

- In the Labrador Interconnected service region, Other Institutional accounts for the largest share of total electricity consumption at 19%, followed by Small Commercial at 18%, Non-food Retail at 14% and Other Buildings at 11%.

Base Year Electricity Use by End Use

- In the Island and Isolated Service Region, general and secondary lighting combined account for the largest share of building electricity consumption at 32%, followed by space heating at 23%, HVAC fans and pumps at 16% and refrigeration at 8%.

- In the Labrador Interconnected service region, space heating accounts for the largest share of building electricity consumption at 37%, followed by general and secondary lighting combined at 30%, HVAC fans and pumps at 10% and refrigeration at 5%.

3. REFERENCE CASE ELECTRICITY USE

INTRODUCTION

This section presents the Commercial sector Reference Case for the study period. The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new utility-based initiatives or rate changes. The Reference Case, therefore, provides the point of comparison for the calculation of electricity savings opportunities associated with each of the subsequent scenarios that are assessed within this study.

The discussion is presented within the following subsections:

- Development of Detailed “New” Building and Equipment Specifications
- “Natural” Changes Affecting Electricity Consumption
- Expected Growth in Building Stock
- Summary of Model Results – Reference Case.

3.2 DEVELOPMENT OF DETAILED “NEW” BUILDING AND EQUIPMENT SPECIFICATIONS

The first task in building the Reference Case involved the development of detailed technical profiles that define building specifications, mechanical equipment, lighting equipment and electricity use for the “new” buildings in each of the commercial building sub sectors. In each case, the new building profiles were developed using Marbek’s CSEEM and the same approach as described previously in Section 2.

Exhibit 3.1 presents a sample summary new building profile. It summarizes the major technical assumptions that have been used for new Offices in the development of the Reference Case. Detailed profiles for each new building sub sector are provided in Appendix A.

Exhibit 3.1: Sample Summary New Building Profile - Office in Island and Isolated Service Region

Building Type:	Office	**Location:**	Island and Isolated

The building characteristics used to define the Office archetype are as follows:
- Average gross floor area of 40,000 ft^2
- Average footprint of 13,333 ft^2 (approx. 115 ft x 115 ft)
- Average height of 3 storeys.

Technical Profile of Major Building Systems

Building Envelope:						
Roof U Value	0.07 Btu/hr.ft^2 .°F					
Wall U Value	0.03 Btu/hr.ft^2 .°F					
Window U Value	0.49 Btu/hr.ft^2 .°F					
Shading Coefficient (SC)	0.58					
Window to Wall Ratio (WWR)	0.35					
General Lighting:	500 Lux		1.2 W/ft^2			
System Types	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH
	0%	0%	0%	0%	100%	0%
Secondary Lighting:	350 Lux		1.5 W/ft^2			
System Types	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH
	10%	30%	0%	0%	40%	20%
Outdoor Lighting:			0.2 W/ft^2			
System Types	FLUOR	INC	HID	Other		
	26%	19%	54%	1%		
Overall LPD			1.4 W/ft^2			
Fans:						
System Types	CAV	VAV				
	50%	50%				
System Air Flow	0.79 CFM/ft^2					
Fan Power	0.63 W/ft^2					
Space Heating:						
System Types	AS HP	WS HP	Resistance	Oil		
	0%	0%	100%	0%		
Peak Heating Load	18 Btu/hr.ft^2					
Space Cooling						
System Types	Centrifugal	Centri HE	Recip Open	DX		
	0%	20%	0%	80%		
Peak Cooling Load	26 Btu/hr.ft^2		454 ft^2/Ton			
Pumps:						
Circulating Pumps	0.1 W/ft^2					
Condenser Pumps	0.1 W/ft^2					

Energy Profile

	Elec	**Oil**
End Use	**kWh/ft^2.yr**	
GENERAL LIGHTING	4.6	
SECONDARY LIGHTING	0.8	
OUTDOOR LIGHTING	0.8	
SPACE HEATING	8.3	0.0
SPACE COOLING	1.1	
HVAC FANS & PUMPS	4.2	
DOMESTIC HOT WATER	0.6	0.0
COMPUTER EQUIPMENT	2.8	
OTHER PLUG LOADS	0.7	
FOOD SERVICE EQUIPMENT	0.1	
REFRIGERATION	0.1	
ELEVATORS	0.0	
MISCELLANEOUS	0.5	
Total	**24.6**	**0.0**

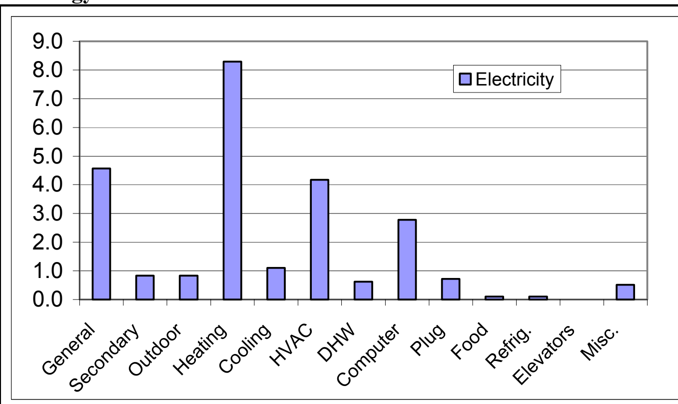


Exhibit 3.2 highlights the resulting whole building electric EUIs for each new commercial building sub sector. For the purposes of comparison, it also shows whole building electric EUIs for each of the existing building sub sectors. As shown, whole building electric EUIs decline for most sub sectors as a result of the following:

- Improved lighting system efficiency, including higher-efficacy lighting sources, more efficient lighting technologies and the use of automatic lighting controls
- Higher-efficiency building envelopes, including improved window U-values and higher levels of wall and roof insulation
- Higher-efficiency HVAC systems, including integrated designs, higher cooling equipment efficiencies and the use of building automation systems.

However, in some cases, gains made through energy efficiency are offset by the following factors that result in increased energy use in new buildings:

- Increased space heating and domestic hot water electric fuel shares, particularly in the Island and Isolated service region
- Increased saturation of space cooling in most sub sectors
- New design guidelines that require higher ventilation rates in selected sub sectors, such as in Schools, Food Retail and Health Care
- Increased use of outdoor lighting, particularly in the retail sub sectors.

Exhibit 3.2: Comparison of Whole Building Electric EUIs by Sub Sector and Service Region, (kWh/ft²/yr.)

Sub Sector	Island and Isolated			Labrador Interconnected		
	Existing Buildings	New Buildings	Comments	Existing Buildings	New Buildings	Comments
Office	26.1	24.6	New office buildings have higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, and higher space heating and hot water fuel shares resulting in a lower whole building EUI.	28.0	27.3	New office buildings have higher efficiency lighting, HVAC and envelope systems, and higher space cooling saturation resulting in a slightly lower whole building EUI.
Non-food Retail	27.8	25.3	New non-food retail buildings are typically "big box" stores with higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, and higher space heating and hot water fuel shares resulting in a lower whole building EUI.	29.9	29.0	New non-food retail buildings are typically "big box" stores with higher efficiency lighting, HVAC and envelope systems, and higher space cooling saturation resulting in a slightly lower whole building EUI.
Food Retail	55.4	53.3	New food retail buildings are typically "big box" stores with higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, higher space heating and hot water fuel shares, and higher penetration of refrigeration equipment resulting in a lower whole building EUI.	58.3	54.8	New food retail buildings are typically "big box" stores with higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, and higher penetration of refrigeration equipment resulting in a lower whole building EUI.
Health Care	26.6	36.2	New health care buildings have higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, higher ventilation rates, and higher space heating and hot water fuel shares resulting in a significantly higher whole building EUI.	30.1	39.0	New health care buildings have higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, higher ventilation rates, and higher space heating fuel shares resulting in a significantly higher whole building EUI.
Schools	11.9	12.3	New school buildings have higher efficiency lighting, HVAC and envelope systems, and higher space heating and hot water fuel shares resulting in a slightly higher whole building EUI.	15.6	14.9	New school buildings have higher efficiency lighting, HVAC and envelope systems, and higher space heating fuel shares resulting in a slightly lower whole building EUI.
Accomodations	23.8	24.3	New hotel/motel buildings have higher efficiency lighting, HVAC and envelope systems, and higher space heating and hot water fuel shares resulting in a slightly higher whole building EUI.	29.5	28.5	New hotel/motel buildings have higher efficiency lighting, HVAC and envelope systems, and higher space cooling saturation resulting in a slightly lower whole building EUI.
University/College	16.3	19.4	New university/college buildings have higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, and higher space heating and hot water fuel shares resulting in a higher whole building EUI.	26.5	21.2	New university/college buildings have higher efficiency lighting, HVAC and envelope systems, and higher space cooling saturation resulting in a lower whole building EUI.
Warehouse/Wholesale	14.1	15.2	New warehouse buildings have higher efficiency lighting, HVAC and envelope systems, and higher space heating and hot water fuel shares resulting in a slightly higher whole building EUI.	21.9	18.3	New warehouse buildings have higher efficiency lighting, HVAC and envelope systems resulting in a lower whole building EUI.
Small Commercial	22.8	22.4	New small commercial buildings have higher efficiency lighting, HVAC and envelope systems, higher space cooling saturation, and higher space heating and hot water fuel shares resulting in a slightly lower whole building EUI.	26.6	25.7	New small commercial buildings have higher efficiency lighting, HVAC and envelope systems, and higher space cooling saturation resulting in a lower whole building EUI.
Other Buildings	15.0	15.9	New other buildings have higher efficiency lighting, HVAC and envelope systems, and higher space heating and hot water fuel shares resulting in a slightly higher whole building EUI.	21.6	19.2	New other buildings have higher efficiency lighting, HVAC and envelope systems resulting in a lower whole building EUI.
Non-Buildings						
Isolated Buildings	7.7	7.4	New isolated buildings have higher efficiency lighting and HVAC systems resulting in a slightly lower whole building EUI.			
Other Institutional				15.5	14.6	New other institutional buildings have higher efficiency lighting, HVAC and envelope systems resulting in a lower whole building EUI.

3.3 "NATURAL" CHANGES AFFECTING ELECTRICITY CONSUMPTION

The next task involved estimating the expected "natural" changes in electricity consumption patterns over the study period with consideration of three major factors:

- "Naturally occurring" improvements in equipment efficiency
- Expected stock penetration by more efficient equipment
- Changes in equipment density, e.g., computers and plug loads, etc.

These factors strongly influence future electricity use within the Commercial sector. While the first two factors will have the effect of reducing electricity consumption, the last factor will result in increased electricity demand.

Other considerations, such as operating hours, fuel share and end-use saturation changes may also affect future electricity demand. These values were assumed to remain constant for existing and new stock over the study period, with two exceptions. Electric fuel share for space heating and DHW in existing buildings was allowed to increase through time,[14] as was space cooling saturation for existing buildings.

Based on the assessment of current trends, the most significant "natural" changes are expected to involve the following end uses:

- Lighting
- Space cooling
- Computer equipment and other plug loads.

Further discussion of these changes follows and, in each case, the discussion identifies the technical change, the major driver(s) and the assumed electricity impact.

3.3.1 Lighting

As a result of natural conservation, it is assumed that the replacement of existing T12 fluorescent lighting and electromagnetic ballasts with new T8 fluorescent lamps and electronic ballasts will continue. Similarly, CFLs will continue to increase their market share over incandescent lamps, particularly in sectors such as Accommodations and Non-food Retail.

The continued growth of CFLs and T8 lighting/electronic ballasts is being driven by:

- Further price decreases and increased consumer recognition of the operating cost savings
- Energy regulations that are gradually removing electromagnetic fluorescent ballasts from the market place.

[14] Electric fuel share is expected to increase as a portion of older, oil-heated buildings are renovated and switched to electric heat and DHW.

Overall, the Reference Case assumes that by 2026 the energy intensity of lighting in the existing building stock will decrease by 10%.

3.3.2 Space Cooling

As a result of natural conservation and efficiency gains, it is assumed that new space cooling equipment will provide improved electricity performance compared to existing equipment. New centrifugal chillers achieve performance efficiencies in the range of 0.49-0.60 kW per ton. Similarly, packaged rooftop units are available on the market with energy-efficiency ratios (EER) of up to 12.[15] The combined effects of natural conservation and efficiency gains are estimated to result in a decrease of 6% in space cooling EUI over the length of the study.

As noted above, space cooling is expected to experience an increase in saturation levels, as shown in Exhibit 3.3. This increase will counter the effect of natural conservation and efficiency gains. Overall, total space cooling energy use is expected to increase by varying degrees depending on building sector.

Exhibit 3.3: Changes to Space Cooling Saturation in Existing Buildings, by Sub Sector and Service Region (%)

Sub Sector	Island and Isolated		Labrador Interconnected	
	A/C Saturation Existing Buildings 2006	A/C Saturation Existing Buildings 2026	A/C Saturation Existing Buildings 2006	A/C Saturation Existing Buildings 2026
Office	80%	90%	50%	60%
Non-food Retail	70%	80%	25%	40%
Food Retail	60%	80%	15%	30%
Health Care	75%	80%	35%	95%
Schools	0%	5%	0%	0%
Accommodations	50%	70%	50%	60%
University/College	10%	20%	25%	35%
Warehouse/Wholesale	5%	10%	0%	0%
Small Commercial	31%	50%	26%	40%
Other Buildings	18%	30%	9%	20%
Non-Buildings				
Isolated Buildings	0%	0%		
Other Institutional			21%	30%

3.3.3 Computer Equipment and Other Plug Loads

Computer equipment and other plug loads will continue to grow as a result of increased density of computers per occupant, increased use of network computers and servers and growth in other peripherals, such as telephone network equipment. Increased penetration of laptops, more efficient server hardware and higher penetration of ENERGY STAR

[15] Current federal energy-efficiency regulations require a minimum EER of 10.3 for rooftop air conditioning units with a capacity of 5.5 - 11 tons.

rated computer equipment and other plug loads is expected to counterbalance the effect of increasing hardware density to some degree.

Overall, the Reference Case assumes that by 2026 the energy intensity of computer equipment and plug loads in the existing building stock will increase by 15%.[16]

3.3.4 Impact on Electricity Use

The net impact of the "natural" changes to the commercial building stock, independent of expected saturation or fuel switching changes, is equivalent to an overall reduction in energy intensity of approximately 1% by 2026 relative to the Base Year 2006. Most sub sectors will experience a reduction in energy use while others such as Health Care will experience a net increase of approximately 1% due to increases in computer equipment and plug loads. Total reductions are expected to be slightly lower in the Labrador Interconnected service region than in the Island and Isolated service region, as lighting and cooling represent a smaller portion of overall electricity use.

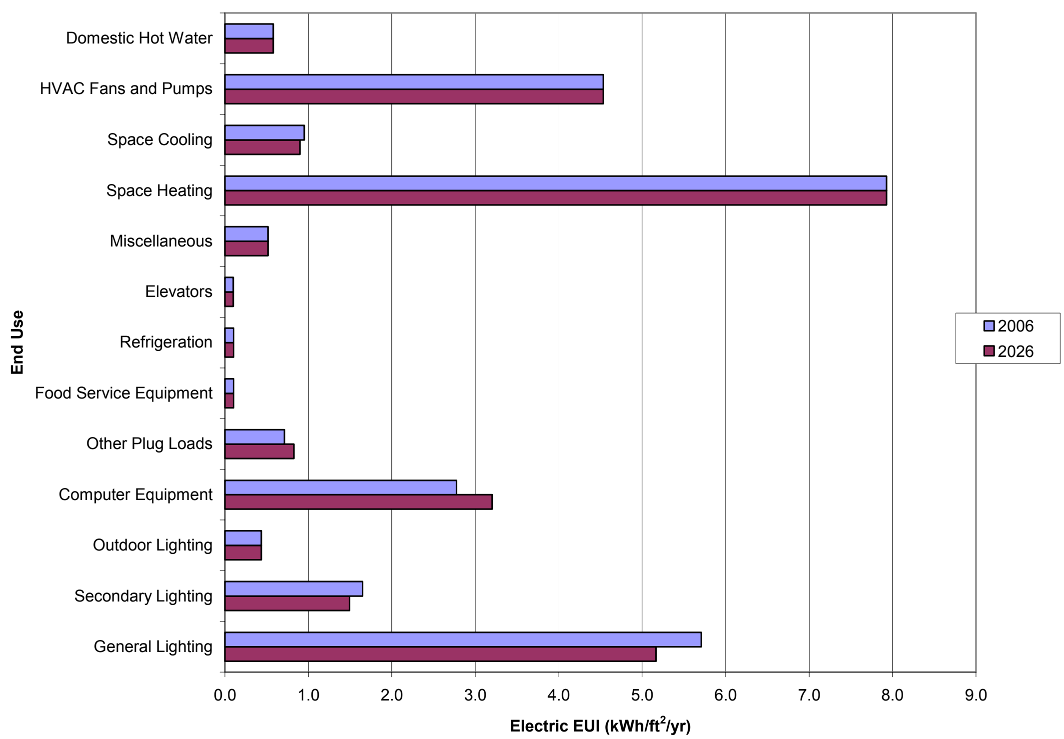
Exhibit 3.4 presents a comparison of electrical EUIs for an existing Office in the Island and Isolated service region for both the Base Year 2006 and 2026. As shown, lighting and space cooling experience a reduction due to the increased penetration of T8 lighting and more efficient cooling equipment, while computer equipment and plug loads increase by 15% due to increased equipment density.

[16] Estimates based on scenarios presented in Arthur D. Little, *Electricity Consumption by Office and Telecommunication Equipment in Commercial Buildings*. U.S. Department of Energy, 2002.

Exhibit 3.4: Comparison of Electrical EUI for Existing Office in Island and Isolated Service Region[17]

End Use	2006 (kWh/ft^2/yr)	2026 (kWh/ft^2/yr)	% Reduction
General Lighting	5.7	5.2	10%
Secondary Lighting	1.7	1.5	10%
Outdoor Lighting	0.4	0.4	0%
Computer Equipment	2.8	3.2	-15%
Other Plug Loads	0.7	0.8	-15%
Food Service Equipment	0.1	0.1	0%
Refrigeration	0.1	0.1	0%
Elevators	0.1	0.1	0%
Miscellaneous	0.5	0.5	0%
Space Heating	7.9	7.9	0%
Space Cooling	1.0	0.9	6%
HVAC Fans and Pumps	4.5	4.5	0%
Domestic Hot Water	0.6	0.6	0%
Total	26.1	25.9	1%

Note: Any differences in totals are due to rounding.



[17] Negative reduction shown above for computer equipment and plug loads represents an increased EUI.

3.4 EXPECTED GROWTH IN BUILDING STOCK

The next step in developing the Reference Case involved the development and application of estimated levels of floor space growth in each building sector and service region over the study period. The stock growth rates were derived from the sales forecast data provided by NLH from the NLH Long Term Planning (PLF) Review Forecast, Summer/Fall 2006. The derivation of floor space data in each of the milestone periods applied the following steps:

- Estimate and apply the expected impact of "natural conservation" (Section 3.3) for each sub sector (i.e., an updated EUI that includes the effects of natural conservation)

- Use the updated EUI to calculate the floor space required to match the NLH forecast electricity consumption in each combination of sub sector, milestone year and service region.

A summary is provided in Exhibits 3.5 and 3.6 for, respectively, the Island and Isolated and Labrador Interconnected service regions.

Exhibit 3.5: Commercial Sector Floor Space - Island and Isolated Service Region

Subsector	Milestone Year				
	2006	2011	2016	2021	2026
Office	12,178,467	12,858,186	13,550,786	14,378,272	15,247,773
Non-food Retail	4,326,634	4,532,248	4,742,020	4,991,339	5,254,885
Food Retail	2,356,898	2,462,484	2,569,935	2,697,329	2,831,624
Health Care	3,790,192	3,853,257	3,917,019	3,986,628	4,063,562
Schools	9,509,360	10,018,076	10,534,471	11,142,498	11,783,405
Accomodations	4,694,717	4,917,421	5,143,450	5,410,901	5,691,876
University/College	7,374,889	7,428,897	7,483,589	7,542,692	7,608,872
Warehouse/Wholesale	3,780,305	3,911,537	4,044,507	4,202,884	4,367,996
Small Commercial	23,464,658	24,785,227	26,131,069	27,330,816	28,620,237
Other Buildings	9,528,256	9,854,396	10,185,108	10,578,414	10,989,451
Non-Buildings					
Isolated Buildings	1,919,228	2,159,540	2,312,767	2,467,213	2,621,676
Other Institutional					
Total	82,923,605	86,781,269	90,614,721	94,728,986	99,081,357

Note: Any differences in totals are due to rounding.

Exhibit 3.6: Commercial Sector Floor Space - Labrador Interconnected Service Region

Subsector	Milestone Year				
	2006	2011	2016	2021	2026
Office	316,584	347,204	362,555	377,839	393,768
Non-food Retail	911,653	1,003,962	1,048,363	1,092,570	1,138,641
Food Retail	173,358	197,343	206,372	215,374	224,770
Health Care	670,349	760,275	785,504	785,504	785,504
Schools	631,026	703,929	735,620	735,620	735,620
Accomodations	155,325	173,527	181,242	188,927	196,936
University/College	198,785	231,416	243,829	243,829	243,829
Warehouse/Wholesale	431,856	477,745	502,304	526,924	552,752
Small Commercial	1,368,078	1,542,560	1,621,353	1,700,320	1,783,132
Other Buildings	1,025,539	1,109,234	1,162,766	1,216,272	1,272,240
Non-Buildings					
Isolated Buldings					
Other Institutional	2,488,528	2,488,528	2,488,528	2,488,528	2,488,528
Total	8,371,081	9,035,722	9,338,436	9,571,706	9,815,719

Note: Any differences in totals are due to rounding.

3.5 SUMMARY OF MODEL RESULTS – REFERENCE CASE

The Reference Case results for the two service regions are presented in Exhibits 3.7 and 3.8. As illustrated, the Reference Case indicates that, in the absence of new utility-based CDM initiatives, total Commercial sector electricity consumption for the Island and Isolated service region is expected to increase from 1,881 GWh/yr. in the Base Year to approximately 2,233 GWh/yr. in 2026, an increase of about 19%. For the Labrador Interconnected service region, consumption is forecast to grow from 201 GWh/yr. to 240 GWh/yr. over the study period, an increase of approximately 20%.

Highlights:

Reference Case Electricity use by Sub Sector

- In the Island and Isolated service region, Isolated Buildings show the greatest increase in electricity consumption over the study period (31%), followed by Office (24%) and Schools (24%). These changes are primarily driven by increases in sub sector building stock.

- Small Commercial buildings have the greatest increase in consumption (27%), followed by Food Retail (26%). Similarly, these increases are primarily driven by growth levels in sub sector building stock.

Reference Case Electricity use by End Use

- In the Island and Isolated Service Region, space cooling has the greatest increase over the study period (53%), followed by computers and plug loads (39% and 36% respectively). Increased space cooling electricity consumption is primarily due to an expected increase in cooling saturation, while the computer and plug loads increase is due to an expected increase in equipment density.

- In the Labrador Interconnected Service Region, space cooling again has the greatest increase over the study period (91%), followed by computers and plug loads (40% and 36% respectively). These increases are expected for similar reasons to those stated above.

Further detail is provided below.

- Exhibit 3.7 presents the Reference Case for the Island and Isolated service region, with the results broken out by building sub sector, end use and milestone year.

- Exhibit 3.8 presents the Reference Case for the Labrador Interconnected service region, with the results broken out by building sub sector, end use and milestone year.

Exhibit 3.7: Reference Case for Annual Electricity Consumption in the Island and Isolated Service Region, (GWh/yr.)[18]

Building Type	Milestone Year	GWh/yr														
		Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneous	Space Heating	Space Cooling	HVAC Fans & Pumps	Domestic Hot Water	Streetlighting
Office	2006	318	69.5	20.1	5.3	33.8	8.7	1.3	1.3	1.2	6.3	96.6	11.6	55.2	7.1	
	2011	335	70.9	20.2	5.9	37.0	9.6	1.3	1.3	1.2	6.6	102.9	12.5	58.0	7.5	
	2016	352	72.2	20.2	6.5	40.5	10.4	1.4	1.4	1.2	7.0	109.2	13.4	60.9	8.0	
	2021	373	73.9	20.4	7.2	44.5	11.5	1.5	1.5	1.2	7.4	116.7	14.4	64.4	8.5	
	2026	395	75.6	20.5	7.9	48.8	12.6	1.6	1.6	1.2	7.9	124.6	15.5	68.0	9.1	
Non-food Retail	2006	120	50.4	4.6	3.8	3.9	2.8	1.1	1.0	0.0	1.1	23.1	4.1	22.6	1.9	
	2011	125	51.0	4.7	4.1	4.2	3.0	1.2	1.0	0.0	1.2	24.6	4.3	23.5	2.0	
	2016	129	51.6	4.7	4.3	4.6	3.3	1.2	1.1	0.0	1.2	26.1	4.6	24.5	2.1	
	2021	135	52.4	4.8	4.7	5.0	3.6	1.3	1.1	0.0	1.3	27.9	4.9	25.7	2.3	
	2026	141	53.1	4.8	5.0	5.5	3.9	1.4	1.2	0.0	1.4	29.7	5.2	26.9	2.4	
Food Retail	2006	131	21.2	3.1	3.1	2.1	2.0	3.7	73.0	0.0	0.6	8.0	1.2	10.6	2.1	
	2011	136	21.5	3.1	3.2	2.2	2.1	3.8	76.1	0.0	0.6	8.6	1.4	11.0	2.3	
	2016	142	21.7	3.2	3.4	2.4	2.3	4.0	79.2	0.0	0.7	9.2	1.5	11.5	2.5	
	2021	148	22.1	3.2	3.5	2.6	2.5	4.2	82.9	0.0	0.7	9.8	1.7	12.0	2.6	
	2026	155	22.5	3.2	3.7	2.9	2.7	4.4	86.8	0.0	0.7	10.5	1.9	12.6	2.8	
Health	2006	101	4.3	21.2	3.3	4.2	6.6	7.8	1.5	0.8	1.0	17.6	2.8	26.0	3.8	
	2011	104	4.3	21.1	3.4	4.5	7.0	8.0	1.5	0.8	1.0	19.1	2.8	26.5	4.1	
	2016	107	4.3	20.9	3.4	4.7	7.3	8.1	1.5	0.8	1.0	20.5	2.9	27.0	4.5	
	2021	110	4.3	20.7	3.5	5.0	7.7	8.2	1.5	0.8	1.0	22.0	2.9	27.5	4.8	
	2026	113	4.2	20.5	3.6	5.2	8.2	8.4	1.6	0.8	1.0	23.6	3.0	28.1	5.2	
Schools	2006	114	28.9	8.5	4.2	6.1	1.0	1.0	0.7	0.0	0.7	52.8	0.0	5.9	3.7	
	2011	120	29.6	8.6	4.3	6.6	1.1	1.0	0.8	0.0	0.8	56.4	0.1	6.4	4.0	
	2016	126	30.2	8.7	4.4	7.2	1.2	1.1	0.8	0.0	0.8	60.0	0.3	6.8	4.3	
	2021	133	31.0	8.9	4.6	7.9	1.4	1.2	0.9	0.0	0.9	64.3	0.4	7.3	4.6	
	2026	141	31.9	9.0	4.8	8.7	1.5	1.2	0.9	0.0	0.9	68.7	0.6	7.8	4.9	
Accomodations	2006	112	13.1	14.9	2.1	2.6	2.3	6.1	3.6	0.5	1.2	27.8	1.5	10.8	25.2	
	2011	117	13.3	15.2	2.2	2.8	2.5	6.2	3.7	0.5	1.3	29.5	1.7	11.3	26.9	
	2016	122	13.4	15.5	2.3	3.0	2.7	6.3	3.8	0.5	1.3	31.3	2.0	11.8	28.5	
	2021	129	13.6	15.9	2.4	3.3	3.0	6.5	3.9	0.5	1.4	33.3	2.2	12.4	30.5	
	2026	136	13.7	16.3	2.5	3.6	3.2	6.7	4.0	0.6	1.5	35.5	2.5	13.0	32.5	
University/College	2006	120	40.3	6.2	3.2	10.5	4.8	2.9	3.8	0.7	1.9	6.2	0.9	36.1	2.4	
	2011	121	39.6	6.1	3.3	11.0	5.0	2.9	3.8	0.7	1.9	7.1	1.1	36.3	2.4	
	2016	123	38.9	6.0	3.3	11.5	5.2	2.9	3.9	0.7	1.9	7.9	1.3	36.5	2.5	
	2021	124	38.1	5.9	3.3	12.0	5.5	2.9	3.9	0.8	1.9	8.9	1.5	36.7	2.6	
	2026	126	37.4	5.8	3.3	12.6	5.7	2.9	3.9	0.8	2.0	9.8	1.8	36.9	2.6	
Warehouse/ Wholesale	2006	53	18.8	2.8	1.7	1.7	3.1	0.4	5.9	0.0	1.0	12.9	0.1	3.6	1.5	
	2011	55	19.0	2.8	1.7	1.9	3.4	0.4	6.1	0.0	1.0	13.7	0.1	3.7	1.5	
	2016	57	19.2	2.7	1.8	2.0	3.6	0.4	6.3	0.0	1.0	14.6	0.2	3.8	1.6	
	2021	60	19.5	2.7	1.8	2.1	3.9	0.4	6.5	0.0	1.1	15.6	0.2	4.0	1.7	
	2026	62	19.8	2.7	1.9	2.3	4.2	0.5	6.8	0.0	1.1	16.7	0.2	4.1	1.8	
Small Commercial	2006	534	150.0	28.5	13.2	25.4	11.5	9.8	43.2	0.5	5.2	134.3	8.4	84.2	20.0	
	2011	563	152.8	29.0	14.2	27.9	12.7	10.3	45.5	0.5	5.4	144.9	10.1	88.6	21.4	
	2016	593	155.5	29.4	15.3	30.6	13.9	10.8	47.8	0.6	5.7	155.7	11.9	93.0	22.9	
	2021	619	157.1	29.6	16.2	33.2	15.0	11.3	49.9	0.6	6.0	165.5	13.7	97.0	24.2	
	2026	648	158.9	29.9	17.2	36.0	16.3	11.8	52.1	0.6	6.3	175.9	15.6	101.2	25.7	
Other Buildings	2006	143	49.3	8.6	5.1	2.7	1.0	3.4	3.0	0.0	2.0	38.2	1.4	25.4	2.8	
	2011	148	49.5	8.5	5.3	2.9	1.1	3.5	3.1	0.0	2.0	41.0	1.7	26.2	3.0	
	2016	153	49.7	8.5	5.5	3.1	1.2	3.7	3.2	0.0	2.1	43.8	1.9	27.0	3.2	
	2021	159	50.1	8.4	5.8	3.3	1.3	3.8	3.4	0.0	2.2	47.0	2.2	27.9	3.5	
	2026	165	50.5	8.4	6.1	3.6	1.4	3.9	3.5	0.0	2.3	50.4	2.5	28.9	3.7	
Non Buildings	2006	82														
	2011	84														
	2016	87														
	2021	91														
	2026	94														
Isolated Buildings	2006	15	6.1	1.4	0.7	0.9	0.6	0.4	3.0	0.0	0.0	0.5	0.0	1.0	0.1	
	2011	16	6.6	1.5	0.7	1.1	0.7	0.5	3.4	0.0	0.0	0.6	0.0	1.2	0.1	
	2016	17	6.8	1.6	0.8	1.2	0.8	0.5	3.6	0.0	0.0	0.6	0.0	1.3	0.2	
	2021	18	7.0	1.6	0.9	1.3	0.9	0.6	3.9	0.0	0.0	0.6	0.0	1.4	0.2	
	2026	19	7.2	1.6	0.9	1.5	1.0	0.6	4.1	0.0	0.0	0.7	0.0	1.6	0.2	
Streetlighting	2006	39														39.4
	2011	39														39.4
	2016	39														39.4
	2021	39														39.5
	2026	40														39.5
Total	2006	1,881	452	120	46	94	45	38	140	4	21	418	32	282	71	39
	2011	1,965	458	121	48	102	48	39	146	4	22	448	36	293	75	39
	2016	2,048	463	121	51	111	52	40	153	4	23	479	40	304	80	39
	2021	2,138	469	122	54	120	56	42	159	4	24	512	44	316	85	39
	2026	2,233	475	123	57	131	61	43	167	4	25	546	49	329	91	40

Note: Any differences in totals are due to rounding.

[18] Results are measured at the customer's point-of-use and do not include line losses. This chart presents percentage of electricity consumption by end use for buildings only; the sub sector Non-Buildings is included in the total load, but is not broken down by end use.

Exhibit 3.8: Reference Case for Annual Electricity Consumption in the Labrador Interconnected Service Region, (GWh/yr.)[19]

Building Type	Milestone Year	GWh/yr														
		Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneous	Space Heating	Space Cooling	HVAC Fans & Pumps	Domestic Hot Water	Streetlighting
Office	2006	9	1.8	0.5	0.1	0.9	0.2	0.0	0.0	0.0	0.2	4.0	0.1	0.7	0.2	
	2011	10	1.9	0.5	0.2	1.0	0.3	0.0	0.0	0.0	0.2	4.4	0.1	0.8	0.2	
	2016	10	1.9	0.5	0.2	1.1	0.3	0.0	0.0	0.0	0.2	4.6	0.2	0.8	0.2	
	2021	11	1.9	0.5	0.2	1.2	0.3	0.0	0.0	0.0	0.2	4.8	0.2	0.9	0.2	
	2026	11	2.0	0.5	0.2	1.3	0.3	0.0	0.0	0.0	0.2	5.0	0.2	0.9	0.3	
Non-Food Retail	2006	27	9.8	0.9	0.8	0.8	0.6	0.2	0.2	0.0	0.2	10.7	0.2	2.3	0.4	
	2011	30	10.3	1.0	0.9	0.9	0.7	0.3	0.2	0.0	0.3	11.6	0.3	2.7	0.5	
	2016	31	10.5	1.0	1.0	1.0	0.7	0.3	0.2	0.0	0.3	12.1	0.4	2.9	0.5	
	2021	32	10.6	1.0	1.0	1.1	0.8	0.3	0.2	0.0	0.3	12.5	0.5	3.1	0.5	
	2026	33	10.7	1.0	1.1	1.2	0.8	0.3	0.3	0.0	0.3	13.0	0.5	3.3	0.6	
Food Retail	2006	10	1.4	0.2	0.2	0.2	0.1	0.3	4.5	0.0	0.0	2.6	0.0	0.4	0.2	
	2011	11	1.6	0.2	0.3	0.2	0.2	0.3	5.1	0.0	0.1	2.7	0.0	0.5	0.3	
	2016	12	1.6	0.2	0.3	0.2	0.2	0.3	5.3	0.0	0.1	2.8	0.0	0.6	0.3	
	2021	12	1.6	0.2	0.3	0.2	0.2	0.3	5.6	0.0	0.1	2.9	0.1	0.7	0.3	
	2026	13	1.7	0.2	0.3	0.2	0.2	0.3	5.8	0.0	0.1	2.9	0.1	0.7	0.3	
Health	2006	20	0.8	3.8	0.6	0.7	1.2	1.4	0.3	0.1	0.2	6.8	0.1	2.1	2.2	
	2011	24	0.9	4.1	0.7	0.9	1.4	1.6	0.3	0.1	0.2	8.3	0.3	2.6	2.6	
	2016	25	0.9	4.1	0.7	0.9	1.5	1.6	0.3	0.1	0.2	8.8	0.3	2.8	2.6	
	2021	25	0.9	4.0	0.7	1.0	1.5	1.6	0.3	0.1	0.2	8.8	0.3	2.8	2.6	
	2026	25	0.8	3.9	0.7	1.0	1.6	1.6	0.3	0.1	0.2	8.8	0.3	2.8	2.6	
Schools	2006	10	2.2	0.6	0.3	0.4	0.1	0.1	0.0	0.0	0.0	5.1	0.0	0.8	0.3	
	2011	11	2.3	0.7	0.3	0.5	0.1	0.1	0.0	0.0	0.1	5.8	0.0	0.9	0.3	
	2016	11	2.3	0.7	0.3	0.5	0.1	0.1	0.0	0.0	0.1	6.1	0.0	0.9	0.4	
	2021	11	2.3	0.7	0.3	0.5	0.1	0.1	0.0	0.0	0.1	6.1	0.0	0.9	0.4	
	2026	11	2.2	0.6	0.3	0.5	0.1	0.1	0.0	0.0	0.1	6.2	0.0	0.9	0.4	
Accomodations	2006	5	0.4	0.5	0.1	0.1	0.1	0.1	0.1	0.0	0.0	1.8	0.0	0.3	1.0	
	2011	5	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.0	0.1	0.4	1.2	
	2016	5	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.1	0.1	0.4	1.2	
	2021	5	0.5	0.6	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.2	0.1	0.4	1.3	
	2026	6	0.5	0.6	0.1	0.1	0.1	0.1	0.1	0.0	0.1	2.3	0.1	0.4	1.3	
University/College	2006	5	1.1	0.2	0.1	0.3	0.1	0.1	0.1	0.0	0.2	2.4	0.0	0.6	0.1	
	2011	6	1.2	0.2	0.1	0.3	0.2	0.1	0.1	0.0	0.2	2.6	0.1	0.8	0.1	
	2016	6	1.2	0.2	0.1	0.4	0.2	0.1	0.1	0.0	0.2	2.7	0.1	0.8	0.2	
	2021	6	1.2	0.2	0.1	0.4	0.2	0.1	0.1	0.0	0.2	2.7	0.1	0.8	0.2	
	2026	6	1.2	0.2	0.1	0.4	0.2	0.1	0.1	0.0	0.2	2.7	0.1	0.8	0.2	
Warehouse/ Wholesale	2006	9	2.1	0.3	0.2	0.2	0.4	0.0	0.7	0.0	0.1	4.6	0.0	0.6	0.2	
	2011	10	2.3	0.3	0.2	0.2	0.4	0.0	0.7	0.0	0.1	5.0	0.0	0.6	0.2	
	2016	11	2.4	0.3	0.2	0.2	0.4	0.1	0.8	0.0	0.1	5.2	0.0	0.7	0.2	
	2021	11	2.5	0.3	0.2	0.3	0.5	0.1	0.8	0.0	0.1	5.3	0.0	0.7	0.3	
	2026	11	2.5	0.3	0.2	0.3	0.5	0.1	0.9	0.0	0.1	5.5	0.0	0.7	0.3	
Small Commercial	2006	36	8.5	1.6	0.8	1.4	0.7	0.5	2.2	0.0	0.3	16.1	0.3	2.6	1.4	
	2011	41	9.2	1.7	0.9	1.6	0.8	0.6	2.4	0.0	0.3	17.9	0.5	3.1	1.6	
	2016	43	9.4	1.7	1.0	1.8	0.9	0.6	2.6	0.0	0.4	18.7	0.5	3.3	1.7	
	2021	44	9.5	1.8	1.1	1.9	0.9	0.7	2.7	0.0	0.4	19.6	0.6	3.6	1.7	
	2026	46	9.7	1.8	1.1	2.1	1.0	0.7	2.8	0.0	0.4	20.5	0.7	3.8	1.8	
Other Buildings	2006	22	5.2	0.9	0.5	0.3	0.1	0.4	0.3	0.0	0.2	11.4	0.1	2.2	0.5	
	2011	24	5.4	0.9	0.6	0.3	0.1	0.4	0.3	0.0	0.2	12.2	0.1	2.4	0.5	
	2016	25	5.5	0.9	0.6	0.4	0.1	0.4	0.4	0.0	0.2	12.7	0.1	2.5	0.5	
	2021	25	5.6	0.9	0.7	0.4	0.1	0.4	0.4	0.0	0.3	13.2	0.1	2.7	0.6	
	2026	26	5.7	0.9	0.7	0.4	0.2	0.5	0.4	0.0	0.3	13.8	0.1	2.8	0.6	
Non Buildings	2006	7														
	2011	8														
	2016	8														
	2021	9														
	2026	9														
Other Institutional Buildings	2006	39	10.7	3.8	1.2	1.0	1.7	0.5	1.5	0.0	0.7	8.4	0.2	6.9	2.0	
	2011	39	10.4	3.7	1.2	1.1	1.8	0.5	1.5	0.0	0.7	8.9	0.2	6.9	2.1	
	2016	39	10.2	3.7	1.2	1.1	1.9	0.5	1.5	0.0	0.7	9.4	0.2	6.9	2.3	
	2021	40	9.9	3.6	1.2	1.1	1.9	0.5	1.5	0.0	0.7	9.9	0.2	6.9	2.4	
	2026	40	9.7	3.5	1.2	1.2	2.0	0.5	1.5	0.0	0.7	10.4	0.2	6.9	2.5	
Streetlighting	2006	2														1.6
	2011	2														1.6
	2016	2														1.6
	2021	2														1.6
	2026	2														1.6
Total	2006	201	44	13	5	6	5	4	10	0	2	74	1	20	9	2
	2011	220	46	14	5	7	6	4	11	0	2	82	2	22	10	2
	2016	227	46	14	6	8	6	4	11	0	2	85	2	23	10	2
	2021	233	46	14	6	8	7	4	12	0	2	88	2	23	10	2
	2026	240	47	14	6	9	7	4	12	0	3	91	2	24	11	2

Note: Any differences in totals are due to rounding.

[19] Results are measured at the customer's point-of-use and do not include line losses. This chart presents percentage of electricity consumption by end use for buildings only; the sub sector Non-Buildings is included in the total load, but is not broken down by end use.

4. CONSERVATION & DEMAND MANAGEMENT (CDM) MEASURES

4.1 INTRODUCTION

This section identifies and assesses the economic attractiveness of the selected energy-efficiency and peak load reduction measures for the Commercial sector. The discussion is organized and presented as follows:

- Methodology for assessment of energy-efficiency measures
- Description of energy-efficiency measures
- Summary of energy-efficiency results
- Peak load reduction measures.

4.2 METHODOLOGY FOR ASSESSMENT OF ENERGY-EFFICIENCY MEASURES

The following steps were employed to assess the energy-efficiency measures:

- Select candidate energy-efficiency measures
- Establish technical performance for each option within a range of applicable load sizes and/or service region conditions (e.g., degree days)
- Establish the capital, installation and operating costs for each option
- Calculate the cost of conserved energy (CCE) for each measure.

A brief discussion of each step is outlined below.

Step 1 Select Candidate Measures

The candidate measures were selected in close collaboration with the Utilities' personnel and from a literature review and previous study team experience. The selected measures are all considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs, which will be addressed in this section, were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources, including the experience and on-going research work of study team members.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources, including the experience and on-going research work of study team members.

The incremental cost is applicable when a measure is installed in a new facility, or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy-efficiency measure relative to the "baseline" technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.

In both cases, the costs and savings are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs. All costs are expressed in constant (2007) dollars.

Step 4 Calculate CCE for Each Measure

One of the important sets of information provided in this section is the CCE associated with each energy-efficiency measure. The CCE for an energy-efficient measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the accompanying tables (see Appendix B) are expressed in constant (2007) dollars.

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast (see Section 5.0). The CCE is calculated according to the following formula:

$$\frac{C_A + M}{S}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of O&M
S is the annual kWh energy savings.

And A is the annualization factor.

Where: $$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

i is the discount rate
n is the life of the measure.

The detailed CCE tables (see Appendix B) show both "incremental" and "full" installed costs for the energy-efficiency measures, as applicable. If the measure or technology is installed in a new facility, or at the point of natural replacement in an existing facility, then the "incremental" cost of the measure versus the cost of the baseline technology is used.

If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the "full" cost of the measure is used. In both cases, the costs of the measures are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations, three discount rates are shown: 4%, 6% and 8%. Based on the Utilities' recommendation, the 6% (net-of-inflation) discount rate was used for the primary CCE calculation[20]. The CCEs were also calculated using the 4% and 8% discount rates to provide the sensitivity analysis.

Selection of the appropriate discount rate for this analysis was guided by the intended use of the study results. This study seeks to identify the economic potential for CDM in Newfoundland and Labrador from a provincial perspective. Therefore, the appropriate discount rate is the social opportunity cost of capital, which is the estimated average pre-tax rate of return on public and private investments in the provincial economy.

4.3 DESCRIPTION OF ENERGY-EFFICIENCY MEASURES

The list of energy-efficiency measures and technologies considered in this study is presented in Exhibit 4.1 below.

Exhibit 4.1: Energy-efficiency Measures and Technologies - Commercial Sector

Lighting
- Standard T8 systems
- Low ballast-factor T8 systems
- High-performance T8 systems
- Fully integrated lighting and control systems
- Lighting redesign
- Occupancy sensors
- Induction lamps
- Compact fluorescents lamps
- White LED lamps
- Halogen infrared lamps
- Ceramic metal halide lamps
- LED exit signs
- Pulse-start metal halide systems
- T5 high-intensity fluorescent systems

Heating, Ventilating, and Air-Conditioning
- Low-temperature air source heat pumps
- Ground source heat pumps
- Water loop heat pumps
- Infrared heaters
- High-efficiency chillers
- High-efficiency rooftop AC units
- Adjustable speed drives
- Premium efficiency motors
- Advanced building automation systems
- Building recommissioning
- Advanced building automation systems
- Programmable thermostats

Refrigeration
- ENERGY STAR refrigerators & freezers
- High-efficiency supermarket refrigeration

Domestic Hot Water
- Low-flow faucet aerators and shower heads
- Grey water heat recovery
- Tankless water heaters
- Heat pump water heaters

Computer Equipment
- ENERGY STAR computers
- ENERGY STAR office equipment
- Energy-efficient server technologies

Building Envelope
- High-performance glazing systems
- Upgrade wall insulation
- Upgrade roof insulation
- Air curtains

New Construction
- New construction - 25% more efficient
- New construction - 40% more efficient

Street Lighting
- Electrodeless induction lighting
- Dimming controls

[20] This discount rate allows for analytic consistency with the earlier NERA Marginal Cost Study, which used a nominal discount rate of 8.4% (approximately 6% real, i.e. net of inflation). NLH lowered its nominal discount rate in the summer of 2007 to 7.75%; however, this change has no material impact on the results of this study.

Energy-efficiency improvement opportunities are presented along with a brief description of the technology, savings relative to the baseline, typical installed costs, applicability and co-benefits. A detailed list of the results of the economic assessment of all measures is provided in Exhibit 4.2. The discussion of measures is organized by end use and sub sector.[21]

The following subsections provide a summary of the results of the technical and economic analysis of each measure. The measures are organized and presented according to the format in which they were evaluated. Refer to Appendix B for details and assumptions related to the analyses.

4.3.1 Lighting

The discussion of the analysis of lighting measures is organized by major lighting type and presented as follows:

- Fluorescent lighting upgrades
- Incandescent lighting upgrades
- High-intensity discharge (HID) lighting upgrades.

❑ **Fluorescent Lighting Upgrades**

Fluorescent lighting in the commercial building stock is typically a mix of T12 magnetic and T8 electronic fluorescent lighting systems. The study therefore considered upgrades to both T12 and T8 fluorescent systems.

T12 Fluorescent Upgrades

Six energy-efficiency upgrade measures were evaluated for T12 lighting systems:

- Standard T8 lighting systems
- Low ballast factor T8 lighting systems
- High-performance T8 lighting systems
- Redesign with standard T8 lighting systems
- Redesign with high-performance T8 lighting systems
- Redesign with fully integrated lighting and control systems.

These measures are applicable to existing buildings with T12 lighting since new buildings are generally illuminated with T8 systems. Each measure was evaluated at 3,000 hours of operation and on both a full cost and incremental cost basis. The baseline technology used for the analysis is a standard fluorescent fixture equipped with two 34-Watt T12 lamps and magnetic ballast.

[21] Measure inputs not otherwise sourced are based on the consultants' recent work with BC Hydro and other utility clients.

- **Standard T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $41/fixture; incremental $0
Savings	26% of lighting energy
Useful Life	16 years

Replacing existing T12 technology with T8 lamps and electronic ballasts reduces the connected lighting load for a two-lamp fixture from 80 Watts to 59 Watts, representing a savings of 26% over the baseline T12 systems. This measure typically results in increased light levels.

- **Low Ballast Factor T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $41/fixture; incremental $0
Savings	36% of lighting energy
Useful Life	16 years

Similarly, replacing existing T12s with T8 lamps and low ballast factor electronic ballasts further reduces the connected lighting load for a two-lamp fixture from 80 Watts to 51 Watts, representing a savings of 36% over the baseline T12 systems, while providing an equivalent amount of light.

- **High-performance T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $50/fixture; incremental $9/fixture
Savings	39% of lighting energy
Useful Life	16 years

High-performance T8 lighting systems operate with an efficacy of 100 lumens per Watt and have a longer lamp life than standard T8 systems. For example, Sylvania's "Xtreme" system, with two high-performance T8 lamps, consumes 49 Watts per fixture, representing a savings of 39% over T12s, while providing the same light output.

- **Redesign with Standard T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $1.58/ft^2$; incremental $0.62/ft^2$
Savings	54% of lighting energy
Useful Life	16 years

Some existing buildings are over-illuminated compared to current Illuminating Engineering Society of North America (IESNA) guidelines. The combination of lighting redesign to lower light levels and standard T8 lighting systems results in savings of 54% and a lower incremental cost (due to a requirement for fewer fixtures) relative to baseline T12 systems.

- **Redesign with High-performance T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $1.72/ft^2$; incremental $0.48/ft^2$
Savings	62% of lighting energy
Useful Life	16 years

The combination of lighting redesign to lower light levels and next generation T8 lighting systems results in savings of 62% and a lower incremental cost (due to fewer fixtures) relative to baseline T12 systems.

- **Redesign with Fully Integrated Lighting and Control Systems**

Measure Profile	
Applicable Building Types	Office
Vintage	Existing
Costs	Full $6.67/ft^2$; incremental $4.47/ft^2$
Savings	65% of lighting energy
Useful Life	16 years

In a typical configuration, an integrated lighting and control system features a pendant-mounted three-lamp T8 direct/indirect fixture and integrated controls including occupancy, daylight dimming and personal controls. One lamp illuminates the ceiling, while two down lamps illuminate the work surface. Occupancy sensors control the down lamps to reduce their operating hours, while daylight sensors provide dimming. Using a networked computer, individuals can adjust the light levels at their workstation. The system can also be centrally controlled in response to time-of-day schedules and peak load signals.

Fully integrated lighting and control systems can achieve savings of 65% relative to the T12 baseline and are primarily applicable to office environments.

T8 Fluorescent Upgrades

Four energy-efficiency upgrade measures were evaluated for standard T8 lighting systems:

- High-performance T8 lighting systems
- Redesign with high-performance T8 lighting systems
- Redesign with fully integrated lighting and control systems
- Occupancy sensors.

These measures are applicable to both existing buildings and new construction and were evaluated at 3,000 hours of operation and on both a full cost and incremental cost basis. The baseline technology used for the analysis is a standard fluorescent fixture equipped with two 32-Watt T8 lamps and electronic ballast.

- **High-performance T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Full \$50/fixture; incremental \$9/fixture
Savings	17% of lighting energy
Useful Life	16 years

This upgrade technology is the same as previously described in the T12 upgrades discussion above. In this case, however, the savings are 17% relative to the baseline standard T8 systems.

- **Redesign with High-performance T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Full \$1.73/ft^2; incremental \$0.01/ft^2
Savings	48% of lighting energy
Useful Life	16 years

This technology upgrade is the same as previously described in the T12 upgrades discussion above. In this case, however, the savings are 48% relative to the baseline standard T8 systems.

- **Redesign with Fully Integrated Lighting and Control Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Full $6.67/ft^2$; incremental $4.95/ft^2$
Savings	53% of lighting energy
Useful Life	16 years

This technology upgrade is the same as previously described in the T12 upgrades discussion above. In this case, however, the savings are 53% relative to the baseline standard T8 systems.

- **Occupancy Sensors**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Full $70/switch; incremental $48/switch
Savings	30% of lighting energy
Useful Life	10 years

This upgrade consists of replacing a standard wall switch with passive infrared (PIR) sensors. Standard applications include spaces with variable occupancy patterns including offices, corridors, washrooms and utility spaces. There are two general types of occupancy sensors available in the market: ultrasonic sensors, which use an inaudible high frequency sound wave to sense movement, and PIR sensors, which sense heat radiated from the human body. Sensors are generally mounted on walls or ceilings, depending on the desired area of coverage. The full cost is estimated to be $70 per switch, the savings are estimated to be 30% of lighting energy and the service life is estimated to be 10 years.

4.3.2 Incandescent Lighting Upgrades

Incandescent lighting is typically used in architectural, display, task and signage applications and is commonly found in lobbies, corridors, utility spaces, hotel rooms, retail spaces and restaurants.

Six energy-efficiency upgrade measures were evaluated for incandescent lighting:

- Compact fluorescent lamp
- Electrodeless induction lamp
- White LED lamp
- Halogen infrared PAR lamp
- Ceramic metal halide PAR lamp
- LED exit sign.

These upgrade options are applicable to both existing buildings and new construction and were evaluated at 3,000 hours of operation per year and on both a full cost and incremental cost basis (except where noted). The baseline technologies used for the analysis include the following:

- 65 W incandescent reflector lamp
- 75 W halogen PAR 38 lamp
- 30 W incandescent exit sign.

❑ Compact Fluorescent Lamp

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Full $22/lamp; incremental $17/lamp
Savings	69% of lighting energy
Useful Life	3 years

This upgrade is a CFL that displays 785 lumens and has a full cost of $22. Relamping a 65-Watt incandescent reflector flood with this upgrade results in savings of 69% while producing an equivalent amount of light. In addition, CFLs have a life of 10,000 hours compared to the shorter life of incandescent lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs.

❑ Electrodeless Induction Lamp

Measure Profile	
Applicable Building Types	Office, Retail, Accommodations
Vintage	Existing & new
Costs	Full $43/lamp; incremental $38/lamp
Savings	65% of lighting energy
Useful Life	5 years

Electrodeless lamps are discharge lamps like fluorescents, but use magnetic induction to generate an electric field rather than a voltage drop across a pair of electrodes.

This upgrade is 23-Watt electrodeless induction lamp that displays 1,100 lumens and has a full cost of $43. Similar to a CFL and without electrodes, the self-ballasted reflector lamp is a direct replacement for incandescent reflector lamps. It has a high colour rendering index (CRI); however, one limitation is that the lamp cannot be dimmed.

Relamping a 65-Watt incandescent reflector flood with this upgrade results in savings of 65% while producing the equivalent amount of light. In addition, electrodeless induction lamps currently have a life of 15,000 hours compared to the shorter life of incandescent lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs.

- **White LED Lamp**

Measure Profile	
Applicable Building Types	Office, Retail, Accommodations
Vintage	Existing & new
Costs	Full $43/lamp; incremental $38/lamp
Savings	75% of lighting energy
Useful Life	12 years

This upgrade is a white light-emitting diode (LED) array that displays 800 lumens at 50 lumens per Watt and has a full cost of $43. Relamping a 65-Watt incandescent reflector lamp with this upgrade results in savings of 75% while producing an equivalent amount of light. In addition, white LEDs currently have a life of 35,000 hours compared to the shorter life of incandescent lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs. However, this technology is in the early stages of market entry and therefore improvements to the technology in terms of cost and efficacy should be expected in the coming years.

- **Halogen IR PAR Lamp**

Measure Profile	
Applicable Building Types	Retail, Office, Accommodations
Vintage	Existing & new
Costs	Full $15/lamp; incremental $6/lamp
Savings	33% of lighting energy
Useful Life	1.5 years

This upgrade is a 50-Watt halogen infrared (IR) lamp that displays 970 lumens and has a full cost of $15. Relamping a 75-Watt halogen PAR 38 with this upgrade results in savings of 33% while producing an equivalent amount of light. In addition, halogen IR lamps have a life of 4,200 hours compared to the shorter life of halogen lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs.

- **Ceramic MH PAR Lamp**

Measure Profile	
Applicable Building Types	Retail, Office, Accommodations
Vintage	Existing & new
Costs	Full $38/lamp; incremental $29/lamp
Savings	53% of lighting energy
Useful Life	3.5 years

This upgrade is a 25-Watt integrated ceramic metal halide (MH) lamp/ballast that displays 1,200 initial lumens and has a full cost of $38. Relamping a 75-Watt halogen PAR 38 with this technology results in savings of 53% while producing an equivalent amount of light. In addition, ceramic MH lamps have a life of 10,500 hours compared to the shorter life of halogen lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs.

❑ **LED Exit Sign**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $70/fixture
Savings	93% of lighting energy
Useful Life	11 years

This upgrade is a 2-Watt LED exit sign that has a full cost of $70. Replacing a 30-Watt incandescent exit sign with this upgrade results in savings of 93% while producing an equivalent amount of light. In addition, LED exit signs have a life of 100,000 hours compared to the shorter life of incandescent lamps, providing additional benefits in the form of lower maintenance and lamp replacement costs. This upgrade is applicable to the existing building stock since incandescent exit signs are no longer available for sale in Canada. This measure was therefore evaluated on a full-cost basis at 8,760 hours per year.

4.3.3 High-intensity Discharge Lighting Upgrades

High-intensity discharge (HID) lighting such as metal halide is commonly used to illuminate high-ceilinged spaces such as warehouses, retail stores and gymnasiums and in outdoor lighting applications.

Two energy-efficiency upgrade options were evaluated for HID lighting:

- Pulse-start metal halide
- T5 high-intensity fluorescent.

These upgrade options are applicable to both existing buildings and new construction and were evaluated at 3,000 hours of operation and on both a full cost and incremental cost basis. The baseline technology for high-bay lighting is a standard 400-Watt metal halide high-bay fixture.

❑ **Pulse-start Metal Halide**

Measure Profile	
Applicable Building Types	All buildings, outdoor and roadway lighting
Vintage	Existing & new
Costs	Full $325/fixture; incremental $10/fixture
Savings	21% of lighting energy
Useful Life	16 years

This upgrade is a pulse-start metal halide high-bay luminaire featuring a 320-Watt lamp, 40-Watt ballast, 26,000 mean lumens, service life of 20,000 hours and a full cost of $325. Compared to traditional metal halides, a change in the lamp and ballast construction allows pulse-start metal halide lamps to start using a high-voltage ignitor in the ballast instead of a starting electrode in the lamp. The result is high lumen output, less lumen degradation, improved colour uniformity and quick start capabilities.

Replacing a standard 400-Watt metal halide luminaire with this upgrade results in savings of 21% while producing an equivalent amount of light. Pulse-start metal halide systems can be used for all traditional metal halide applications including high-bay, outdoor and roadway lighting.

- **T5 High-intensity Fluorescent**

Measure Profile	
Applicable Building Types	Warehouse, Retail, School
Vintage	Existing & new
Costs	Full $350/fixture; incremental $35/fixture
Savings	53% of lighting energy
Useful Life	16 years

This upgrade is a high-intensity fluorescent fixture equipped with four F54T5 high-output lamps and an occupancy sensor. This luminaire draws 239 Watts and displays 20,000 initial lumens, has a 20,000-hour lamp life and a full cost of $350.

Improvements in fluorescent lamps and the emergence of high-intensity fluorescent fixtures has made fluorescent lighting the most cost-effective choice for lighting high indoor spaces. These high-intensity fluorescent systems are more energy efficient than traditional HID fixtures and feature lower lumen depreciation, occupancy control, dimming options, instant start-up and better colour rendition.

Replacing a standard 400-Watt metal halide luminaire with this upgrade results in savings of 53% while producing an equivalent amount of light.

4.3.3 Heating, Ventilating and Air conditioning

Eleven energy-efficiency upgrade measures were evaluated for building heating, ventilating and air conditioning (HVAC) systems:

- Low-temperature heat pumps
- Ground source heat pumps
- Water loop heat pumps
- Infrared heaters
- High-efficiency chillers
- High-efficiency rooftop AC units
- Adjustable speed drives
- Premium efficiency motors
- Building recommissioning
- Advanced building automation systems
- Programmable thermostats.

As applicable, HVAC upgrade measures were evaluated at both low and high heating/cooling loads to reflect the range of building types and climate regions found in Newfoundland and Labrador.

- **Low-temperature Air Source Heat Pumps**

Measure Profile	
Applicable Building Types	Small Commercial
Vintage	Existing and new
Costs	\$1.80 to \$2.50/ft^2 incremental cost
Savings	56% to 59% of space heating and cooling energy
Useful Life	15 years

When outdoor air temperatures drop below freezing, standard air source heat pump systems switch to auxiliary electric resistance heaters to meet the space heating requirements. This limitation has served to minimize the penetration of air source heat pumps in cold climates. However, a low-temperature air source heat pump (LTHP) developed by Hallowell International[22] is capable of operating at 0°F with a coefficient of performance (COP) of greater than 2. At this temperature, standard air source heat pumps operate less efficiently, produce less than half their rated capacity and rely primarily on backup electric resistance heaters to maintain comfort.

The LTHP features a two-speed, two-cylinder compressor for efficient operation, a back-up booster compressor that allows the system to operate efficiently down to 15ºF and a plate heat exchanger called an "economizer" that further extends the performance of the heat pump to well below 0ºF.

This measure involves upgrading a standard HVAC system with an equivalent LTHP system. The target market is both residential and small commercial buildings and the baseline is electric- resistance heating and direct expansion cooling. This technology is applicable to existing buildings (at the end of HVAC life cycle) and new construction. The incremental cost ranges between \$1.80 and \$2.50 per square foot, the savings range between 56% and 59% of space heating and cooling energy and the service life is 15 years.

Currently, the LTHP is available only as a 3.0 and 3.5 ton split system, however Hallowell International expects to launch an expanded product line targeting the commercial market, including a packaged rooftop heat pump and a packaged terminal heat pump (PTHP) as early as 2008.[23]

[22] http://www.gotohallowell.com.
[23] Conversation with James Bryant of Hallowell International. September 2007.

❑ Ground Source Heat Pumps

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	$4.90/ft^2 incremental cost
Savings	61% to 64% of heating & cooling energy
Useful Life	20 years

Ground source heat pump (GSHP) systems are more efficient than conventional heat pump systems, with higher COPs and EERs. GSHPs also replace the need for a boiler in winter by utilizing heat stored in the ground; this heat is upgraded by a vapour-compressor refrigeration cycle. In summer, heat from a building is rejected to the ground, eliminating the need for a cooling tower or a heat rejector. They also lower operating costs because the ground is cooler than the outdoor air.

Water-to-air heat pumps are typically installed throughout a building with duct work serving only the immediate zone; a two-pipe water distribution system conveys water to and from the ground source heat exchanger. The heat exchanger field consists of a grid of vertical boreholes with plastic u-tube heat exchangers connected in parallel.

This measure involves upgrading a standard HVAC system with a GSHP system and is applicable to existing buildings (at the end of HVAC life cycle) and new construction. The baseline is a commercial building with standard electric resistance heating and direct expansion cooling. The incremental cost is $4.90 per square foot, the savings range between 61% and 64% of heating and cooling energy and the service life is 20 years.

❑ Water Loop Heat Pumps

Water loop heat pump systems, also known as California heat pump systems, consist of several individual water source heat pumps installed in multiple building zones and connected to a single water loop. Each heat pump adds or removes heat from the circulating water as required. Heat pump loop systems are typically used in large buildings requiring concurrent heating and cooling in different zones, where they are used to recover heat from some zones and deliver it to others. When internal heat gains are insufficient to meet the heating load on the perimeter, an electric boiler would provide the necessary supplementary heating. Disadvantages include a high initial cost and maintenance costs.

Given the heating dominated climate and relatively small internal heat gains in most buildings, and consequently the requirement for supplemental electric heating, water loop heat pumps are unlikely to have significant market uptake in Newfoundland and Labrador and will not be considered any further in this study.

- **Infrared Heaters**

Measure Profile	
Applicable Building Types	Warehouse
Vintage	Existing & new
Costs	Full & incremental cost $750/heater
Savings	14% of space heating energy
Useful Life	10 years

Radiant infrared heaters can be used as primary heating sources or in applications where supplementary or spot heating is required. Radiant heating systems offer energy savings because building occupants feel comfortable at lower air temperatures in radiantly heated spaces.

This measure involves using infrared heaters to provide supplementary spot heating and maintaining a lower ambient air temperature in the space. It is applicable to both existing buildings and new construction and the baseline is a Warehouse heated with standard electric resistance heating. The cost is estimated to be $750 per heater, the savings are 14% of space heating energy and the service life is 10 years.

- **High-efficiency Chillers**

Measure Profile	
Applicable Building Types	Large Commercial/Institutional
Vintage	Existing & new
Costs	25% incremental cost
Savings	29% of space cooling
Useful Life	25 years

High-efficiency chillers feature oil-free centrifugal compressors, magnetic bearings and variable speed drives to deliver better integrated part-load value (IPLV) efficiencies than conventional oil-lubricated centrifugal, scroll and screw compressors.

This measure involves upgrading a standard efficiency chiller with a high-efficiency chiller and is applicable to both existing buildings (at end of chiller life cycle) and new construction. The baseline is a large commercial building cooled with a standard efficiency chiller. The incremental cost is 25%, the savings are 29% of space cooling energy and the service life is 25 years.

- **High-efficiency Rooftop AC Units**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	20% incremental cost
Savings	24% of space cooling energy
Useful Life	15 years

Packaged rooftop air conditioning units dominate the market for small and medium low-rise buildings accounting for the majority of the space cooling energy in the Commercial sector. The most common sizes are 5 to 20 ton units. Rooftops are often purchased and installed to minimize first cost, with little consideration of energy and operating costs. High-efficiency rooftop units featuring more efficient compressors, fans, heat exchangers and controls are available on the market with EERs as high as 13.5.

This measure involves upgrading a standard packaged rooftop unit with an equivalent high-efficiency unit. It is applicable to both existing buildings (at end of rooftop life cycle) and new construction. The baseline is a commercial building cooled with standard packaged rooftop air conditioning units with a rated EER of 10.3. The incremental cost is estimated to be 20% more than a conventional rooftop air conditioner and the savings are 24% of space cooling energy. The cost of high-efficiency units is likely to reduce over the coming years as the market matures. The service life is estimated to be 15 years.

- **Adjustable Speed Drives**

Measure Profile	
Applicable Building Types	Medium and Large Commercial
Vintage	Existing & new
Costs	Full cost of $2,750 (10-HP)
Savings	30% of fan energy
Useful Life	10 years

Adjustable speed drives (ASD) allow induction motor-driven loads such as fans and pumps to operate in response to varying load requirements. ASDs increase efficiency, improve power factor and provide precise control.

This measure involves upgrading a motor-driven centrifugal fan with an ASD and controlling the speed of the fan in response to variable load requirements. It is applicable to both existing buildings and new construction and the baseline is a centrifugal fan equipped with inlet vanes operating at an average of 80% capacity. The full cost is estimated to be $2,750, the savings are 30% of fan motor energy and the service life is estimated to be 10 years.

- **Premium Efficiency Motors**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	20% incremental cost
Savings	1.4%
Useful Life	10 years

Premium efficiency motors typically have reduced losses of 10%-40%, thereby increasing motor efficiency by 1% to 10%.[24] In a retrofit situation, it is considered best

[24] BC Hydro. *Power Smart Tips & Practices*.

practice to replace failed motors with new premium efficiency motors rather than rewind them since motor rewinding often degrades motor efficiency by 1% to 3%.

This measure involves upgrading an induction motor with an equivalent premium efficiency motor. It is applicable to both existing buildings (at end of motor life cycle) and new construction. The baseline is a standard efficiency induction motor. The incremental cost is estimated to be 20% relative to a standard efficiency motor, the savings are 1.4% and the service life is 10 years.

- **Building Recommissioning**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full cost of $\$0.60/ft^2$
Savings	20% of HVAC energy use
Useful Life	5 years

Recommissioning is a quality assurance process for ensuring that a building's complex array of mechanical and electrical systems is operated to perform according to the design intent and current operational needs of the building. The process generally involves monitoring and simulation of building systems to gain a thorough understanding of current operation and possibilities for optimization. Energy savings generally result from equipment repairs, air and water rebalancing and control optimization.

Recommissioning is applicable to existing buildings only. The baseline is a typical Office building with an electricity intensity of 26 kWh/ft^2yr. The full cost is estimated to be $\$0.60/ft^2$, the savings are 20% of HVAC energy use and the service life is 5 years.

- **Advanced Building Automation Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full cost of $\$0.90/ft^2$
Savings	10% of total energy use
Useful Life	10 years

Advanced building automation systems (BAS) are able to automatically detect anomalies in building operations and can automate building diagnostics as well. These systems typically take data on how energy systems are performing in a building, analyze them using logic and physical modelling to detect deviations from expected performance and use built-in logic to suggest the cause of the deviation.[25] In addition, advanced BAS have improved predictive, self-tuning control algorithms that help to minimize the need for bypass or override of the BAS. Energy savings generally result from re-instituting

[25] E Source E News. *Automated Building Diagnostics: Improving Electricity Performance and Occupant Comfort*. ER-01. November 18, 2001.

equipment scheduling, expanded control to lighting and VAV boxes, instituting integrated control strategies and improving self-tuning diagnostics.

This measure involves installing an advanced BAS or upgrading an existing BAS with an advanced BAS. It is applicable to existing buildings and the baseline is a typical Office building with an electricity intensity of 26 kWh/ft²yr. The full cost is estimated to be $0.90/ft^2, the savings are 10% of total building energy use and the service life is 10 years.

- ❑ **Programmable Thermostats**

Measure Profile	
Applicable Building Types	Small Commercial
Vintage	Existing & new
Costs	Full cost of $400/thermostat
Savings	10% of HVAC energy use
Useful Life	10 years

The use of programmable thermostats with packaged HVAC equipment provides improved control, scheduling and setpoint reset capability.

This measure involves upgrading standard thermostats with programmable thermostats and scheduling the operation of the equipment based on occupancy requirements. It is applicable to both existing buildings and new construction and the baseline is a Small Commercial building with packaged rooftop units and standard thermostats. The full cost is estimated to be $400 per thermostat, the savings are 10% of HVAC energy use and the service life is 10 years.

4.3.5 Refrigeration

Commercial refrigeration generally consists of medium- and low-temperature applications including reach-in refrigerators and freezers, walk-in coolers and freezers, display cases and refrigerated rooms. The energy used by refrigeration systems includes compressors, evaporator and condenser fans, lighting and defrost and anti-sweat heaters.

Two energy-efficiency measures were evaluated for refrigeration:

- ENERGY STAR refrigerators and freezers
- High-efficiency supermarket refrigeration.

- ❑ **ENERGY STAR Refrigerators and Freezers**

Measure Profile	
Applicable Building Types	Food Retail, Restaurant
Vintage	Existing & new
Costs	Incremental cost of 20%
Savings	25% of refrigeration energy
Useful Life	10 years

Commercial self-contained, reach-in refrigerators and freezers are electrically-powered refrigerated cases with shelves and lighting and having up to three opaque or transparent doors. These appliances are used primarily in the retail sector by convenience stores, supermarkets, restaurants, pubs, cafeterias, flower shops, drug stores and others for storing or merchandising refrigerated or frozen products such as cold drinks, ice cube bags, frozen foods, etc. Canada has over 340,000 commercial reach-in refrigerators and freezers, and approximately 38,000 new units sell each year.26 A typical refrigerator consumes 4,300 kWh per year and a freezer 9,800 kWh per year.

On September 1, 2006, ENERGY STAR qualifying criteria for commercial solid door, self-contained refrigerators and freezers came into effect in Canada. ENERGY STAR qualified commercial solid door refrigerators and freezers use electronically commutated motors (ECM) for evaporator and condenser fans, hot gas anti-sweat heaters and high-efficiency compressors. These features make them considerably more energy efficient than standard appliances.

This measure involves upgrading a standard reach-in refrigerator or freezer with an equivalent ENERGY STAR appliance. It is applicable to both existing buildings (at end of refrigeration life cycle) and new construction. The incremental cost is 20%, the savings are 25% and the service life is 10 years.

- **High-efficiency Supermarket Refrigeration**

Measure Profile	
Applicable Building Types	Large Food Retail
Vintage	Existing & new
Costs	Incremental cost of $2.70/ft^2$
Savings	25% of refrigeration energy
Useful Life	10 years

Supermarket refrigeration is divided into two distinct segments that have different technologies. The more visible part of these systems is the display cases that hold food for the self-service shopping style of supermarkets. The display cases have their own electric loads and are served by a central refrigeration system. The mechanical equipment, including compressors, condensers, and associated controls, is located in the machine room. The potential for energy consumption reductions associated with machine room equipment is limited to about 5% of overall supermarket refrigeration energy usage. Reduction of 1% of overall usage is possible with increased use of evaporative condensers, a technology which currently has little market penetration. Additional reductions of 4% could be achieved by further use of floating head pressure, mechanical subcooling and heat reclaim, technologies which currently have varying degrees of market penetration.

The potential for energy consumption reductions associated with display cases is about 20% of overall supermarket refrigeration energy usage. Savings of 12% can be achieved with high-efficiency evaporator fan motors and hot-gas defrost. Additional savings of 8%

[26] Natural Resources Canada. www.oee.nrcan.gc.ca/commercial/equipment/selfcontained-refrigerators-freezers.

can be achieved with liquid suction heat exchangers, anti-sweat control and defrost control.

This measure involves upgrading a standard supermarket refrigeration system with an equivalent high-efficiency refrigeration system. It is applicable to existing large Food Retail buildings (at end of refrigeration life cycle) and new construction. The baseline is a Food Retail building with a refrigeration energy intensity of 31 $kWh/ft^2/yr$. The incremental cost is estimated to be $\$2.70/ft^2$, savings are 25% of refrigeration energy use and the service life is 10 years.

4.3.6 Domestic Hot Water

Domestic hot water (DHW) is typically used in commercial buildings for hand washing, showers, cleaning and food preparation. Four DHW energy-efficiency upgrades were evaluated:

- Low-flow faucet aerators and shower heads
- Heat pump water heaters
- Grey water heat recovery
- Tankless water heaters.

❑ Low-flow Faucet Aerators and Shower Heads

Measure Profile	
Applicable Building Types	All
Vintage	Existing & New
Costs	$40/lavatory
Savings	40% of domestic hot water energy use
Useful Life	5 years

Low-flow faucet aerators lower the water flow to 0.5 to 2 gallons per minute (gpm) by introducing air into the water stream. The aerator creates a fine water spray with a screen that is inserted in the faucet head. Similarly, low-flow shower heads use the same principle as faucet aerators to achieve flow rates in the range of 1.5 to 2.2 gpm.

This measure involves upgrading faucet aerators and shower heads with equivalent water efficient units. It is applicable to existing buildings and new construction. The baseline is a standard shower head with a flow rate of 2.5 to 3 gpm and a standard faucet aerator with a flow rate of 2 to 3 gpm. The cost is estimated to be $40 per lavatory (four sinks and one shower stall), the savings are estimated to be 40% and the service life is 5 years.

❑ Heat Pump Water Heaters

Heat pump water heaters extract heat from the surrounding air to heat hot water. During the heating season the surrounding air will have to be re-heated. Given the 9-month heating season in Newfoundland and Labrador, this technology is not a practical solution and would provide very little economic benefit. Therefore, it is recommended that this technology not be considered any further in this study.

- **Grey Water Heat Recovery**

Grey water heat recovery systems (GWHR) capture energy from warm wastewater to pre-heat incoming water for a DHW tank. GWHR is most effective in buildings with large, sustained DHW requirements such as laundries, gymnasiums and restaurants. As the opportunity for this measure is restricted to niche applications within sub sectors, it will not be considered as an individual measure in the present study. It is recognized, however, that GWHR will be applicable in some new building construction and will, therefore, be considered to be among the family of DHW efficiency measures captured in the measure *New Commercial Building – 40% More Efficient than Current Standards* in Section 4.10 below.

- **Tankless Water Heaters**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & New
Costs	Incremental cost of $5,600
Savings	7% of domestic hot water energy use
Useful Life	10 years

Tankless water heaters, also known as instantaneous water heaters, provide hot water without using a storage tank. Like tank water heaters, tankless water heaters use electricity to operate. Cold water travels through a pipe into the unit, and an electric element heats the water. Tankless water heaters can be supplementary units placed at the point of use or can replace conventional tank water heaters. Electric tank water heaters have an energy factor of about 0.91 compared with 0.98 for electric tankless water heaters.

Electric heating elements for tankless water heaters are much larger than for storage water heaters because the heater must be sized for the peak instantaneous. For example, a typical residential electric storage water heater draws at most 7,000 Watts, a whole-house electric tankless heater can draw as much as 19,200 Watts, and may require a larger electrical service.

This measure involves upgrading a central DHW tank heater with multiple point-of-use tankless heaters. It is applicable to existing buildings (at end of tank life cycle) and new construction. The incremental cost is estimated to be $5,600, the savings are 7% and the service life is 10 years.

4.3.7 Computer Equipment

Computer equipment typically includes computers, monitors, servers, printers, copiers and fax machines. Three computer equipment energy-efficiency upgrades were evaluated:

- ENERGY STAR computer and monitor
- ENERGY STAR office equipment

- Energy-efficient server technologies.

- **ENERGY STAR Computer and Monitor**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Incremental cost of $0/unit
Savings	75% of unit energy consumption
Useful Life	5 years

Beginning on July 20, 2007, ENERGY STAR's new specifications for computers went into effect. Only the market's most energy-efficient computing products will qualify for the ENERGY STAR label. Qualified products must now meet energy use guidelines in three distinct operating modes: standby, sleep mode and while computers are being used, and will include a more efficient internal power supply.

This measure involves upgrading a standard computer and monitor with an equivalent ENERGY STAR unit. It is applicable to both existing and new buildings at the end of the computer life cycle. The baseline is a standard desktop computer equipped with a 17" liquid crystal display (LCD) monitor and operating under default power management settings. The system is assumed to be on for approximately 40% of the time drawing 93 Watts and 4 Watts while turned off.

The upgrade is a comparable ENERGY STAR rated computer and monitor (17" LCD) operating with ENERGY STAR power management settings. The savings are estimated to be 75%, the incremental cost is zero[27] and the service life is 5 years.

- **ENERGY STAR Office Equipment**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	Incremental cost $0/unit
Savings	40% of unit energy consumption
Useful Life	5 years

This measure involves upgrading a standard photocopier with an equivalent ENERGY STAR rated unit. It is applicable to both existing and new buildings at the end of the computer life cycle. The baseline is a standard medium speed copier (21-44 copies per minute) operating under default power management settings. The system is assumed to be on for approximately 50% of the time drawing 177 Watts, on standard for 35% of the time drawings 163 Watts and 14 Watts while turned off. The results of this analysis can be extrapolated to other types of office equipment such as faxes and printers.

The upgrade is a comparable ENERGY STAR rated photocopier featuring reduced standby and off mode consumption as well as enabled ENERGY STAR power

[27] http://www.energystar.gov.

management settings. The savings are estimated to be 40%, the incremental cost is zero[28] and the service life is 5 years.

- **Energy-efficient Server Technologies**

Measure Profile	
Applicable Building Types	All
Vintage	Existing & new
Costs	$50/server
Savings	40% of server energy
Useful Life	5 years

This upgrade features two server technologies: server virtualization and energy-efficient servers, however the savings are not additive. The measures apply to both existing and new buildings at the end the server life cycle. The baseline server draws 217 Watts[29] based on the weighted average of the top three servers in the U.S. by shipment volume in 2005.

Server Virtualization. Servers are "virtualized" using software that allows a server to run multiple operating systems or instances of the same operating system concurrently. This allows for server consolidation resulting in a reduced number of servers required for operations. Potential energy savings are 40% in applications where many servers are used, such as data centres. Software and installation costs are estimated at $50/unit.[30]

Energy-efficient Servers. Servers using "multi-threaded" technology perform multiple parallel operations, achieving a higher performance per Watt than conventional servers. Potential energy savings are 35% and equipment costs are comparable to traditional servers.[31]

4.3.8 Building Envelope

Building envelope measures improve the thermal performance of a building's walls, windows and roof.

Four energy-efficiency upgrade options were evaluated for the building envelope:

- High-performance glazing systems
- Upgrade wall insulation
- Upgrade roof insulation
- Air curtains.

Each measure is evaluated at a low- and high-heating load to reflect the range of climate conditions found in Newfoundland and Labrador.

[28] http://www.energystar.gov.
[29] J.G. Koomey. *Estimating Total Power Consumption by Servers in the U.S. and the World*. 2007.
[30] http://www.microsoft.com.
[31] http://www.sun.com.

- **High-performance Glazing Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	\$2.00/ft^2 (floor area) incremental cost
Savings	28% to 34% of heating and cooling energy
Useful Life	20 years

High-performance glazing systems consist of low-e coated films suspended inside an insulating glass unit. These units can be incorporated into both window and curtain wall systems. In addition to superior insulating performance and lower energy costs, the co-benefits include enhanced comfort, noise reduction, the elimination of perimeter heating and reduced HVAC equipment costs.

Visionwall window and curtain wall systems manufactured by Visionwall Corporation[32] have thermal resistance R-values ranging from 3 to 7 hr.ft^2.^{o}F/Btu, low shading coefficients and high visible light transmission. The highest performing product on the market is Superglass Quad (R-value 12.5 hr.ft^2.^{o}F/Btu) manufactured by Southwall Technologies.[33] It features two films suspended inside an insulating glass unit creating three krypton-filled air spaces. A tape system is used for gas retention and a thermally broken insolating spacer stops the conduction through the edge of the glass.

This upgrade is a high-performance glazing system with an overall U-value of 0.25 Btu/hr.ft^2.^{o}F (R-4). It is applicable to both existing buildings (at end of window life cycle) and new construction. The baseline is an electrically-heated commercial building with standard double-glazed windows with an overall U-value of 0.45 Btu/hr.ft^2.^{o}F (R-2.2). The incremental cost is \$2 per square foot of floor area, the savings range from 28% to 34% of the heating and cooling energy and the service life is 20 years.

- **Upgrade Wall Insulation**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	\$1.38/ft^2 (floor area) incremental cost
Savings	18% of heating energy
Useful Life	25 years

Various insulating materials and methods can be used to upgrade wall insulation including applying rigid polystyrene board to the exterior of a building or installing fibreglass batts between interior wall studs.

This measure involves upgrading wall insulation to R-24. It is applicable to both existing buildings (at time of recladding) and new construction. The baseline is an electrically-

[32] http://www.visionwall.com.
[33] http://www.southwall.com.

heated commercial building with R-12 wall insulation. The incremental cost is $1.38 per square foot of floor area, the savings are 18% of heating energy and the service life is 25 years.

- **Upgrade Roof Insulation**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	$1/ft^2 (floor area) incremental cost
Savings	13% of heating energy
Useful Life	25 years

Upgrading insulation on a built-up roofing system typically involves adding additional layers of rigid insulation at the time of re-roofing.

This measure involves upgrading roof insulation to R-30. It is applicable to both existing buildings (at time of re-roofing) and new construction. The baseline is an electrically-heated commercial building with R-20 roof insulation. The incremental cost is $1 per square foot of floor area, the savings are 13% of heating energy and the service life is 25 years.

- **Air Curtains**

Measure Profile	
Applicable Building Types	Retail, Warehouse
Vintage	Existing & new
Costs	Full $2,150 per double door
Savings	9% of space heating energy
Useful Life	15 years

Air curtain systems use a fan to generate a laminar air flow across an open doorway. This mass flow of air acts as a barrier, reducing outside air infiltration by approximately 90%, thus preventing unwanted heat transfer both at the building envelope and between rooms within buildings. Typical applications include entrances to buildings in the Retail sub sector, overhead garage doors, loading docks and refrigerated rooms. The co-benefits include protecting employees from adverse environmental conditions such as cold drafts and dust.

This upgrade involves the installation of an air curtain to a double door entrance. It is applicable to both existing buildings and new construction and the baseline is a Non-food Retail building with a double door entrance. The full cost is $2,150 per double door, the savings are 9% of the space heating energy and the service life is estimated to be 15 years.

4.3.9 New Construction

New construction refers to new high-efficiency buildings designed using the integrated design process that achieve substantial improvements over conventional new buildings through the application and integration of energy-efficiency technologies and design approaches.

Baseline new construction is assumed to follow the MNECB and ASHRAE 90.1 - 1999 standards.

Two energy-efficiency upgrade options were evaluated for new construction:

- New Commercial Building - 25% more efficient than current standards
- New Commercial Building - 40% more efficient than current standards.

❑ New Commercial Building - 25% More Efficient than Current Standards

Measure Profile	
Applicable Building Types	All
Vintage	New
Costs	$1/ft^2$ incremental cost
Savings	25%
Useful Life	30 years

The integrated design approach (IDA) to new building design is predicated on a systematic application of energy measures to all end uses at the design stage. This includes targeting the building envelope, lighting, HVAC equipment (fans and pumps) and, finally, the heating and cooling plants. Savings of 25% are achievable at an average incremental cost of $1/ft^2$.

❑ New Commercial Building - 40% More Efficient than Current Standards

Measure Profile	
Applicable Building Types	All
Vintage	New
Costs	$4.50/ft^2$ incremental cost
Savings	40%
Useful Life	30 years

A new commercial building that is 40% more efficient than current design practice will require a very high-performance design, equivalent to C-2000 levels. This requires a full IDA that takes advantage of costs trade-offs from equipment downsizing. The design will require the most energy-efficient technologies, extremely efficient lighting designs and heating/cooling plants with very high part-load efficiencies. Savings of 40% are achievable at an average incremental cost of $4.50/ft^2$.

4.3.10 Street Lighting

Street lighting refers to all outdoor and roadway lighting intended to illuminate municipal streets and highways. Street lighting is dominated by high-pressure sodium lamps at approximately 85%, followed by metal halide at approximately 15%.

Two energy-efficiency upgrade options were evaluated for this end use:

- Electrodeless induction lighting
- Dimming controls.

❑ **Electrodeless Induction Lighting**

Measure Profile	
Applicable Building Types	Street Lighting
Vintage	Existing and new
Costs	$300/fixture incremental cost
Savings	25%
Useful Life	16 years

Induction lighting uses a magnetic field instead of electrodes to produce the electric field that excites the gas to emit light. This technology was first introduced in Europe in 1991 but has been slow to catch on in North America. Induction lighting has numerous benefits, the most important being an exceptionally long life, rated at 100,000 hours. Other benefits include instant-on capabilities, a high colour rendering index (CRI) of approximately 80 and an efficacy of 60-80 lumens per Watt. The drawbacks to this technology are that the capital cost is high, the technology does not work with dimmers, the lamps are large and not compatible with existing fixtures and the lamps do not work in temperatures above 35ºC to 40ºC.

Currently, Philips and OSRAM/Sylvania are the only manufacturers that have available products. The Philips Quality Light (QL) product line includes 55-, 85- and 165-Watt systems. OSRAM/Sylvania has a 100- and 150-Watt version called the Icetron.

Experts are mixed on the future of this technology. However, at a minimum, it is expected that these lamps will find a niche in areas where long life is a critical factor, such as in hard to reach areas and areas where maintenance costs would be high, e.g., in tunnels and over bridges.

This upgrade involves retrofitting of a 175-Watt metal halide with an equivalent 150-Watt induction luminaire. The incremental cost is $300 per luminaire,[34] the savings are 25% and the service life is 16 years.

[34] Bonneville Power Administration. http://www.bpa.gov/Energy/N.

- **Dimming Controls**

Measure Profile	
Applicable Building Types	Street Lighting
Vintage	Existing and new
Costs	Full $220/fixture
Savings	30%
Useful Life	16 years

Dimming controls (sometimes called adaptive lighting) have the potential to reduce annual energy use by 20% to 40% by lowering light levels during periods of low activity. Several companies are currently investigating different approaches to the application of this technology. In one configuration, the controls are incorporated as an add-on device to an existing magnetic ballast. In a second configuration, the technology is combined with advanced monitoring and wireless, computer enabled controls to further increase savings.

Currently, there is very little dimming being used in outdoor lighting in Canada. Issues related to safety and possible liability arising from the lower light levels, have made lighting designers and policy makers reluctant change the status quo. However, many industry experts believe that this technology could have a significant impact on the market if the issues of safety and liability can be adequately addressed.

This upgrade involves adding dimming controls to street lighting to reduce or shut off lighting during silent periods. The savings are estimated to be 30%, the full cost is $220[35] per luminaire and the service life is 16 years.

4.4 SUMMARY OF ENERGY-EFFICIENCY RESULTS

The energy-efficiency measures and their associated CCEs are summarized in Exhibit 4.2. Note that the negative values shown for selected lighting upgrades indicate that the annualized capital cost of the energy-efficiency measure is less expensive than the baseline technology.

[35] Average cost including hardware, controls and estimated installation costs. Streetlight Intelligence Ltd.

Exhibit 4.2: Commercial Energy-efficiency Technologies and Measures – Cost of Conserved Energy

		Measure/Technology	Sub Sector	Vintage	CCEs (¢/kWh) 4.0% DR Full	4.0% DR Incr.	6.0% DR Full	6.0% DR Incr.	8.0% DR Full	8.0% DR Incr.
Lighting	T12	Standard T8s	All	Existing	5.4	0.0	6.3	0.0	7.2	0.0
		Low BF T8s	All	Existing	3.9	0.0	4.6	0.0	5.2	0.0
		High-performance T8s	All	Existing	4.2	0.5	4.9	0.7	5.7	0.8
		Redesign with standard T8s	All	Existing	5.1	-2.0	5.9	-2.3	6.8	-2.6
		Redesign with high-performance T8s	All	Existing	4.9	-1.3	5.6	-1.6	6.4	-1.8
		Fully integrated lighting and controls	All	Existing	17.7	11.9	20.5	13.7	23.5	15.8
	T8	High-performance T8s	All	Existing & New	13.1	1.7	15.3	2.1	17.6	2.5
		Redesign with high-performance T8s	All	Existing & New	8.4	0.0	9.8	0.0	11.2	0.0
		Fully integrated lighting and controls	All	Existing & New	29.6	22.0	34.3	25.4	39.3	29.2
		Occupancy sensors	All	Existing & New	6.0	4.3	6.6	4.7	7.2	5.1
	Inc	Compact fluorescent lamps	All	Existing & New	2.7	-1.1	2.9	-1.0	3.2	-0.8
		Induction lighting	Retail	Existing & New	4.5	0.4	4.9	0.7	5.4	1.1
		White LEDs	All	Existing & New	0.1	-3.5	0.4	-3.2	0.8	-2.8
		Halogen IR	All	Existing & New	10.1	-4.8	10.5	-4.7	10.8	-4.6
		Ceramic metal halide	Retail	Existing & New	4.7	-4.6	5.1	-4.4	5.6	-4.1
		LED exit signs	All	Existing	1.7	na	2.0	na	2.4	na
	HID	Pulse-start metal halide	All, outdoor, roadway	Existing & New	9.5	0.3	10.9	0.3	12.5	0.4
		High intensity fluorescents	Warehouse, retail, school	Existing & New	4.1	0.4	4.8	0.5	5.4	0.5
HVAC		Low temperature heat pumps - Island	Small commercial	Existing & New	na	5.5	na	6.0	na	6.6
		Low temperature heat pumps - Labrador	Small commercial	Existing & New	na	4.8	na	5.3	na	5.8
		Ground source heat pumps - Island	All	Existing & New	na	6.2	na	7.3	na	8.6
		Ground source heat pumps - Labrador	All	Existing & New	na	4.5	na	5.4	na	6.3
		Infrared heaters - Island	Retail, warehouse	Existing & New	6.7	6.7	7.4	7.4	8.1	8.1
		Infrared heaters - Labrador	Retail, warehouse	Existing & New	4.8	4.8	5.3	5.3	5.8	5.8
		High-efficiency chillers - Island	Large commercial	Existing & New	na	6.1	na	7.4	na	8.9
		High-efficiency chillers - Labrador	Large commercial	Existing & New	na	8.1	na	9.9	na	11.8
		High-efficiency AC units - Island	All	Existing & New	na	11.3	na	12.9	na	14.7
		High-efficiency AC units - Labrador	All	Existing & New	na	18.7	na	21.5	na	24.3
		Adjustable speed drives	All	Existing & New	5.0	5.0	5.6	5.6	6.1	6.1
		Premium efficiency motors	All	Existing & New	19.5	2.9	21.5	3.2	23.5	3.6
		Building recommissioning	All	Existing	4.0	na	4.3	na	4.5	na
		Advanced BAS	All	Existing & New	4.3	na	4.7	na	5.1	na
		Programmable thermostats - Island	Small commercial	Existing & New	1.8	0.9	2.0	1.0	2.2	1.1
		Programmable thermostats - Labrador	Small commercial	Existing & New	1.6	0.8	1.8	0.9	1.9	1.0
Refrigeration		ENERGY STAR refrigerators & freezers	Food retail, restaurant	Existing & New	na	6.7	na	7.3	na	8.0
		HE supermarket refrigeration	Food retail	Existing & New	na	4.3	na	4.7	na	5.2
DHW		Low-flow aerators & shower heads	All	Existing & New	2.6	na	2.8	na	2.9	na
		Tankless water heaters	All	Existing & New	na	37.4	na	41.2	na	45.2
Computer Equipment		ENERGY STAR computers	All	Existing & New	na	0.0	na	0.0	na	0.0
		ENERGY STAR office equipment	All	Existing & New	na	0.0	na	0.0	na	0.0
		High-efficiency servers	All	Existing & New	na	1.5	na	1.6	na	1.7
Building Envelope		High-performance glazings - Island	All	Existing & New	na	5.5	na	6.5	na	7.5
		High-performance glazings - Labrador	All	Existing & New	na	3.3	na	4.0	na	4.6
		Wall insulation - Island	All	Existing & New	na	6.0	na	7.4	na	8.8
		Wall insulation - Labrador	All	Existing & New	na	4.2	na	5.1	na	6.1
		Roof insulation - Island	All	Existing & New	na	6.9	na	8.5	na	10.1
		Roof insulation - Labrador	All	Existing & New	na	4.4	na	5.3	na	6.4
		Air curtains - Island	Warehouse, retail	Existing & New	5.1	5.1	5.8	5.8	6.6	6.6
		Air curtains - Labrador	Warehouse, retail	Existing & New	3.3	3.3	3.8	3.8	4.3	4.3
New Construction		New buildings - 25% more efficient	All	New	na	0.9	na	1.1	na	1.4
		New buildings - 40% more efficient	All	New	na	2.5	na	3.1	na	3.8
Streetlighting		Induction lighting		Existing & New	na	10.4	na	12.3	na	14.4
		Dimming controls		Existing & New	5.0	5.0	5.8	5.8	6.6	6.6

4.5 PEAK LOAD REDUCTION MEASURES

4.5.1 Overview

Electric utilities are typically interested in peak load reduction measures as a means to avoid or defer the costs of capacity expansion. Capacity costs refer to a wide range of capital-based investments, including generating stations (new and upgraded), transmission lines, distribution lines, substations, transformers and other infrastructure required to deliver power.

From the customer's perspective, adoption of peak load reduction measures is typically dependent on the overall benefits to them, such as direct incentive payments or rate benefits. Although most medium and large commercial customers do pay a monthly demand charge that reflects their monthly peak, small commercial customers with a monthly demand of less than 10 kW are billed only for electricity (kWh) regardless of when it is used.

The current trend throughout much of the North American utility industry is towards more specific pricing such as time-of-use and even hourly pricing, or peak incentives that pass along some of the utility benefits to customers on a performance basis. These new pricing structures provide added incentive to larger commercial customers (who already pay a demand charge); they also provide an incentive for small commercial customers to implement measures or to participate in utility peak load reduction programs, as long as the differential between peak and off-peak prices is sufficient to provide a noticeable financial benefit to the customer.

Currently, several Canadian jurisdictions[36] are in the early stages of implementing pilot load reduction initiatives targeted to both commercial and residential customers. These initiatives are designed to test:

- New metering technologies, such as advanced meters (also referred to as "smart meters")
- New rate structures, such as real-time feedback, pay-as-you-go billing and critical peak pricing
- Direct load control.

Most conventional meters used in small commercial facilities monitor electricity consumption (kWh) but do not track *when* the electricity is used. Instead, conventional meters are occasionally read and reported to electric utilities, which then bill customers every one or two months. As a result, customers only find out their electricity usage after the fact.

In contrast, *advanced meters* (known in some industry circles as "smart meters") record how much electricity is used and when. Advanced meters, through their interval metering and two-way communications, allow the implementation of numerous utility programs

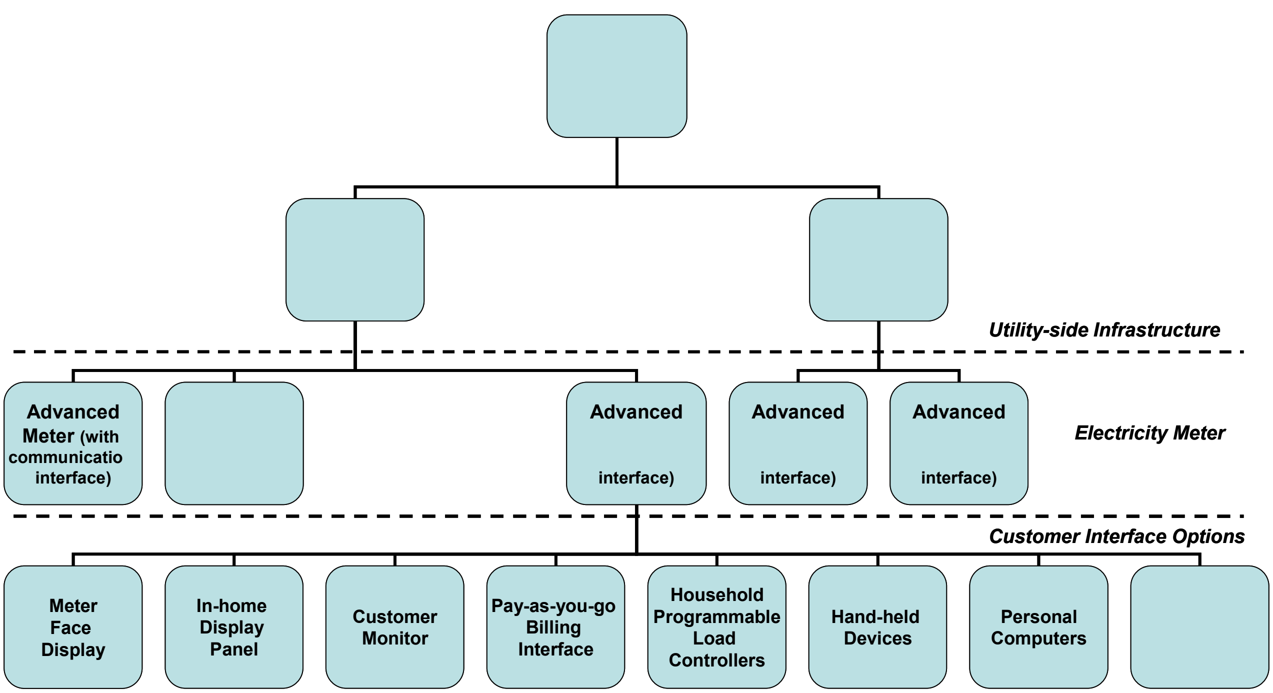
[36] Marbek Resource Consultants, *Technology & Market Assessment of Residential Electricity Advanced Metering In Canada*. Prepared for Natural Resources Canada, November 2006.

and services that encourage customers to reduce or shift (i.e., change the time of) their electricity consumption, particularly away from peak times when the cost of supply is becoming increasingly more expensive.

Exhibit 4.3 presents an illustrative schematic of an advanced metering system. As illustrated there are three major levels of system components:

- **Customer Interface Options** — The hardware interfaces that can be used for the advanced meter to communicate with the customer and, to a certain extent, any applicable electrical load controllers in the customer's household.
- **Electricity Meter** — The advanced meter itself, equipped with a communication interface to facilitate communication to other devices and the utility.
- **Utility-side Infrastructure** — The infrastructure required for two-way communication between the utility and the advanced meter.[37]

Exhibit 4.3
Illustrative Schematic of an Advanced Metering System



As illustrated in Exhibit 4.3, there is wide range of technical options available at each level in a typical advanced metering system. This is particularly the case at the customer interface level where there is a growing number of devices that can be used to provide real-time feedback to customers in a convenient and understandable manner. Typically, these devices provide a numerical or graphical display that is either wired into the same

[37] Ibid.

room as the meter, wired next to the main thermostat or is a wireless panel that can be placed anywhere in the home or commercial facility. However, alone, none of these devices save energy *per se*.

In summary, new electric metering and customer interface technologies, when combined with the applicable utility infrastructure, have the potential to support a wide range of utility-sponsored peak load reduction and load shifting initiatives via pricing and promotional initiatives. Within the agreed study scope, it is not feasible to provide further specific rate design or system infrastructure specifications. However, further information is provided below on selected direct load control options.

4.5.2 Peak Load Reduction Measures – Direct Load Control

Consistent with the agreed study scope, the information provided below is based on existing secondary data sources and does not include a detailed analysis of specific NLH/NP peak load conditions. Much of the information provided draws from work that the consultant team is currently undertaking for BC Hydro.[38] To that end, the material presented is intended to be indicative of general trends and costs but would need to be adjusted for specific application to NLH/NP peak load conditions.[39]

The remainder of this subsection provides an overview of the following Commercial sector peak load reduction measures:

- Utility-based control of space heating (HVAC) equipment using remote thermostat
- Utility-based control of space heating (HVAC) equipment using remote switch
- Utility-based control of hot water heater using remote switch.

❑ **Utility-Based Control of Space Heating (HVAC) Equipment Using Remote Thermostat**[40]

Thermostat-based load control is accomplished by the installation of a remote communicating thermostat that facilitates utility remote control of the thermostat (for space heating and/or, in some cases, space cooling). Utility control would occur under specific, pre-arranged, capacity-constrained conditions that would typically occur during a limited number of pre-specified hours during winter peak months.

The control options typically include thermostat setback (specific number of degrees) or cycling, whereby the units are limited to a fixed percentage of operating time per hour. These systems typically provide capability for local override by participants and are either one-way or two-way communicating systems. Two-way communicating systems also enable access by participants to their thermostats via the Internet, utility

[38] Marbek Resource Consultants and Applied Energy Group. *BC Hydro Conservation Potential Review – 2007*. Prepared for BC Hydro. In process, 2007.
[39] As both BC Hydro and NLH/NP are winter peaking utilities and both are hydro-based with fossil fuel plants serving peak load conditions, the information provided is expected to be generally applicable to the NLH/NP context.
[40] Op. cit., *BC Hydro Conservation Potential Review – 2007*, p. 109.

confirmation of communication during curtailments and collection of data on runtime[41] and temperature from the individual units.

Two-way communicating technology is commercially available and implemented in over 100,000 sites in the U.S. However, to date it has been primarily applied to central air conditioning equipment.

This measure is most applicable in buildings that have thermostat control of specific heating units (e.g., packaged rooftop units) rather than central heating systems such as those found in large buildings. In some cases, where multiple package systems are used in a single building, multiple thermostats, each controlling one package unit, could be accessed through a single data communications point or gateway and redistributed to the individual thermostats, rather than directly accessing each individual thermostat from the utility.

Experience in space heating load control is more limited than for air conditioning control. The BC Hydro study concluded that the potential peak load reductions for this measure are likely to vary widely depending on the type and size of commercial facility. Some of the particularly influential site-specific considerations include:

- Heating unit capacity (i.e., ability to restore temperature at the end of the control period)
- Facility thermal insulation levels (i.e., ability to maintain temperature during a control cycle)
- Occupancy patterns (i.e., are there periods of low occupancy that overlap with control periods such as the 4 to 8 pm period)
- Occupant comfort needs.

It was also noted that where occupants are not owners, they might not have access to the thermostats (which are often locked); this would preclude easy access to overrides if comfort is affected and would, consequently, adversely affect participation rates.

Subject to the preceding caveats, the BC Hydro study estimated that the potential peak load reduction (during the 8 am to 1 pm period on a typical BC winter peak day) would range between about 1.07 kW and 1.43 kW for a range of “typical” small (under 20,000 ft^2) commercial facilities such as Small Offices, Food Retail and Non-food Retail.

Large commercial facilities that have an existing building automation system (e.g., Large Offices) may offer a more attractive opportunity for this type of control option than smaller facilities. In some cases, it may be relatively easy for the utility to link into to existing building automation system and to cycle key HVAC loads such as heating equipment, fans, pumps, etc., during the control period. A typical load reduction for this type of site was not estimated. However, it was noted that this opportunity is increasingly attractive if load control is desired in the early evening winter period hours (e.g., 4 to 8 pm), which is typical in many Canadian jurisdictions. At this time of day, many large

[41] Runtime data typically represents number of minutes that the unit operates each hour for a period of time (e.g., one week) that can be stored in the unit.

buildings are at, or near, the end of their daily full occupancy period but typically have not yet reduced their HVAC loads.

Based on a one-time cost of approximately $315 (one-way communication) to $500 (two-way communication), ongoing maintenance of 5% (about $12) for one-way systems to $25 (two-way systems) per year and estimated annual impacts of 1.07 kW-1.43 kW per site, the BC Hydro study estimated that the cost would be in the range of about $45-$60 per kW/year when applied to a small commercial facility with 100% electric fuel use.

Utility infrastructure costs as well as program administration, promotion and incentive costs are in addition. Additional costs would also include maintenance of a call centre to handle participant calls, including off-hours support and referrals to "on-call" installers.

Caveats

Although some pilot space heat control projects have been tested in the U.S., the experience with this technology has primarily been with central air conditioning loads. Because space heating is much less discretionary, customer acceptance of this type of measure remains uncertain.

- **Utility-Based Control of Space Heating (HVAC) Equipment Using Remote Switch**[42]

Switch-based heating unit load control is similar to the preceding measure except that a remote control switch is installed on the heating unit itself or on the circuits controlling the heating unit. As with the preceding measure, utility control would occur under specific, pre-arranged, capacity-constrained conditions that typically would occur during a limited number of pre-specified hours during winter peak months. Typically, units are not shut off for the entire control period but rather "cycled" to limit their on-time to a pre-determined number of minutes per control cycle. The technology is commercially available and has been implemented in millions of sites in the U.S. (primarily for central air conditioning and water heating).

This measure primarily addresses units where temperature control is on each room unit, without a central thermostat capability. Typically, this would include baseboard units with individual controls or where one or more units are controlled from an electrical circuit.

Costs are similar to one-way thermostat control presented in the preceding discussion. The installation cost is higher for the switch because it involves a high voltage connection and thus a higher skilled installer (in many locales a licensed electrician). Installation costs are the same in both new and existing buildings.

Electric peak load reduction would be comparable to the thermostat control systems. However, without two-way access or thermostats, it would be more difficult to predict the effect on comfort and there would be a higher risk of over-control and adverse comfort impacts.

[42] Op. cit., *BC Hydro Conservation Potential Review – 2007*, p. 114.

Unlike thermostat-based systems, a control switch would not provide customers with any ancillary benefits (e.g., a programmable thermostats for comfort and energy savings and remote/Internet access to the thermostat) and thus the only incentive for participation would be monetary in nature, adding to recurring program costs.

- **Utility Control of Domestic Hot Water Heater Using Remote Switch**[43]

Switch-based water heating load control is accomplished by the installation of a remote control switch on either the water heater itself or on the circuits controlling the water heater. In older systems, this type of control has been accomplished via radio frequency (RF) control. In the systems that are currently offered, pager-based communications is used.

Costs are reduced if a communications system already exists. For example, if space heat control already exists, water heat control can be added via a hard-wired or wireless connection. This can reduce the total cost of the water heat control by up to 40%.

Depending upon the length of the control period and the size of the water heater tank, units can be shut off for the entire control period or "cycled" to limit their operating time to a predetermined number of minutes per control cycle. Water heat control technology is commercially available and implemented in hundreds of thousands of sites in the U.S.

This measure is applicable to small commercial buildings that have an electric water heater with a minimum 40-gallon capacity. The size of the tank is important because it provides hot water during times when the control is in effect. The larger the water heater tank, the longer the control can be in place without disrupting the customer's service.

Switches cost about $100 per unit, plus $150 for installation, plus maintenance. Costs are reduced to $150 (i.e., $50 incremental installation) if the control switch can be added to an existing control system at the same time, including one-way/two-way thermostats and switches for space heating. There is no savings in installation costs for a new facility.

Based on a one-time cost of approximately $250, ongoing maintenance of 5% (about $12/year) and estimated annual impacts of 0.39 kW to 0.46 kW per small commercial facility, the BC Hydro study estimated that the cost would be in the range of $75 - $88[44] per kW/year when applied to small commercial buildings with 4,000 annual kWh for electric DHW. Utility infrastructure costs as well as program administration, promotion and incentive costs are in addition.

[43] Op. cit., *BC Hydro Conservation Potential Review – 2007*, p. 120.
[44] Assumes 10-year life, 6% discount rate.

Caveats

This technology has a long history, going back at least 30 years on various types of equipment, including central air conditioners, water heaters and pool pumps.

Since the water heater switch uses a one-way communications-based system, it will require support analyses including the need for signal propagation studies and periodic sampling and re-estimation of reliability levels, accompanied by sufficient maintenance, to maintain an adequate level and accurate estimate of losses.

Experience in the utility industry has shown that performance is likely to erode significantly over time[45] if the system is not properly maintained.

The water heater control switch would not provide customers with any ancillary benefits and thus the only incentive for participation would be monetary in nature, likely on a per annum or per control event basis.

[45] Switch communications failures ranged from 10% to nearly 40% in utility reported data (Energy Pulse article by C. King – December 2005).

5. ECONOMIC POTENTIAL ELECTRICITY FORECAST

5.1 INTRODUCTION

This section presents the Commercial sector Economic Potential Forecast for the study period 2006 to 2026. The Economic Potential Forecast estimates the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the long-run avoided cost of electricity in the Newfoundland and Labrador service area. In this study, "cost effective" means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) in the preceding section, is equal to, or less than, the economic screen.[46]

The discussion in this section is organized according to the following subsections:

- Avoided Cost Used for Screening
- Major Modelling Tasks
- Technologies Included in Economic Potential Forecast
- Summary of Results
- CDM Measure Supply Curves.

5.2 AVOIDED COST USED FOR SCREENING

NLH has determined that the primary avoided costs of new electricity supply to be used for this analysis are $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region. These avoided costs represent a future in which the Lower Churchill project is not built and there is no DC link from Labrador to the Island.[47]

Therefore, the Economic Potential Forecast incorporates all the CDM measures reviewed in the preceding Section 4 that have a CCE equal to or less than the avoided costs.

NLH is currently studying the Lower Churchill/DC Link project. However, a decision on whether to proceed is not expected until 2009 and, even if the project proceeds, the earliest completion date would be in late 2014. This means that, regardless of the decision, the avoided cost values shown above will be in effect until the approximate mid point of the study period. If the Lower Churchill/DC Link project does proceed, the avoided costs presented above are expected to change. To provide insight into the potential impacts of the Lower Churchill/DC Link project on this study, it was agreed that the consultants would provide a high-level sensitivity analysis.

[46] Costs related to program design and implementation are not yet included.
[47] The avoided costs draw on the results of the earlier study conducted by NERA Economic Consulting, which is entitled: Newfoundland and Labrador Hydro. *Marginal Costs of Generation and Transmission*. May 2006. The avoided costs used in this study include generation, transmission and distribution.

5.3 MAJOR MODELLING TASKS

By comparing the results of the Commercial sector Economic Potential Electricity Forecast with the Reference Case, it is possible to determine the aggregate level of potential electricity savings within the Commercial sector, as well as identify which specific building types and end uses provide the most significant opportunities for savings.

To develop the Commercial sector Economic Potential Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibit 4.2 were reviewed, using the 6% (real) discount rate.[48]
- Technology upgrades that had a CCE equal to, or less than, the avoided cost threshold were selected for inclusion in the economic potential scenario, either on a "full cost" or "incremental" basis. It is assumed that technical upgrades having a "full cost" CCE that met the cost threshold were implemented in the first milestone year. It is assumed that those upgrades that only met the cost threshold on an "incremental" basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Electricity use within each of the building types was modelled with the same energy models that were used to generate the Reference Case. However, for this forecast, the remaining "baseline" technologies included in the Reference Case forecast were replaced with the most efficient "technology upgrade option" and associated performance efficiency that met the cost threshold of $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region.
- When more than one upgrade option was applied to a given end use, upgrades were applied in sequence. The general approach was to first reduce total end-use load, then to meet the remaining load with the most efficient technology that passed the economic screen. For example, measures to reduce the overall space heating load (e.g., envelope insulation) were applied before efficient heating plant measures (e.g., ground source heat pump).
- A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC Link.

5.4 TECHNOLOGIES INCLUDED IN ECONOMIC POTENTIAL FORECAST

Exhibits 5.1 and 5.2 provide a list of the technologies selected for inclusion in this forecast for, respectively, the Island and Isolated and Labrador Interconnected service regions. In each case, the exhibits show the following:

- End use affected
- Upgrade option(s) selected

[48] See Section 4.2.

- Building types to which the upgrade options were applied
- Rate at which the upgrade options were introduced into the stock.

Exhibit 5.1: Technologies Included in Economic Potential Forecast for the Island and Isolated Service Region

Category	Upgrade Technology/Measures	Applicability of Upgrade Options by Building Type	Vintage	Rate of Stock Introduction
Lighting	T12 baseline: Redesign with high-performance T8s	All	Existing	Immediate
	T8 baseline: Redesign with high-performance T8s	All	Existing	Immediate
	Occupancy sensors	All	Existing	Immediate
	Compact fluorescent lamps	All	Existing	Immediate
	Pulse-start metal halide	All	Existing	Rate of turnover
	High-intensity fluorescent	Retail, warehouse, school	Existing	Immediate
HVAC	Ground source heat pump	All	Existing	Rate of turnover
	High-efficiency chillers	Large commercial/institutional	Existing	Rate of turnover
	Adjustable speed drives	All	Existing	Immediate
	Premium efficiency motors	All	Existing	Rate of turnover
	Advanced BAS/Building recommissioning	All	Existing	Immediate
Refrigeration	ENERGY STAR Refrigerators and Freezers	All	Existing	Rate of turnover
	High-efficiency supermarket refrigeration	Food retail	Existing	Rate of turnover
DHW	Low-flow aerators & shower heads	All	Existing	Immediate
Computer Equipment	ENERGY STAR computers	All	Existing	Rate of turnover
	ENERGY STAR office equipment	All	Existing	Rate of turnover
	High-efficiency servers	All	Existing	Rate of turnover
Building Envelope	High-performance glazings	All	Existing	Rate of turnover
	Wall insulation	All	Existing	Rate of turnover
	Roof insulation	All	Existing	Rate of turnover
	Air curtains	Retail,warehouse	Existing	Immediate
New Construction	New buildings - 40% more efficient	All	New	Rate of construction
Streetlighting	Dimming controls	Streetlighting	Existing & New	Immediate

Exhibit 5.2: Technologies Included in Economic Potential Forecast for the Labrador Interconnected Service Region

Category	Upgrade Technology/Measures	Applicability of Upgrade Options by Building Type	Vintage	Rate of Stock Introduction
Lighting	T12 baseline: Redesign with high-performance T8s	All	Existing	Rate of turnover
	T8 baseline: Redesign with high-performance T8s	All	Existing	Rate of turnover
	Compact fluorescent lamps	All	Existing	Immediate
	High-intensity fluorescent	Retail, warehouse, school	Existing	Rate of turnover
HVAC	Premium efficiency motors	All	Existing	Rate of turnover
	Advanced BAS/Building recommissioning	All	Existing	Immediate
DHW	Low-flow aerators & shower heads	All	Existing	Immediate
Computer Equipment	ENERGY STAR computers	All	Existing	Rate of turnover
	ENERGY STAR office equipment	All	Existing	Rate of turnover
	High-efficiency servers	All	Existing	Rate of turnover
Building Envelope	High-performance glazings	All	Existing	Rate of turnover
	Air curtains	Retail,warehouse	Existing	Immediate
New Construction	New buildings - 40% more efficient	All	New	Rate of construction

Note: Individually, advanced BAS fails the economic screen for the Labrador Interconnected service region, while building recommissioning passes. The combined measure, advanced BAS/building recommissioning has a CCE below the Labrador threshold of $0.0432 and is, therefore, included in the Economic Potential Forecast.

5.5 SUMMARY OF RESULTS[49]

This section compares the Reference Case and Economic Potential Electricity Forecast levels of commercial electricity consumption for the two service regions. In each case, the results are presented as electricity savings that would occur at the customer's point-of-use. The results are presented in the following exhibits:

- Exhibit 5.3 shows the electricity savings for the Island and Isolated service region over the study period. As illustrated, under the Reference Case commercial electricity use would grow from the Base Year level of 1,881 GWh/yr. to approximately 2,233 GWh/yr. by 2026. This contrasts with the Economic Potential Forecast in which electricity use would increase to approximately 1,541 GWh/yr. by 2026, approximately 692 GWh/yr. (31%) below the Reference Case consumption.

- Exhibit 5.4 shows the electricity savings for the Labrador Interconnected service region over the study period. As illustrated, under the Reference Case commercial electricity use would grow from the Base Year level of 201 GWh/yr. to approximately 240 GWh/yr. by 2026. This contrasts with the Economic Potential Forecast in which electricity use would increase to approximately 197 GWh/yr. for the same period, approximately 43 GWh/yr. (18%) below the Reference Case consumption.

- Exhibits 5.5 and 5.6 present the results by end use, building type and milestone year for, respectively, the Island and Isolated and Labrador Interconnected service regions.

- Exhibits 5.7 and 5.8 show the 2026 savings by major end use and building type for, respectively, the Island and Isolated and Labrador Interconnected service regions.

- Exhibits 5.9 and 5.10 show 2026 savings by major end use and vintage for, respectively, the Island and Isolated and Labrador Interconnected service regions.

[49] All results are reported at the customer's point-of-use and do not include line losses.

Exhibit 5.3: Reference Case versus Economic Potential Electricity Consumption in Commercial Sector, (GWh/yr.) for the Island and Isolated Service Region

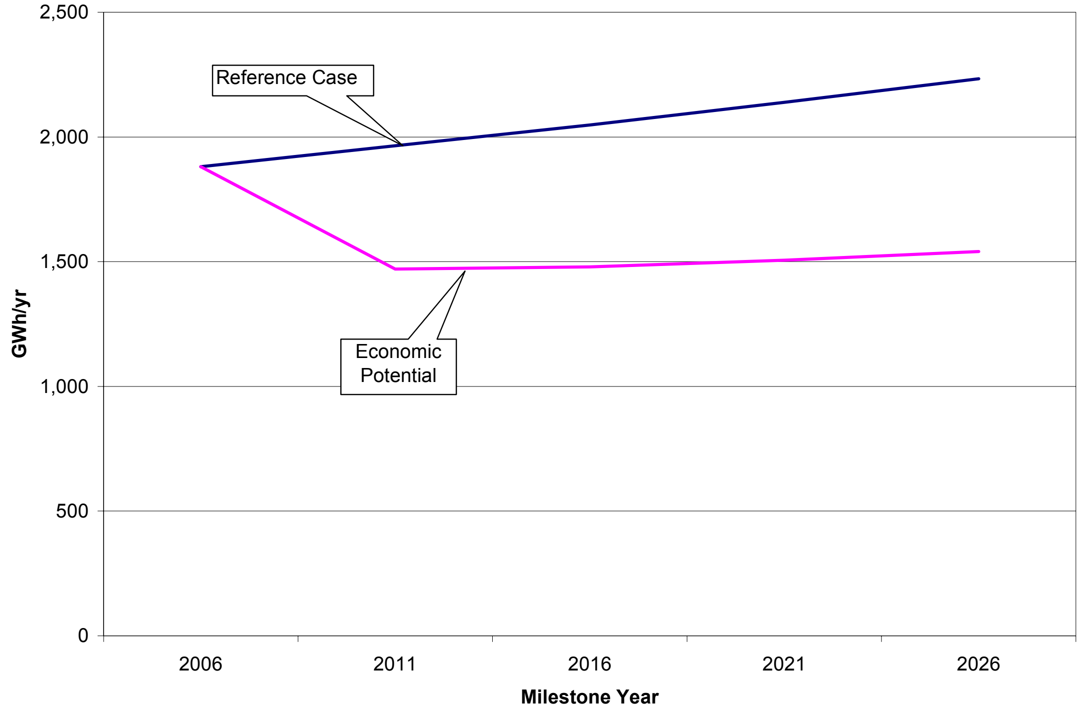


Exhibit 5.4: Reference Case versus Economic Potential Electricity Consumption in Commercial Sector, (GWh/yr.) for the Labrador Interconnected Service Region

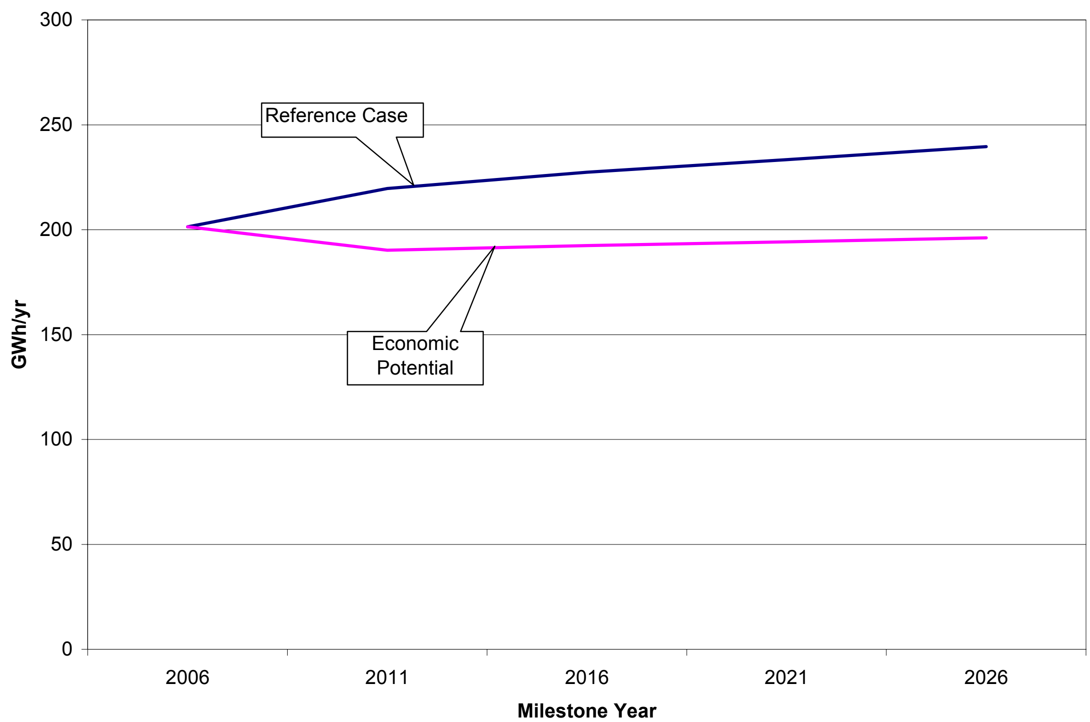


Exhibit 5.5: Total Potential Electricity Savings by End Use, Building Type and Milestone Year for the Island and Isolated Service Region (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneaous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	122.9	40.6	11.0	0.7	21.9	0.0	0.0	0.2	0.0	0.1	14.2	5.0	26.7	2.7	
	2016	146.4	41.1	11.1	1.0	23.7	0.0	0.0	0.3	0.0	0.1	32.8	5.6	27.7	2.9	
	2021	169.0	41.8	11.3	1.3	25.8	0.0	0.0	0.4	0.0	0.2	49.7	6.3	28.9	3.2	
	2026	190.1	42.5	11.5	1.7	28.1	0.0	0.1	0.4	0.0	0.3	64.9	6.9	30.2	3.5	
Non-food Retail	2011	48.1	27.5	2.7	0.5	2.0	0.0	0.0	0.1	0.0	0.0	3.9	3.3	7.3	0.7	
	2016	53.8	27.6	2.7	0.7	2.2	0.0	0.0	0.3	0.0	0.0	8.3	3.5	7.6	0.8	
	2021	59.2	27.9	2.8	0.9	2.4	0.0	0.0	0.3	0.0	0.0	12.3	3.6	8.0	0.8	
	2026	64.2	28.2	2.9	1.1	2.6	0.0	0.0	0.3	0.0	0.0	15.9	3.8	8.5	0.9	
Food Retail	2011	26.9	10.0	1.1	0.2	1.1	0.0	0.0	10.3	0.0	0.0	0.0	0.6	2.8	0.8	
	2016	40.1	10.1	1.2	0.4	1.1	0.0	0.1	20.6	0.0	0.0	2.1	0.6	3.0	0.9	
	2021	44.3	10.4	1.2	0.5	1.2	0.1	0.1	22.0	0.0	0.0	3.9	0.7	3.2	1.0	
	2026	48.3	10.6	1.3	0.6	1.4	0.1	0.1	23.5	0.0	0.0	5.4	0.8	3.4	1.1	
Healthcare	2011	28.4	2.1	9.0	0.5	2.4	0.0	0.0	0.0	0.0	0.0	5.4	0.6	7.0	1.5	
	2016	31.0	2.1	8.9	0.6	2.5	0.0	0.1	0.0	0.0	0.0	7.3	0.8	7.2	1.6	
	2021	33.7	2.0	8.8	0.7	2.6	0.0	0.1	0.0	0.0	0.0	9.2	1.0	7.4	1.7	
	2026	36.5	2.0	8.7	0.8	2.7	0.0	0.1	0.0	0.0	0.0	11.3	1.2	7.6	1.9	
Schools	2011	30.1	8.9	1.5	0.5	4.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	2.5	1.4	
	2016	39.3	9.4	2.6	0.7	4.4	0.0	0.0	0.0	0.0	0.0	18.0	0.0	2.7	1.5	
	2021	48.6	9.9	3.7	0.9	4.7	0.0	0.0	0.0	0.0	0.0	24.7	0.0	2.9	1.7	
	2026	57.5	10.5	4.7	1.1	5.1	0.0	0.0	0.0	0.0	0.0	31.0	0.0	3.0	1.8	
Accomodations	2011	33.9	8.4	10.3	0.2	1.5	0.0	0.0	0.5	0.0	0.0	-0.2	0.7	2.9	9.6	
	2016	41.5	8.4	10.4	0.3	1.6	0.0	0.1	1.0	0.0	0.0	5.5	0.8	3.1	10.4	
	2021	48.5	8.4	10.5	0.4	1.7	0.0	0.1	1.0	0.0	0.0	10.8	1.0	3.3	11.4	
	2026	55.3	8.5	10.6	0.5	1.9	0.0	0.1	1.0	0.0	0.1	15.6	1.1	3.5	12.4	
University/College	2011	34.7	11.2	2.8	0.2	6.1	0.0	0.0	0.5	0.0	0.0	0.4	0.3	12.4	0.9	
	2016	36.9	11.1	2.7	0.4	6.4	0.0	0.0	1.0	0.0	0.0	1.6	0.4	12.4	0.9	
	2021	38.7	10.9	2.7	0.5	6.7	0.0	0.0	1.0	0.0	0.0	3.0	0.5	12.5	0.9	
	2026	40.6	10.8	2.6	0.6	7.0	0.0	0.0	1.0	0.0	0.0	4.4	0.6	12.6	1.0	
Warehouse/Whole sale	2011	13.6	8.4	1.1	0.2	1.1	0.0	0.0	0.8	0.0	0.0	-0.1	0.1	1.5	0.5	
	2016	17.2	8.5	1.1	0.3	1.2	0.0	0.0	1.6	0.0	0.0	2.3	0.1	1.5	0.6	
	2021	20.0	8.7	1.1	0.4	1.2	0.0	0.0	1.6	0.0	0.0	4.6	0.1	1.6	0.6	
	2026	22.7	8.9	1.1	0.5	1.3	0.0	0.0	1.7	0.0	0.0	6.8	0.1	1.6	0.7	
Small Commercial	2011	120.1														
	2016	126.6														
	2021	133.3														
	2026	139.2														
Other Buildings	2011	21.4														
	2016	22.2														
	2021	22.9														
	2026	23.8														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Isolated Buildings	2011	1.9														
	2016	2.2														
	2021	2.4														
	2026	2.5														
Streetlighting	2011	11.8														11.8
	2016	11.8														11.8
	2021	11.8														11.8
	2026	11.9														11.9
Total	2011	493.9	117.0	39.4	3.0	40.0	0.0	0.1	12.4	0.0	0.1	34.7	10.6	63.1	18.2	11.8
	2016	569.0	118.3	40.7	4.2	43.0	0.0	0.3	24.7	0.0	0.2	77.9	11.8	65.3	19.6	11.8
	2021	632.4	120.1	42.1	5.5	46.5	0.1	0.4	26.3	0.0	0.4	118.2	13.2	67.8	21.4	11.8
	2026	692.5	121.9	43.4	6.9	50.1	0.1	0.6	28.0	0.0	0.5	155.2	14.7	70.5	23.2	11.9

Notes: 1) Savings are at customer's point-of-use. 2) Any differences in totals are due to rounding.

Exhibit 5.6: Total Potential Electricity Savings by End Use, Building Type and Milestone Year for the Labrador Interconnected Service Region (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	1.2	0.2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	
	2016	1.9	0.3	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.3	0.1	
	2021	2.6	0.5	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.3	0.1	
	2026	3.3	0.6	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	1.4	0.1	0.3	0.1	
Non-food Retail	2011	6.4	4.3	0.1	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.7	0.2	
	2016	7.6	4.7	0.1	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.8	0.3	0.8	0.2	
	2021	8.8	5.0	0.1	0.2	0.6	0.0	0.0	0.0	0.0	0.0	1.5	0.3	0.9	0.2	
	2026	10.0	5.4	0.1	0.2	0.6	0.0	0.0	0.0	0.0	0.0	2.1	0.4	0.9	0.2	
Food Retail	2011	1.5	0.4	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.5	0.0	0.1	0.1	
	2016	1.9	0.5	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.1	0.1	
	2021	2.2	0.6	0.1	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.6	0.0	0.2	0.1	
	2026	2.5	0.8	0.1	0.1	0.1	0.0	0.0	0.5	0.0	0.0	0.6	0.0	0.2	0.1	
Healthcare	2011	3.3	0.2	0.9	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.9	
	2016	4.2	0.2	1.1	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.6	0.9	
	2021	4.7	0.3	1.2	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.6	0.9	
	2026	5.1	0.3	1.3	0.2	0.5	0.0	0.0	0.0	0.0	0.0	1.2	0.1	0.6	0.9	
Schools	2011	1.3	0.2	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.1	
	2016	1.8	0.4	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.1	
	2021	2.1	0.5	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.3	0.1	
	2026	2.3	0.6	0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	0.1	
Accomodations	2011	1.0	0.3	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.4	
	2016	1.3	0.3	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.4	
	2021	1.5	0.3	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.5	
	2026	1.8	0.3	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.5	
University/College	2011	0.7	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.3	0.1	
	2016	1.1	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	
	2021	1.3	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.1	
	2026	1.5	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.3	0.1	
Warehouse/Wholesale	2011	0.8	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.2	0.1	
	2016	1.2	0.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	
	2021	1.6	0.9	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	
	2026	2.0	1.1	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.1	
Small Commercial	2011	5.3														
	2016	5.9														
	2021	6.2														
	2026	6.5														
Other Buildings	2011	2.2														
	2016	2.3														
	2021	2.4														
	2026	2.5														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Other Institutional	2011	5.7														
	2016	5.7														
	2021	5.8														
	2026	5.8														
Streetlighting	2011	0.0														0.0
	2016	0.0														0.0
	2021	0.0														0.0
	2026	0.0														0.0
Total	2011	29.4	6.0	1.4	0.4	2.4	0.0	0.1	0.3	0.0	0.0	1.0	0.4	2.5	1.9	0.0
	2016	34.9	7.3	1.7	0.5	2.6	0.0	0.1	0.4	0.0	0.0	3.2	0.4	2.7	2.0	0.0
	2021	39.2	8.3	1.9	0.6	2.7	0.0	0.1	0.5	0.0	0.0	5.2	0.5	2.9	2.1	0.0
	2026	43.4	9.3	2.1	0.7	2.9	0.0	0.1	0.6	0.0	0.0	7.2	0.6	3.0	2.1	0.0

Notes: 1) Savings are at customer's point-of-use. 2) Any differences in totals are due to rounding.

Exhibit 5.7: Savings by Major End Use and Building Type for the Island and Isolated Service Region, 2026

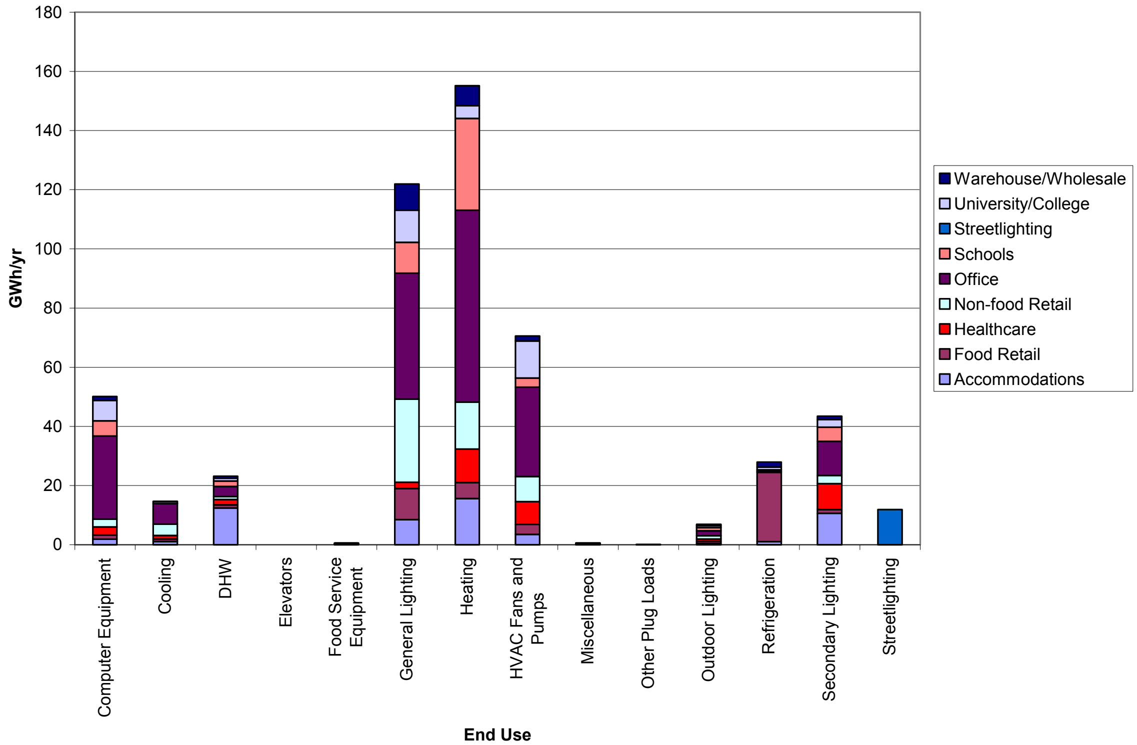


Exhibit 5.8: Savings by Major End Use and Building Type for the Labrador Interconnected Service Region, 2026

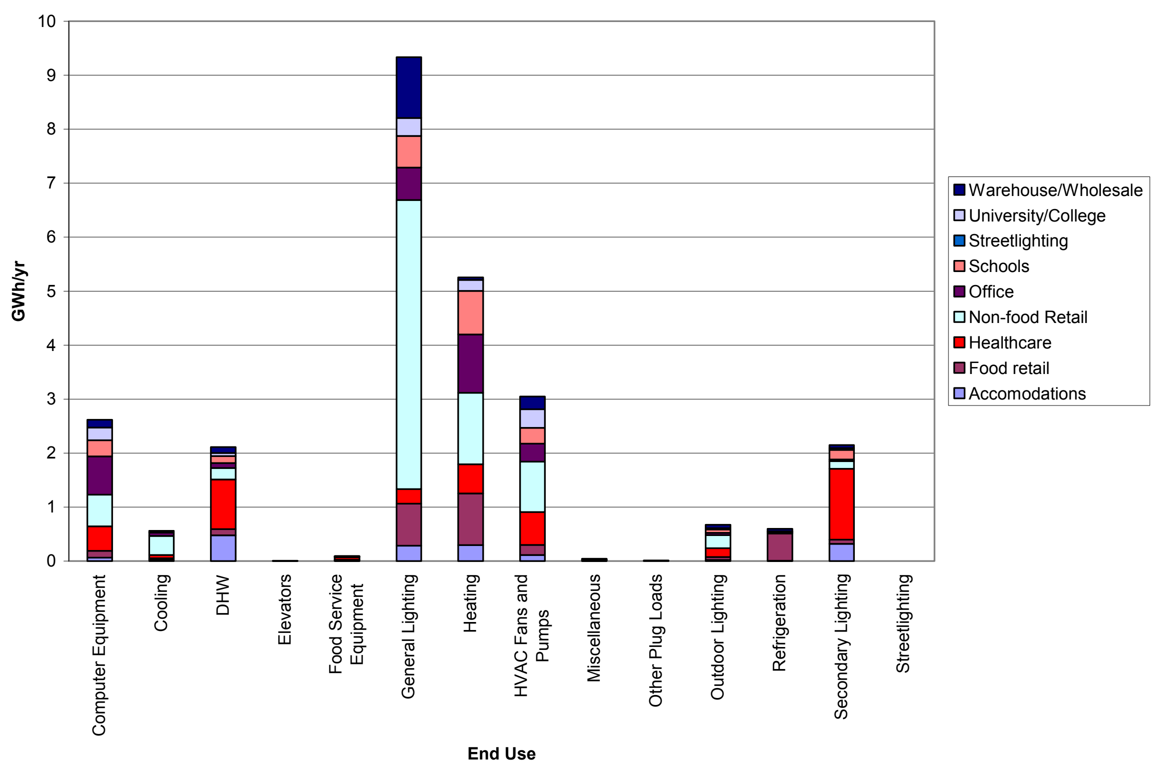


Exhibit 5.9: Savings by Major End Use and Vintage for the Island and Isolated Service Region, 2026

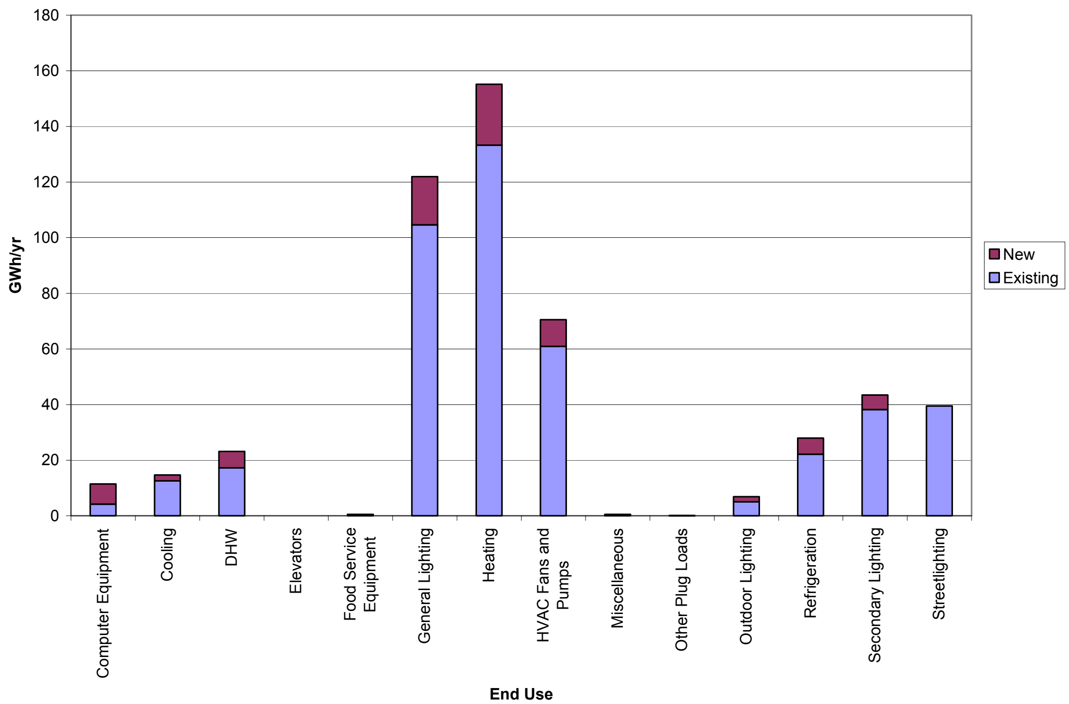
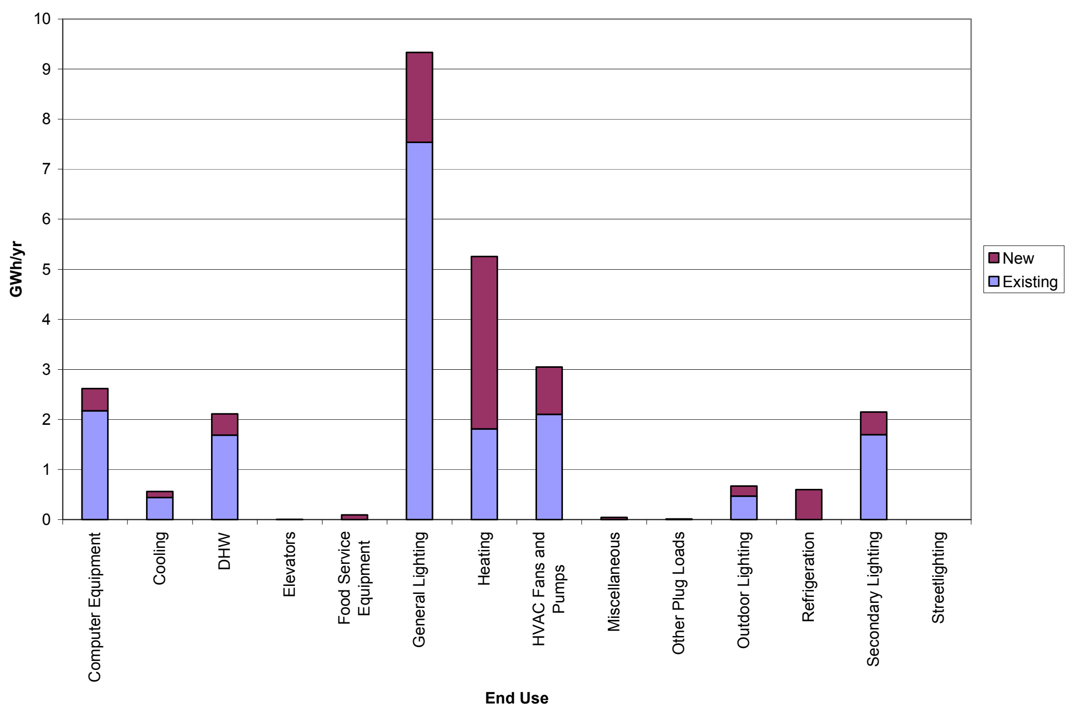


Exhibit 5.10: Savings by Major End Use and Vintage for the Labrador Interconnected Service Region, 2026



5.5.1 Interpretation of Results

Highlights:

- **Electricity Savings by Service Region**

The Island and Isolated service region has the largest economic potential savings at approximately 94% of the total, followed by the Labrador Interconnected service region at 6% in 2026.

- **Electricity Savings by Sub Sector**

In the Island and Isolated service region, the Office sub sector has the largest economic potential at approximately 27% of the total in 2026, followed by Small Commercial at 20%, Non-food Retail at 9% and Schools and Accommodations at 8%.

In the Labrador Interconnected service region, the Non-food Retail sub sector has the largest economic potential at 22% of the total in 2026, followed by Small Commercial at 16%, Other Institutional at 14% and Healthcare at 11%.

- **Electricity Savings by End Use**

In the Island and Isolated service region, the space heating end use has the largest economic potential at approximately 29% of the total in 2026, followed by general lighting at 23%, HVAC fans and pumps at 12% and computer equipment at 10%.

In the Labrador Interconnected service region, the general lighting end use has the largest economic potential at approximately 35% of the total in 2026, followed by space heating at 20%, HVAC fans and pumps at 13% and computer equipment at 10%.

Note 1: In some cases, the space heating savings are negative due to a reduction in internal heat gains associated with lighting, computer equipment and HVAC efficiency measures.

Note 2: As shown in Exhibit 5.10, in the Labrador Interconnected service region, space heating savings in existing buildings represent a small proportion of the total space heating savings. This is due to the fact that few space heating measures for existing buildings pass the economic screen.

5.5.2 Caveats

A systems approach was used to model the energy impacts of the CDM measures presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible. More specifically, there are two particularly important considerations:

- **More than one upgrade may affect a given end use**. For example, improved insulation reduces space heating electricity use, as does the installation of a heat pump. On their own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of "bundles of measures" that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a high-efficiency space heating system).

- **There are interactive effects among end uses**. For example, the electricity savings from more efficient lighting results in reduced heat generation. During the space heating season, internal heat gains lower the amount of heat that must be provided by the space heating system and, conversely, increase the amount of heat that must be removed by the space cooling system. For instance, in a typical commercial building, a measure with a 25% reduction in lighting energy would result in a 2% to 4% increase in space heating energy. Interactive effects have been analyzed using CEEAM for each measure and are included in the Economic and Achievable Forecasts.

5.5.3 Sensitivity Analysis – Alternative Avoided Costs

A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC link. The analysis reviewed the scope of measures that would pass or fail the economic screen under the changed avoided costs. Based on the preliminary avoided cost values assessed, the analysis concluded that any impacts would be modest.

5.6 CDM MEASURE SUPPLY CURVES

A supply curve was constructed for each of the service regions based on the economic potential savings associated with the above measures. The following approach was followed:

- Measures are introduced in sequence to see incremental impact and cost
- Sequence is determined by principle of 1) reduce load, then 2) meeting residual load with most efficient technology
- Is organized by CCE levels.

Exhibits 5.11 and 5.12 show the supply curves for, respectively, the Island and Isolated and the Labrador Interconnected service regions. Exhibits 5.13 and 5.14 show the measures included in each of the supply curves.

Note: The average CCE is the weighted average of all sub sector CCEs for a particular measure. It is calculated by adding measure costs for all sub sectors and dividing the result by total electricity saving, inclusive of interactive effects across all sub sectors. The following exhibits may include measures with a CCE that exceeds the study's avoided cost threshold. This increased CCE is due to the impact of interactive effects. The measures shown maintain consistency with previous exhibits.

Exhibit 5.11: Supply Curve for Commercial Sector, Island and Isolated Service Region, 2026

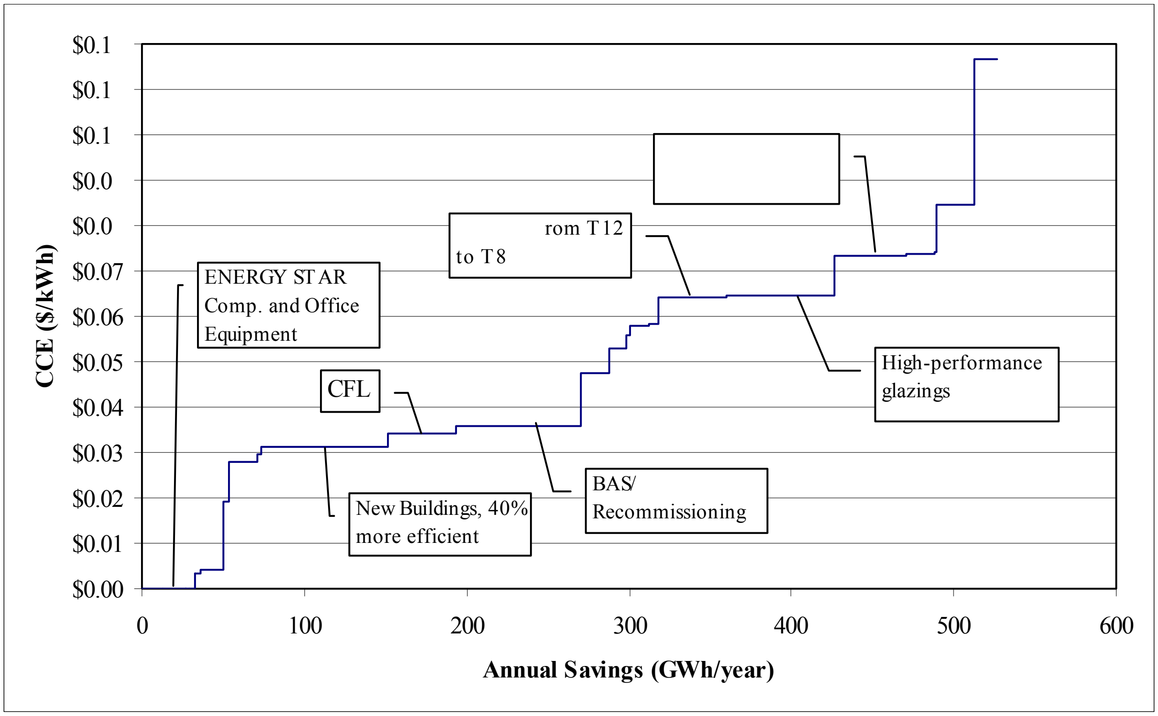


Exhibit 5.12: Supply Curve for Commercial Sector, Labrador Interconnected Service Region, 2026

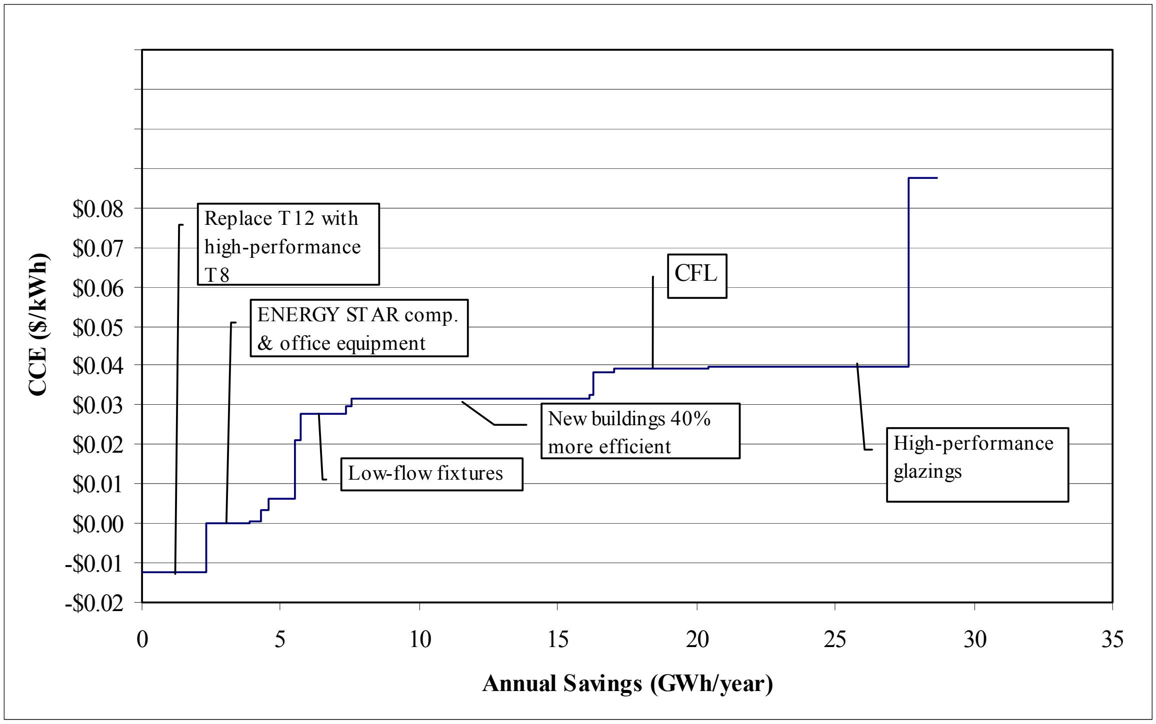


Exhibit 5.13: Summary of Commercial Sector Energy-efficiency Measures, Island and Isolated Service Region 2026

Measure	Average* CCE ($/kWh)	Annual Savings (GWh/yr)
ENERGY STAR computers	$0.000	26
ENERGY STAR office equipment	$0.000	6
Pulse-start metal halide	$0.003	3
High-intensity fluorescent	$0.004	15
High-efficiency servers	$0.019	4
Low-flow aerators & shower heads	$0.028	17
Compact fluorescent lamps (Outdoor)	$0.029	2
New buildings - 40% more efficient	$0.031	78
Compact fluorescent lamps	$0.034	42
Advanced BAS/Recommissioning	$0.036	76
HE supermarket refrigeration	$0.047	18
Occupancy sensors	$0.053	10
Adjustable speed drives	$0.056	2
Dimming controls	$0.058	12
Air curtains	$0.058	6
T12 Baseline - Redesign with high-performance T8s	$0.064	42
High-performance glazings	$0.065	66
ENERGY STAR refrigerators & freezers	$0.073	4
Ground source heat pumps	$0.073	40
Wall insulation	$0.074	17
High-efficiency chillers	$0.074	1
Roof insulation	$0.085	24
T8 Baseline - Redesign with high-performance T8s	$0.117	14

Exhibit 5.14: Summary of Commercial Sector Energy-efficiency Measures, Labrador Interconnected Service Region 2026

Measure	Average* CCE ($/kWh)	Annual Savings (GWh/yr)
T12 baseline - redesign with high-performance T8s	-$0.012	2.3
ENERGY STAR computers	$0.000	1.3
ENERGY STAR office equipment	$0.000	0.3
T8 baseline - redesign with high-performance T8s	$0.000	0.4
Pulse-start metal halide	$0.003	0.3
High-intensity fluorescents	$0.006	0.9
High-efficiency servers	$0.021	0.2
Low-flow aerators & shower heads	$0.028	1.7
Compact fluorescent lamps (Outdoor)	$0.029	0.2
New buildings - 40% more efficient	$0.031	8.6
Premium efficiency motors	$0.032	0.1
Air curtains	$0.038	0.7
Compact fluorescent lamps	$0.039	3.4
High-performance glazings	$0.040	7.2
Advanced BAS/Recommissioning	$0.088	1.0

6. ACHIEVABLE POTENTIAL

6.1 INTRODUCTION

This section presents the Commercial sector Achievable Potential electricity savings for the study period. The Achievable Potential is defined as the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to the estimation of Achievable Potential
- Workshop results
- Summary of Achievable electricity savings
- Peak load impacts.

6.2 DESCRIPTION OF ACHIEVABLE POTENTIAL

Achievable Potential recognizes that it is difficult to induce all customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability
- Consumer awareness.

The rate at which customers accept and purchase energy-efficient products can be influenced by a variety of factors including, the level of financial incentives, information and other measures put in place by the utilities, governments and the private sector to remove barriers such as those noted above.

Exhibit 6.1 presents the level of electricity consumption that is estimated in the Achievable Potential scenarios. As illustrated, the Achievable Potential scenarios are “banded” by the two forecasts presented in previous sections, namely the Economic Potential Forecast and the Reference Case.

Electricity savings under Achievable Potential are typically less than in the Economic Potential Forecast. In the Economic Potential Forecast, efficient new technologies are assumed to fully penetrate the market as soon as it is financially attractive to do so. However, the Achievable Potential recognizes that under “real world” conditions, the rate at which customers are likely to implement new technologies will be influenced by additional practical considerations and will, therefore, occur more slowly than under the assumptions employed in the Economic Potential Forecast. Exhibit 6.1 also shows that future electricity consumption under the Reference Case is greater than in either of the two Achievable Potential Forecasts. This is because the Reference

Case represents a "worst case" situation in which there are no additional utility market interventions and hence no additional electricity savings beyond those that occur "naturally."

Exhibit 6.1 presents the achievable results as a band of possibilities, rather than a single line. This recognizes that any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty and that there are different levels of potential CDM program intervention.

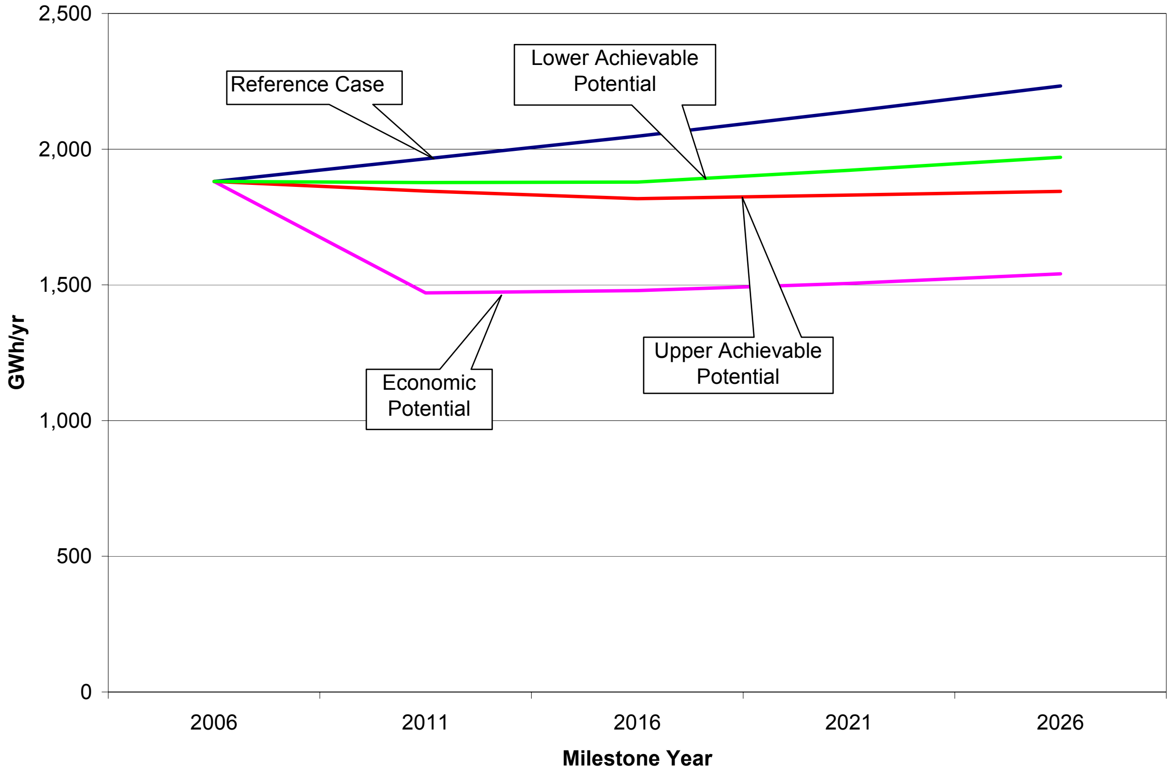
- **The Upper Achievable Potential** assumes both an aggressive program approach and a very supportive context, e.g., healthy economy, very strong public commitment to climate change mitigation, etc.

  However, the Upper Achievable Potential scenario also recognizes that there are limits to the scope of influence of any electric utility. It recognizes that some markets or submarkets may be so price sensitive or constrained by market barriers beyond the influence of CDM programs that they will only fully act if forced to by legal or other legislative means. It also recognizes that there are practical constraints related to the pace that existing inefficient equipment can be replaced by new, more efficient models or that existing building stock can be retrofitted to new energy performance levels.

  For the purposes of this study, the Upper Achievable Potential can, informally, be described as: "*Economic Potential less those customers that "can't" or "won't" participate."*

- **The Lower Achievable Potential** assumes that existing CDM programs and the scope of technologies addressed are expanded, but at a more modest level than in the Upper Achievable Potential. Market interest and customer commitment to energy efficiency and sustainable environmental practices remain approximately as current. Similarly, federal, provincial and municipal government energy-efficiency and GHG mitigation efforts remain similar to the present.

Exhibit 6.1: Annual Electricity Consumption – Illustration of Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Commercial Sector (GWh/yr.)



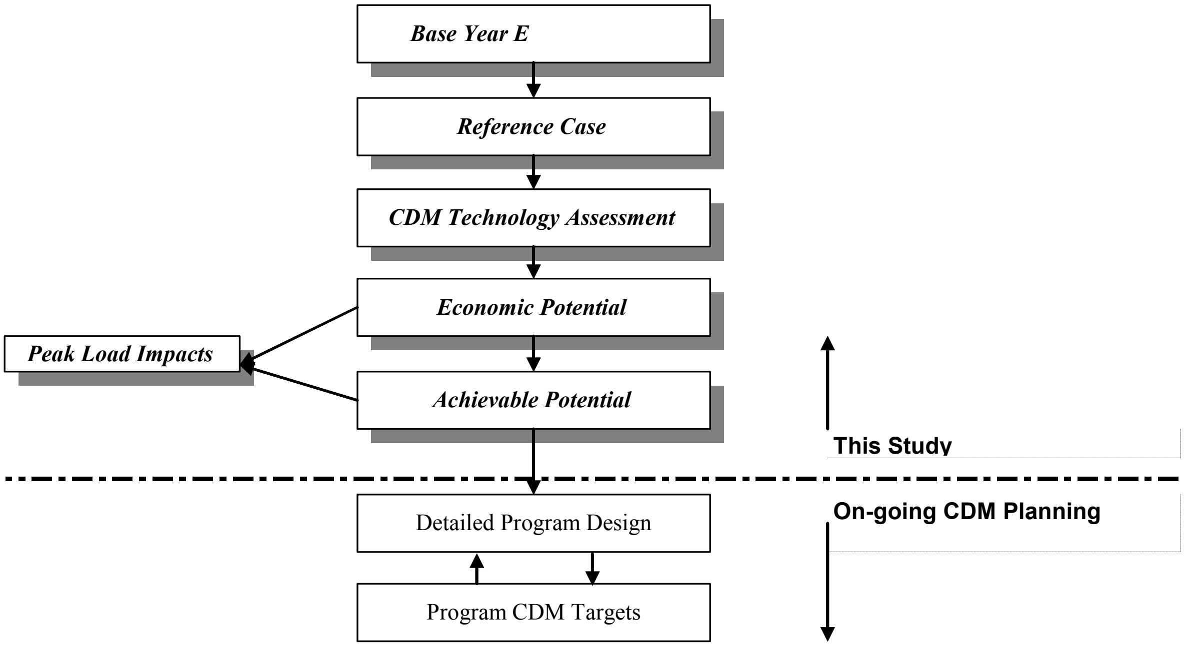
Achievable Potential versus Detailed Program Design

It should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.[50]

Exhibit 6.2 illustrates the relationship between Achievable Potential and the more detailed program design.

[50] The Achievable Potential savings assume program start-up in 2007. Consequently, electricity savings in the first milestone year of 2011 will need to be adjusted to reflect actual program initiation dates. This step will occur during the detailed program design phase, which will follows this study.

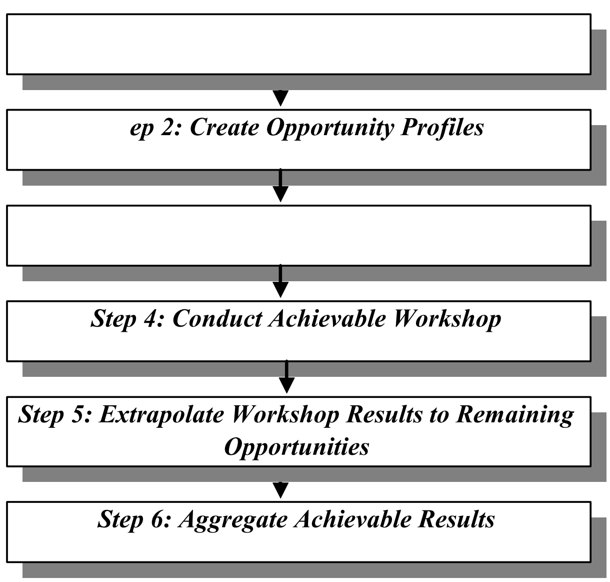
Exhibit 6.2: Achievable Potential versus Detailed Program Design



6.3 APPROACH TO THE ESTIMATION OF ACHIEVABLE POTENTIAL

Achievable Potential was estimated in a six-step approach. A schematic showing the major steps is shown in Exhibit 6.3 and each step is discussed below.

Exhibit 6.3: Approach to Estimating Achievable Potential



Step 1: Select Priority Opportunities

The first step in developing the Achievable Potential estimates required that the energy-saving opportunities identified in the Economic Potential Forecasts be "bundled" into a set of opportunity areas that would facilitate the subsequent assessment of their potential market penetration.

The amount of time available in the Achievable Potential workshop for the discussion of energy-efficiency opportunities was limited. Consequently, the energy-efficiency opportunity areas shown in Exhibit 6.4 were selected based primarily on the basis that they represent a significant portion of the energy savings potential identified in the Economic Potential Forecast. Where two or more opportunities offered similar levels of potential energy savings, consideration was also given to whether discussion of the selected opportunity area in the workshop would provide insights into the participation rates to be used for related opportunities that could not be covered during the workshop.

Eight energy-efficiency opportunity areas were selected for discussion in the Commercial sector workshop that was held on October 31, 2007. Exhibit 6.4 identifies the opportunity areas and shows the approximate percentage that each represents of the total Commercial sector potential contained in the Economic Potential Forecast.

Exhibit 6.4: Commercial Sector Opportunity Areas

Opportunity Area	Title	Approximate % of Economic Potential Savings
C1	T8 Fluorescent Upgrades (T12 Baseline)	8%
C2	T8 Fluorescent Upgrades (T8 Baseline)	3%
C3	Incandescent Upgrades	8%
C4	Building Envelope Measures	20%
C5	Building Recommissioning & Advanced BAS	14%
C6	Ground Source Heat Pumps	8%
C7	Advanced New Commercial Building Construction	15%
C8	ENERGY STAR Computer Equipment	7%
	Total	83%

Step 2: Create Opportunity Profiles

The next step involved the development of brief profiles for the priority opportunity areas noted in Exhibit 6.4. A sample profile for Opportunity C1: T8 Fluorescent Upgrade (T12 baseline) is presented in Exhibit 6.5; the remaining Opportunity Profiles are provided in Appendix C.

The purpose of the Opportunity Profiles was to provide a "high-level" logic framework that would serve as a guide for participant discussions in the workshop. The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project.

Exhibit 6.5: Sample Opportunity Profile

Opportunity Profile
C1 – T8 Fluorescent Upgrades (T12 Baseline)

Overview:
• General lighting in the commercial building stock is typically a mix of fluorescent T12 and T8 lighting systems.
• This Opportunity Profile covers the replacement of T12 lighting systems with advanced T8 technologies in commercial buildings.
• Our discussion will be based on Office buildings and will focus on the three standard approaches to achieving lighting energy savings:
  • Redesign with advanced T8s (new layout, fewer fixtures, lower light levels)
  • Retrofit with advanced T8s (relamp/reballast)
  • Occupancy controls (occupancy sensors, time-of day scheduling, etc.)
• The target market is the remaining stock of T12 lighting

Target Technologies and Building Types: • The target technologies include: redesign with advanced T8s, retrofit with advanced T8s and controls as outlined above. • The target market includes all existing commercial buildings with T12 lighting; however, the focus of our discussion is Office buildings (> 40,000 ft^2) in Newfoundland. • The penetration of T12 lighting is estimated to be 60%
Opportunity Costs and Savings Profile: • Redesign with advanced T8s: full cost \$1.7/ft^2; savings 62%; CCE \$0.056/kWh; simple payback 6 years. • Retrofit with advanced T8s: full cost \$1.0/ft^2; savings 39%; CCE \$0.049/kWh; simple payback 6 years. • Occupancy controls: full cost \$0.5/ft^2; savings 30%; CCE \$0.066 cents/kWh; simple payback 5 years.
Target Audience(s) & Potential Delivery Allies: • Owners, developers, facility managers, BOMA members • Lighting manufacturers and suppliers • Lighting designers, IESNA • Electrical maintenance contractors • NRCan and Ministry of Energy re: lighting standards and regulations • Performance contractors • Commercial renovation contractors

Constraints & Challenges:
• The most significant barriers are:
  • Lack of customer awareness, e.g., energy savings, improved light quality, productivity, longer life
  • Split incentive, e.g., lease arrangements – commercial "triple net lease" discourages owner participation
  • High paybacks, particularly for the redesign upgrades
  • Financing, e.g., access to capital
  • Lack of standards to differentiate "advanced" T8, manufacturer sets own protocol

Opportunities & Synergies: • Phasing out of T12s through regulations • Trade ally alliances, tying trade "partners" to qualified leads • Opportunities for work environment improvements, customized to work function needs • Link to renovation upgrades, building sales

As illustrated in Exhibit 6.5, each Opportunity Profile addresses the following areas:

- ***Overview*** – provides a summary statement of the broad goal and rationale for the opportunity.

- ***Target Technologies and Building Types –*** highlights the major technologies and the sub sectors where the most significant opportunities have been identified in the Economic Potential Forecast.

- ***Opportunity Costs and Savings Profile*** – provides information on the financial attractiveness of the opportunity from the perspective of both the customer and NLH or NP.

- ***Target Audiences and Potential Delivery Allies*** – identifies key market players that would be expected to be involved in the actual delivery of services. The list of stakeholders shown is intended to be "indicative" and is by no means comprehensive.

- ***Constraints and Challenges –*** identifies key market barriers that are currently constraining the increased penetration of energy-efficient technologies or measures. Interventions for addressing the identified barriers are noted. Again, it is recognized that the interventions are not necessarily comprehensive; rather, their primary purpose was to help guide the workshop discussions.

- ***Opportunities and Synergies –*** identifies information or possible synergies with other opportunities that may affect workshop participant views on possible customer participation rates.

Step 3: Prepare Draft Opportunity Assessment Worksheets

A draft Assessment Worksheet was prepared for each Opportunity Profile in advance of the workshop. The Assessment Worksheets complemented the information contained in the Opportunity Profiles by providing quantitative data on the potential energy savings for each opportunity, as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

A sample Assessment Worksheet for Opportunity C3 – Incandescent Upgrades is presented in Exhibit 6.6 (worksheets for the remaining opportunity areas are provided in Appendix D). As illustrated in Exhibit 6.6, each Assessment Worksheet addresses the following areas:

- ***Total Economic Savings Potential –*** shows the yearly total of economically attractive potential for electricity savings, by milestone period, for the measures included in the opportunity area.

- ***Market Size*** – shows the total population of potential participants that could theoretically take part in the opportunity area. Numbers shown are from the eligible populations used in the Economic Potential Forecasts. The definition of "participant" varies by opportunity area. In the example shown, a participant is defined as an equivalent 40,000 ft^2 Office building.

- ***Major Technologies and Contribution to Savings –*** shows the technical components of each opportunity area and its approximate contribution to the economic potential savings of the opportunity area as a whole.

- ***Approximate CCE*** – shows the approximate CCE for the measure(s) included within each opportunity area. Where multiple measures are included, a weighted average value is presented. The CCE provides an indication of the relative economic attractiveness of the energy-efficiency measures from the utility's perspective. For the purposes of the workshop, this information provided participants with an indication of the scope for using financial incentives to influence customer participation rates. The CCE value, combined with the preceding customer payback information, provided an important reference point for the workshop participants when considering potential participation rates. The combined information enabled participants to "roughly" estimate the level of financial incentives that could be employed to increase the opportunity's attractiveness to customers without making the measures economically unattractive to NLH or NP.

- ***Approximate Payback*** – shows the simple payback from the customer's perspective for the package of energy-efficiency measures included in the opportunity area. This information provided an indication of the level of attractiveness that the opportunity measures would present to customers.

- ***Participation Rates, By Year –*** show the percentage of economic savings that workshop participants concluded could be achievable in each milestone period. As noted in the introduction to this section, two Achievable scenarios are shown: Lower and Upper. For example, Exhibit 6.6 shows a participation rate of 90% (Lower) and 98% (Upper) for the measure "Relamp incandescent with CFL" in existing offices by the year 2026. This means that, by 2026, between 90% and 98% of the potential savings contained in the Economic Potential Forecast could be achieved.

- ***Savings, By Year –*** shows the calculated electricity savings in each milestone period based on the savings and participation rates presented in the preceding columns of the Assessment Worksheet.

Exhibit 6.6: Sample Commercial Sector Opportunity Assessment Worksheet

Commercial Sector -- C3 -- Incandescent Upgrades

Sub Sector		**Office - Existing**			
Total Economic Savings Potential (GWh/yr) in 2026	General and Secondary Lighting	10			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	50%	Approx. 60% for LED exit sign		
	# eligible sites	191			
Major Technologies & Approx. Contribution to Economic Potential Savings	CFL	100%			
	LED Exit Sign	0%			
	Other Technologies	0%			
	Sub total:	100%			
Approx CCE (c/kWh)	CFL	2.9	Full Cost		
	LED Exit Sign	2.0	Full Cost		
	Other Technologies	0.5 - 5.0	Full Cost		
Approx payback (years)	CFL	1.4			
	LED Exit Sign	3			
	Other Technologies	1 - 3			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
Relamp Incandescent with CFL	*Lower*				90%
	Upper				98%
Incandescent to LED Exit Sign	*Lower*				95%
	Upper				98%
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
Relamp Incandescent with CFL	*Lower*				8
	Upper				9
Incandescent to LED Exit Sign	*Lower*				1
	Upper				1
Total	*Lower*				9
	Upper				10

Step 4: Achievable Potential Workshop

The most critical step in developing the estimates of Achievable Potential was the one-day workshop held October 31, 2007. Workshop participants consisted of core members of the consultant team, program personnel from NP and NLH and local trade allies.

The purpose of this workshop was twofold:

- Promote discussion regarding the technical and market conditions confronting the identified energy-efficiency opportunities

- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

The discussion of each opportunity area began with a brief consultant presentation. The floor was then opened to participant discussion. Key areas that were explored for each opportunity area included:

- Target audiences and potential delivery allies
- Constraints, barriers and challenges
- Potential opportunities and synergies
- Estimates of Lower Achievable and Upper Achievable for milestone years
- Guidelines for consultants for extrapolating to related sub sectors.

Following discussion of the broad market and intervention conditions affecting the opportunity areas, workshop participant views were recorded on Lower and Upper customer participation rates. To facilitate this portion, the discussion of the Commercial sector opportunity areas focused initially on Office buildings in the Island and Isolated service region. The following four-step process was employed:[51]

- The participation rate for the Upper Potential in 2026 was estimated. As noted previously, this participation rate was "roughly" defined as 100% of the Economic Potential minus the market share represented by the "can't" or 'won't" population.

- The shape of the adoption curve was selected for the Upper scenario. Rather than seek consensus on the specific values to be employed in each of the intervening milestone years, workshop participants selected one of four curve shapes that best matched their view of the appropriate "ramp-up" rate for each opportunity.

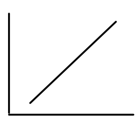
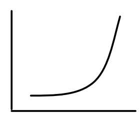
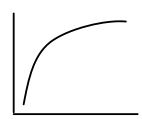
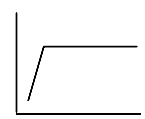
- The preceding process was repeated for the Lower scenario.

[51] Some minor variations on these steps occurred, depending on the specific opportunity area; however, the general approach was applied across the range of opportunity areas.

Exhibit 6.7 shows the four curves that were used in the workshop discussions.

- **Curve A** represents a steady increase in the expected participation rate over the 20-year study period
- **Curve B** represents a relatively slow participation rate during the first half of the 20-year study period followed by a rapid growth in participation during the second half of the 20-year study period
- **Curve C** represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the 20-year study period
- **Curve D** represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first milestone period of the 20-year study period.

Exhibit 6.7: Adoption Curve Shapes (2006 to 2026)

Curve A	Curve B	Curve C	Curve D
			

Finally, as applicable, workshop participants provided guidelines to the consultants for extrapolating the results of the workshop discussion to the remaining sub sectors and service regions.

Step 5: Extrapolate Workshop Results to Remaining Opportunities

As noted earlier, it was not possible to fully address all opportunities in the one-day workshop. Consequently, the workshop focused on the "big ticket" opportunities. Participation rates for the remaining opportunities were completed by the consultants, guided by the workshop results and discussions. The values shown in the summary tables and attached appendices incorporate the results of the two sets of inputs.

Step 6: Aggregate Achievable Potential Results

The final step involved aggregating the results of the individual opportunity areas to provide a view of the potential Achievable savings for the total Commercial sector.

6.4 WORKSHOP RESULTS

The following subsection provides a summary of the participation rates established by the workshop participants for each of the opportunity areas that were discussed during the workshop. As noted previously, the Commercial sector opportunity areas were:

- C1 - T8 Fluorescent Upgrades (T12 Baseline)
- C2 - T8 Fluorescent Upgrades (T8 Baseline)
- C3 - Incandescent Upgrades
- C4 - Building Envelope Measures
- C5 - Building Recommissioning & Advanced BAS
- C6 - Ground Source Heat Pumps
- C7 - Advanced New Building Construction
- C8 - ENERGY STAR Computer Equipment

Further detail on each of the above opportunity areas is provided below and, as applicable, the following information is provided for each:

- Summary of Upper and Lower Achievable participation rates
- Shape of Adoption Curve selected by the workshop participants
- Highlights of key issues arising during the workshop discussions
- Summary of major assumptions employed by the consultants for extrapolating the workshop results to other sub sectors.

6.4.1 C1 - T8 Fluorescent Upgrades (T12 Baseline)

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 74%[52] could be achieved in Office buildings in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve A represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 64% could be achieved in Office buildings in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve A represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

- Possible barriers discussed included limited capital resources for energy retrofits, increased space heating loads due to reduced internal heat gain and increased cost due to asbestos removal when undertaking redesign work in buildings older than approximately 30 years.

[52] Participation rates cited in this section are a weighted average of participation rates discussed for two separate but related measures during the workshop; "Redesign with high-performance T8" and "Retrofit with high-performance T8."

- Potential positive influences on participation rates discussed included previous experience with fluorescent lighting program design and implementation in the early 1990's, co-benefits of increased chargeable rental rates in offices as a result of lighting retrofits and more attractive economics in buildings with high hours of use such as hospitals.
- Schools are presently undertaking T8 retrofits as part of ongoing electrical upgrades and repairs started in 2006.
- Labrador participation rates may be substantially lower if not driven by participation in government buildings.

The preceding results were used as a reference point for estimating participation rates related to other lighting opportunities in the Commercial sector.

Selected highlights:

- Participation rates for T8 upgrades from both T8 and T 12 baselines were taken into account when estimating rates for both pulse-start metal halide and high-intensity fluorescent lamps and fixtures.

6.4.2 C2 - T8 Fluorescent Upgrades (T8 Baseline)

Unlike opportunity C1, measures discussed within this opportunity were evaluated at incremental cost and applied at the rate of natural stock turnover.[53]

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 100%[54] could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve C represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario. Occupancy sensors were also considered as part of this discussion. Upper Achievable participation rates were estimated at 98%.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 82% could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve C represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario. For occupancy sensors, Lower Achievable participation rates were estimated at 80%.

Since measures contained within this opportunity are applicable only at the time of stock turnover, lower participation rates in early milestone periods represent a lost savings opportunity that persists for the duration of the replaced equipment's service life. C2

[53] Fluorescent upgrades (T8 baseline) were evaluated at full cost with a CCE of $0.0979/kWh in the Economic Potential analysis. Because of unattractive customer paybacks and virtually zero opportunity for utility incentive under the CCE cutoff of $0.098/kWh, these measures are evaluated at incremental cost in the Achievable analysis.

[54] Participation rates cited in this section are a weighted average of participation rates discussed for two separate but related measures during the workshop: "Redesign with high-performance T8" and "Retrofit with high-performance T8."

participation rates, shown in Exhibits 6.8 and 6.9, represent the percentage of the *total stock* that would turn over to the evaluated technologies by 2026, under the two participation scenarios described above.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Workshop participants identified potential barriers and positive influences on participation rates very similar to those listed in opportunity C1, above. In addition, workshop participants felt that customers with T8 fixtures already installed have been market leaders in the past and would likely continue to employ cutting-edge technology. There were also some concerns voiced about the present availability and consumer awareness of high-performance T8 systems.

The preceding results were used as a reference point for estimating participation rates related to other lighting opportunities in the Commercial sector.

Selected highlights:

- Participation rates for T8 upgrades from both T8 and T 12 baselines were taken into account when estimating rates for both pulse-start metal halide and high-intensity fluorescent lamps and fixtures.

6.4.4 C3 - Incandescent Upgrades

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 98% could be achieved in Office buildings in the Island and Isolated service region by 2026 for the measure “Relamp incandescent with CFL.” Workshop participants agreed that Adoption Curve D (reaching a maximum in 2016) represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario. LED exit signs were also considered as part of this discussion. Upper Achievable participation rates were estimated at 98%, following adoption curve C. A weighted average participation rate for these two measures is reported in Exhibit 6.8 below

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 90% could be achieved in Office buildings in the Island and Isolated service region by 2026 for “Relamp incandescent with CFL.” Workshop participants agreed that Adoption Curve D (reaching a maximum at 2016) represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario. For LED exit signs, Lower Achievable participation rates were estimated at 95% following adoption curve C. A weighted average participation rate for these two measures is reported in Exhibit 6.9 below.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Selected highlights:

- Real and perceived issues regarding light quality and technical shortcomings may act as a barrier to uptake for CFL technologies.
- Increased consumer awareness (especially as it pertains to residential applications) and a possible phase-out of incandescent light bulbs by manufacturers or legislation may facilitate uptake.

6.4.5 C4 - Building Envelope Measures

This opportunity considered achievable participation rates for three building envelope measures: high-performance glazings, wall insulation and roof insulation. All of the measures discussed within this opportunity were evaluated at incremental cost and applied at the rate of natural stock turnover.

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates of up to 13%, 13% and 21% for the respective measures listed above could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve A represented the best fit for all three measures in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 4%, 4% and 13% respectively could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve A represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Since measures contained within this opportunity are applicable only at the time of stock turnover, lower participation rates in early milestone periods represent a lost savings opportunity that persists for the duration of the replaced equipment's service life. C4 participation rates shown in Exhibits 6.8 and 6.9 represent the percentage of the *total* *stock* that would turn over to the evaluated technologies by 2026, under the two participation scenarios described above.

Selected highlights:

- Technical issues and lack of physical space as they pertain to wall insulation upgrades may act as a barrier to building envelope measure participation.
- Conversely, the relative technical simplicity of upgrading roof insulation may facilitate uptake.
- Predictable savings levels may lead to a relatively low perceived risk and increased uptake.
- Co-benefits, such as increased occupant comfort, may facilitate uptake.
- Workshop participants noted that there is an ongoing roof insulation improvement program in Newfoundland and Labrador schools, that there have been few insulation retrofits in Labrador to date, and that in addition to insulation, air infiltration issues must be considered, especially with respect to preventing moisture damage.

The preceding results were used as a reference point for estimating participation rates related to other building envelope opportunities in the Commercial sector. Specifically, participation rates for the measure "Roof insulation" were taken into account when estimating participation rates for the measure "Air curtains."

6.4.6 C5 - Building Recommissioning & Advanced BAS

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 85% could be achieved in Office buildings in the Island and Isolated service region by 2026 for the measure "Building Recommissioning." Workshop participants agreed that a "flattened" Adoption Curve B (essentially a hybrid between curves A and B) represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario. Advanced BAS were also considered as part of this discussion. Upper Achievable participation rates were estimated at 65%, following adoption curve A. A weighted average participation rate for these two measures is reported in Exhibit 6.8 below.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 40% could be achieved in Office buildings in the Island and Isolated service region by 2026 for the measure "Building Recommissioning." Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario. For Advanced BAS, Upper Achievable participation rates were estimated at 25%, following adoption curve B. A weighted average participation rate for these two measures is reported in Exhibit 6.9 below.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values.

Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Selected highlights:

- Workshop participants felt that this was a particularly large opportunity in buildings of all ages, especially buildings older than 15 years
- Participants stressed the importance of maintaining savings over time by training building managers and through service contracts
- Possible roles identified for the Utilities included assistance with training programs for building owners and operators, producing and providing technical information or specific case studies and financial incentives for pre-audits or to lower cost the cost of building "tuning."

The preceding participation rates were also applied to the HVAC measure "adjustable speed drives," which was not discussed during the workshop.

6.4.7 C6 – Ground Source Heat Pumps

This opportunity considered achievable participation rates for the measure "Ground Source Heat Pumps." This measure was evaluated at incremental cost and applied at the rate of natural stock turnover.

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates of up to 20% could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve B represented the best fit in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 2% could be achieved in Office buildings in the Island and Isolated service region in the year 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates would be directionally higher in institutional sub sectors (Health, Schools and University/College) and directionally lower in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Since measures contained within this opportunity are applicable only at the time of stock turnover, lower participation rates in early milestone periods represent a lost savings opportunity that persists for the duration of the replaced equipment's service life. C6 participation rates shown in Exhibits 6.8 and 6.9 represent the percentage of the *total stock* that would turn over to the evaluated technologies by 2026, under the two participation scenarios described above.

Selected highlights:

- This measure was seen to be much more attractive for new construction than for retrofits
- In addition to the limited opportunity for uptake of ground source heat pumps, participants felt that there may be some additional opportunity for installation of air source heat pumps and low-temperature heat pumps
- Public and institutional buildings were expected to have slightly higher participation rates
- A commitment by the provincial government to build efficient new public buildings, which could include heat pump systems, may facilitate uptake in retrofit applications.

6.4.6 C7 – Advanced New Building Construction

This opportunity considered achievable participation rates for the measures "New buildings – 40% more efficient" and "New buildings – 25% more efficient." These measures were evaluated at incremental cost and applied at the time of construction.

Workshop participants drew a distinction between likely participation rates within the private and public/institutional sectors. Consequently, participation rates were discussed separately for these two sector groups, and combined in a weighted average in Exhibits 6.8 and 6.9.

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates of up to 100% for public Office buildings and 25% in private buildings for the measure "New buildings – 40% more efficient" could be achieved in Office buildings in the Island and Isolated service region in the year 2026. In addition, participation rates of up to 50% in private buildings for the measure "New buildings – 25% more efficient" could be achieved in Office buildings in 2026. No curve shape was applied to the estimated participation rates. Instead, participation rates were discussed for earlier milestone years. It was estimated that private offices would achieve participation rates of 30%, and publicly owned offices would achieve participation rates of 100% for the measure "New buildings – 25% more efficient" in 2011. It was assumed that no new buildings would be built to a 40% more efficient standard by the 2011 milestone year.

Lower Achievable participation rates were not discussed for this opportunity during the workshop. Discussion during the workshop, data from other jurisdictions and the prior experience of the consulting team were used to estimate the Lower Achievable participation rates presented in Exhibit 6.9.

Based on the workshop discussions, it was assumed that participation rates would be similar to the rates discussed for publicly-owned Office buildings in institutional sub sectors (Health, Schools and University/College) and similar to those discussed for private Office buildings in the primarily private sub sectors (Non-food Retail, Food Retail, Accommodations and Warehouse/Wholesale) when compared to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar those for the Island and Isolated service region.

Selected highlights:

- Participants noted that as part of its recent Energy Plan, the Government of Newfoundland and Labrador will implement a policy requiring construction of all buildings receiving provincial funding to exceed the Model National Energy Code by 25%
- Participants estimated that new office construction will be split 50-50 between the public and private sectors.

Since measures contained within this opportunity are applicable only at the time of stock turnover, lower participation rates in early milestone periods represent a lost savings opportunity that persists for the duration of the replaced equipment's service life. C4 participation rates shown in Exhibits 6.8 and 6.9 represent the percentage of the *total stock* that would turn over to the evaluated technologies by 2026, under the two participation scenarios described above.

6.4.7 C8 – ENERGY STAR Computer Equipment

This opportunity considered achievable participation rates for three computer equipment measures: ENERGY STAR computers, ENERGY STAR office equipment and high-efficiency servers. All of the measures discussed within this opportunity were evaluated at incremental cost and applied at the rate of natural stock turnover.

Due to time constraints and the fact that this opportunity was outside of the expertise of most workshop participants, this measure was not discussed during the workshop. Estimates made for participation rates for the residential measure "ENERGY STAR computer" (residential workshop opportunity R8) were used to estimate participation rates for this opportunity.

6.4.8 Extrapolated Participation Rates – Remaining Energy-efficiency Opportunities

As noted previously, the workshop results and follow-up email responses were used as a reference point, combined with consultant experience, to estimate participation rates for the remaining energy-efficiency opportunities that are contained in the Economic Potential Forecast.

Exhibits 6.8 and 6.9 provide, respectively, a summary of the estimated Upper and Lower participation rates for the remaining energy-efficiency opportunities. As illustrated, each exhibit shows:

- Workshop reference number, which refers to the package of Opportunity Profiles that were provided to workshop participants
- The affected technology
- The participation rates by 2026 (or in 2026, in the case of measures implemented at time of existing stock turnover).

- Notes that illustrate sources and rationale used by the consultant when estimating the participation rates shown.

Exhibit 6.8: Participation Rates – Upper Achievable Potential

Workshop Reference #	Upgrade Technology/Measures	Participation Rate 2026	Adoption Curve Shape	Notes
C1	T12 baseline: Redesign with high-performance T8s	74%	A	Workshop measure C1
C2	T8 baseline: Redesign with high-performance T8s	90%	C	Workshop measure C2
C2	Occupancy sensors	98%	C	Workshop measure C2
C3	Compact fluorescent lamps	98%	D	Curve D in 2016, Workshop measure C3
	Pulse-start metal halide	85%	C	Based on Measures C1 & C2
	High-intensity fluorescent	85%	C	Based on Measures C1 & C2
C6	Ground source heat pump	9%	B	Workshop measure C6
	High-efficiency chillers	38%	A	Based on workshop results, consultant experience
	Adjustable speed drives	73%	B/A	Flattened curve B, based on measure C5
	Premium efficiency motors	78%	C	Based on workshop results, consultant experience, Industrial workshop measure I6
C5	Advanced BAS/Building recommissioning	73%	B/A	Flattened curve B. Workshop measure C5
	ENERGY STAR Refrigerators and Freezers	47%	B	Based on consultant experience
	High-efficiency supermarket refrigeration	63%	B	Based on consultant experience
	Low-flow aerators & shower heads	90%	C	Based on workshop results, consultant experience
	ENERGY STAR computers	80%	B	Based on residential workshop measure R8
	ENERGY STAR office equipment	80%	B	Based on residential workshop measure R8
	High-efficiency servers	80%	B	Based on residential workshop measure R8
C4	High-performance glazings	13%	A	Workshop measure C4
C4	Wall insulation	13%	A	Workshop measure C4
C4	Roof insulation	21%	A	Workshop measure C4
	Air curtains	33%	A	Based on workshop measure C4
C7	New buildings - 40% more efficient	60%	*	Based on input from workshop measure C7
	Dimming controls	20%	A	Based on consultant experience, barriers to significant uptake

* An adoption curve was not assigned to the measure "New buildings - 40% more efficient". Participation rates and trends were discussed for multiple milestone periods, as well as for public and private buildings. The participation rates approximate a flattened curve B.

Exhibit 6.9: Participation Rates – Lower Achievable Potential

Workshop Reference #	Upgrade Technology/Measures	Participation Rate 2026	Adoption Curve Shape	Notes
C1	T12 baseline: Redesign with high-performance T8s	64%	A	Workshop measure C1
C2	T8 baseline: Redesign with high-performance T8s	73%	C	Workshop measure C2
C2	Occupancy sensors	80%	C	Workshop measure C2
C3	Compact fluorescent lamps	90%	D	Curve D in 2016, Workshop measure C3
	Pulse-start metal halide	75%	C	Based on Measures C1 & C2
	High-intensity fluorescent	75%	C	Based on Measures C1 & C2
C6	Ground source heat pump	1%	B	Workshop measure C6
	High-efficiency chillers	28%	A	Based on workshop results, consultant experience
	Adjustable speed drives	31%	B	Based on measure C5
	Premium efficiency motors	68%	C	Based on workshop results, consultant experience, Industrial workshop measure I6
C5	Advanced BAS/Building recommissioning	31%	B	Workshop measure C5
	ENERGY STAR Refrigerators and Freezers	35%	B	Based on consultant experience
	High-efficiency supermarket refrigeration	47%	B	Based on consultant experience
	Low-flow aerators & shower heads	75%	C	Based on workshop results, consultant experience
	ENERGY STAR computers	15%	B	Based on residential workshop measure R8
	ENERGY STAR office equipment	15%	B	Based on residential workshop measure R8
	High-efficiency servers	15%	B	Based on residential workshop measure R8
C4	High-performance glazings	4%	A	Workshop measure C4
C4	Wall insulation	4%	A	Workshop measure C4
C4	Roof insulation	13%	A	Workshop measure C4
	Air curtains	27%	A	Based on workshop measure C4
C7	New buildings - 40% more efficient	40%	*	Based on input from workshop measure C7
	Dimming controls	10%	A	Based on consultant experience, barriers to significant uptake

* An adoption curve was not assigned to the measure "New buildings - 40% more efficient". Participation rates and trends were discussed for multiple milestone periods, as well as for public and private buildings. The participation rates approximate a flattened curve B.

6.5 SUMMARY OF ACHIEVABLE ELECTRICITY SAVINGS

Exhibits 6.10 and 6.11 provide a summary of the achievable electricity savings under both the Lower and Upper scenarios for the Island and Isolated and Labrador Interconnected service regions respectively.

Under the Reference Case for the Island and Isolated service region, commercial electricity use would grow from the Base Year level of 1,881GWh/yr. to approximately 2,233 GWh/yr. by 2026. This contrasts with the Upper Achievable scenario in which electricity use would increase to approximately 1,846 GWh/yr. for the same period, a difference of approximately 387 GWh/yr., or about 17%. Under the Lower Achievable scenario, electricity use would increase to approximately 1,972 GWh/yr. for the same period, a difference of approximately 261 GWh/yr., or about 12%.

Under the Reference Case for the Labrador Interconnected service region, commercial electricity use would grow from the Base Year level of 201GWh/yr. to approximately 240 GWh/yr. by 2026. This contrasts with the Upper Achievable scenario in which electricity use would increase to approximately 212 GWh/yr. for the same period, a difference of approximately 28 GWh/yr., or about 12%. Under the Lower Achievable scenario, electricity use would increase to approximately 221 GWh/yr. for the same period, a difference of approximately 19 GWh/yr., or about 8%.

Exhibit 6.10: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in Commercial Sector for the Island and Isolated Service Region (GWh/yr.)

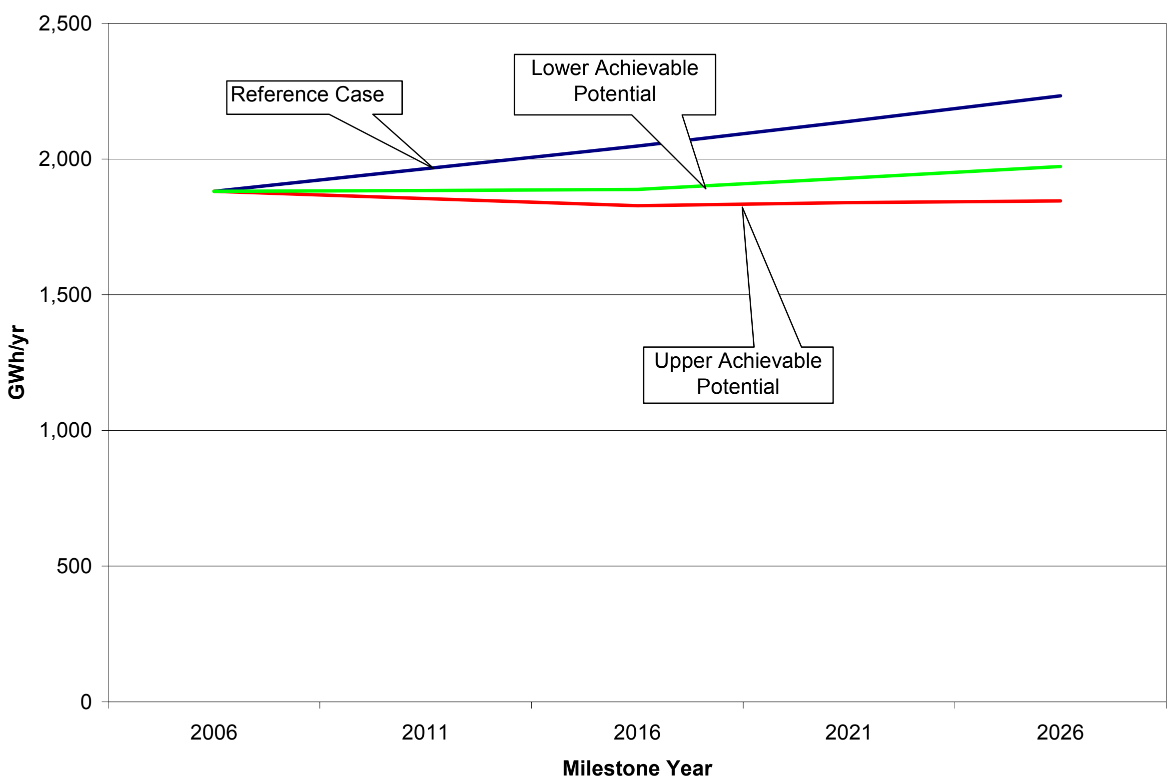
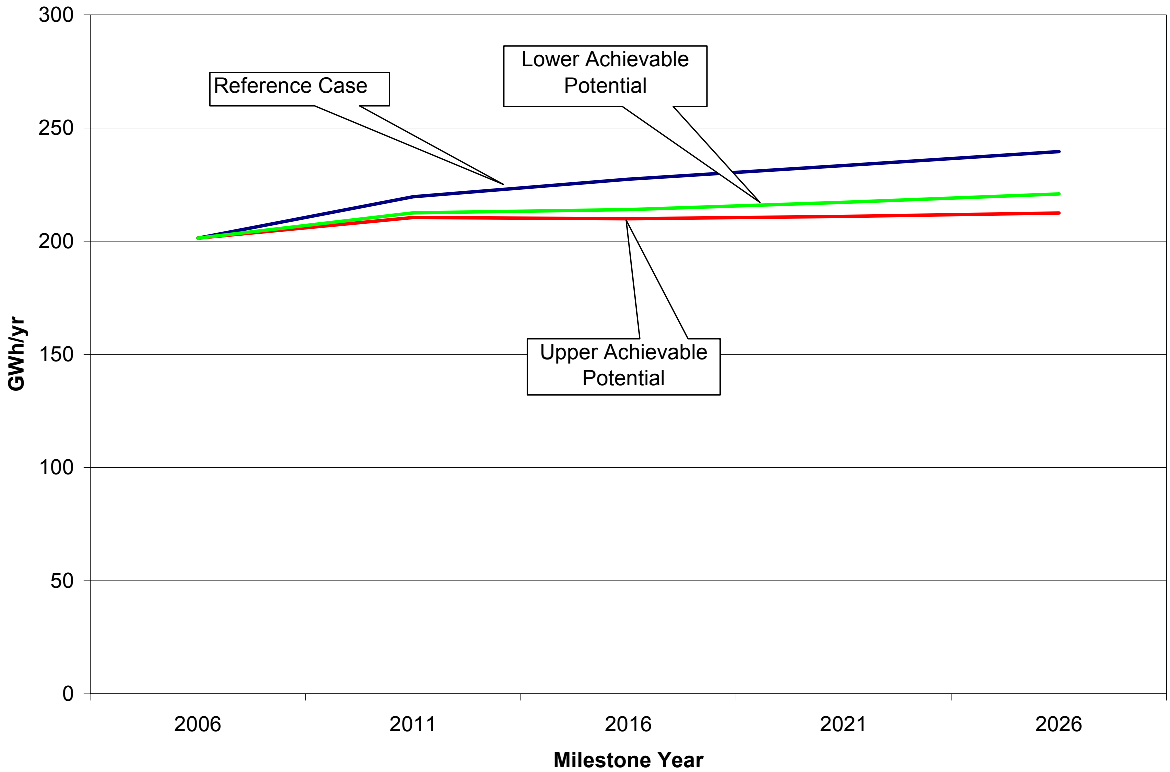


Exhibit 6.11: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in Commercial Sector for the Island and Isolated Service Region (GWh/yr.)



Further detail on the total potential electricity savings provided by the Achievable Potential Forecasts is provided in the following exhibits:

- Exhibits 6.12 and 6.13 present, respectively, the Upper and Lower Achievable results by end use, sub sector and milestone year for the Island and Isolated service region.
- Exhibits 6.14 and 6.15 present, respectively, the Upper and Lower Achievable results by end use, sub sector and milestone year for the Labrador Interconnected service region.
- Exhibits 6.16 and 6.17 present, respectively, Upper and Lower Achievable savings in 2026 by major end use and sub sector for the Island and Isolated service region.
- Exhibits 6.18 and 6.19, respectively, present Upper and Lower Achievable savings in 2026 by major end use and sub sector for the Labrador Interconnected service region.
- Exhibit 6.20 presents Upper and Lower Achievable savings by scenario, milestone year and service region.

Exhibit 6.12: Summary of Annual Electricity Savings for the Island and Isolated Service Region by End Use and Sub Sector, Upper Achievable Potential (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneaous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	22.7	10.8	5.3	0.2	1.1	0.0	0.0	0.0	0.0	0.0	0.8	1.1	2.1	1.1	
	2016	48.4	19.7	10.5	0.6	4.7	0.0	0.0	0.0	0.0	0.1	1.8	2.4	6.7	1.9	
	2021	72.1	26.8	10.5	0.8	11.1	0.0	0.0	0.1	0.0	0.1	3.3	3.5	13.3	2.5	
	2026	103.7	33.1	10.6	1.1	20.5	0.0	0.0	0.2	0.0	0.2	8.6	4.9	21.6	2.8	
Non-food Retail	2011	14.4	11.4	1.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.5	0.2	
	2016	27.9	21.0	2.2	0.4	0.4	0.0	0.0	0.1	0.0	0.0	0.2	1.6	1.6	0.4	
	2021	32.1	21.9	2.2	0.6	0.9	0.0	0.0	0.1	0.0	0.0	0.4	2.1	3.3	0.6	
	2026	36.7	22.3	2.2	0.7	1.7	0.0	0.0	0.1	0.0	0.0	0.8	2.8	5.4	0.6	
Food Retail	2011	5.4	3.2	0.3	0.1	0.1	0.0	0.0	1.2	0.0	0.0	-0.1	0.2	0.2	0.3	
	2016	12.3	5.4	0.6	0.2	0.2	0.0	0.0	4.3	0.0	0.0	0.1	0.3	0.7	0.5	
	2021	17.6	6.8	0.7	0.3	0.5	0.0	0.0	6.7	0.0	0.0	0.2	0.4	1.3	0.7	
	2026	22.4	7.3	0.8	0.4	0.9	0.0	0.1	9.2	0.0	0.0	0.3	0.5	2.2	0.7	
Healthcare	2011	7.3	1.0	4.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.6	0.6	
	2016	14.5	1.7	7.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.4	0.3	1.9	1.2	
	2021	20.5	1.9	7.9	0.6	1.3	0.0	0.1	0.0	0.0	0.0	3.0	0.5	3.7	1.5	
	2026	27.2	1.9	8.2	0.7	2.3	0.0	0.1	0.0	0.0	0.0	5.3	0.7	6.1	1.8	
Schools	2011	6.0	3.3	0.6	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.6	
	2016	13.6	5.8	1.8	0.5	1.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.7	1.1	
	2021	22.7	7.7	3.1	0.7	2.2	0.0	0.0	0.0	0.0	0.0	5.8	0.0	1.4	1.5	
	2026	33.2	9.2	4.3	0.9	4.1	0.0	0.0	0.0	0.0	0.0	10.4	0.0	2.4	1.7	
Accomodations	2011	10.4	3.2	4.2	0.1	0.1	0.0	0.0	0.1	0.0	0.0	-0.6	0.2	0.2	3.0	
	2016	21.1	6.3	7.5	0.2	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.5	0.6	5.2	
	2021	24.4	6.3	7.8	0.3	0.6	0.0	0.0	0.3	0.0	0.0	0.5	0.6	1.2	6.8	
	2026	27.2	6.2	7.9	0.3	1.1	0.0	0.0	0.4	0.0	0.0	0.8	0.7	2.0	7.7	
University/College	2011	7.8	4.6	1.3	0.1	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.9	0.4	
	2016	15.8	7.6	2.4	0.3	1.4	0.0	0.0	0.2	0.0	0.0	0.1	0.2	3.0	0.7	
	2021	23.1	9.2	2.5	0.4	3.3	0.0	0.0	0.3	0.0	0.0	0.2	0.3	6.1	0.8	
	2026	30.8	9.4	2.5	0.6	6.0	0.0	0.0	0.4	0.0	0.0	0.3	0.4	10.1	0.9	
Warehouse/Whole sale	2011	3.3	2.8	0.4	0.1	0.1	0.0	0.0	0.1	0.0	0.0	-0.3	0.0	0.1	0.2	
	2016	6.8	4.6	0.6	0.2	0.2	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.3	0.3	
	2021	9.1	5.8	0.7	0.3	0.5	0.0	0.0	0.5	0.0	0.0	0.3	0.0	0.6	0.4	
	2026	10.9	6.2	0.8	0.4	0.9	0.0	0.0	0.7	0.0	0.0	0.4	0.1	1.1	0.5	
Small Commercial	2011	26.7														
	2016	48.9														
	2021	62.8														
	2026	77.8														
Other Buildings	2011	4.8														
	2016	8.6														
	2021	10.8														
	2026	13.3														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Isolated Buildings	2011	0.5														
	2016	1.0														
	2021	1.4														
	2026	1.8														
Streetlighting	2011	0.6														0.6
	2016	1.2														1.2
	2021	1.8														1.8
	2026	2.4														2.4
Total	2011	110.0	40.3	17.3	1.2	2.1	0.0	0.0	1.4	0.0	0.0	1.2	2.4	4.9	6.4	0.6
	2016	220.1	72.1	32.4	2.9	8.7	0.0	0.1	5.1	0.0	0.1	6.7	5.3	15.5	11.3	1.2
	2021	298.4	86.2	35.4	4.0	20.4	0.0	0.2	8.0	0.0	0.2	13.8	7.5	31.0	14.8	1.8
	2026	387.4	95.6	37.4	5.2	37.7	0.0	0.3	11.0	0.0	0.3	27.0	10.1	50.7	16.8	2.4

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) In the above Exhibit, a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures.

Exhibit 6.13: Summary of Annual Electricity Savings for the Island and Isolated Service Region by End Use and Sub Sector, Lower Achievable Potential (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneaous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	14.6	6.3	4.9	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.8	0.9	
	2016	31.3	13.0	9.5	0.5	1.2	0.0	0.0	0.0	0.0	0.0	1.2	1.6	2.7	1.5	
	2021	45.4	19.7	9.5	0.8	2.9	0.0	0.0	0.1	0.0	0.1	2.2	2.4	5.7	2.0	
	2026	62.8	27.4	9.5	1.0	5.4	0.0	0.0	0.1	0.0	0.1	3.5	3.4	10.0	2.3	
Non-food Retail	2011	12.0	9.8	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.2	
	2016	23.4	18.4	1.9	0.4	0.1	0.0	0.0	0.1	0.0	0.0	0.2	1.2	0.7	0.4	
	2021	26.1	19.4	2.0	0.5	0.3	0.0	0.0	0.1	0.0	0.0	0.4	1.5	1.4	0.5	
	2026	29.2	20.3	2.0	0.7	0.5	0.0	0.0	0.1	0.0	0.0	0.7	1.9	2.5	0.5	
Food Retail	2011	4.5	2.6	0.2	0.1	0.0	0.0	0.0	1.2	0.0	0.0	-0.1	0.1	0.1	0.2	
	2016	10.5	4.5	0.4	0.2	0.1	0.0	0.0	4.3	0.0	0.0	0.1	0.2	0.3	0.4	
	2021	15.1	5.7	0.6	0.3	0.1	0.0	0.0	6.7	0.0	0.0	0.2	0.3	0.6	0.6	
	2026	19.5	6.4	0.7	0.4	0.2	0.0	0.1	9.2	0.0	0.0	0.3	0.4	1.0	0.6	
Healthcare	2011	5.2	0.8	3.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	
	2016	10.2	1.4	5.8	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.7	0.9	
	2021	13.5	1.6	6.7	0.6	0.3	0.0	0.0	0.0	0.0	0.0	1.1	0.4	1.6	1.2	
	2026	17.1	1.7	7.4	0.7	0.5	0.0	0.0	0.0	0.0	0.0	2.1	0.5	2.7	1.4	
Schools	2011	3.7	2.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.5	
	2016	8.0	3.9	1.4	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.3	0.9	
	2021	13.2	5.5	2.6	0.7	0.6	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.6	1.2	
	2026	19.1	7.1	3.6	0.9	1.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	1.1	1.3	
Accomodations	2011	9.0	3.0	3.7	0.1	0.0	0.0	0.0	0.1	0.0	0.0	-0.6	0.2	0.1	2.5	
	2016	18.4	5.8	6.8	0.2	0.1	0.0	0.0	0.2	0.0	0.0	0.3	0.4	0.3	4.4	
	2021	20.7	5.8	7.0	0.2	0.2	0.0	0.0	0.3	0.0	0.0	0.5	0.5	0.5	5.7	
	2026	22.7	5.7	7.2	0.3	0.3	0.0	0.0	0.4	0.0	0.0	0.7	0.6	0.9	6.5	
University/College	2011	4.8	2.8	1.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	
	2016	9.8	5.1	2.2	0.3	0.3	0.0	0.0	0.2	0.0	0.0	0.1	0.1	1.1	0.5	
	2021	13.9	6.8	2.3	0.4	0.6	0.0	0.0	0.3	0.0	0.0	0.1	0.2	2.5	0.7	
	2026	18.2	8.1	2.4	0.5	1.2	0.0	0.0	0.4	0.0	0.0	0.2	0.3	4.4	0.8	
Warehouse/Wholesale	2011	2.7	2.3	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	-0.3	0.0	0.0	0.2	
	2016	5.5	3.9	0.5	0.2	0.1	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.1	0.3	
	2021	7.4	5.0	0.6	0.2	0.1	0.0	0.0	0.5	0.0	0.0	0.3	0.0	0.3	0.4	
	2026	8.7	5.5	0.7	0.3	0.2	0.0	0.0	0.7	0.0	0.0	0.4	0.1	0.5	0.4	
Small Commercial	2011	19.5														
	2016	35.7														
	2021	44.0														
	2026	52.4														
Other Buildings	2011	3.5														
	2016	6.2														
	2021	7.6														
	2026	9.0														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Isolated Buildings	2011	0.3														
	2016	0.7														
	2021	1.0														
	2026	1.3														
Streetlighting	2011	0.3														0.3
	2016	0.6														0.6
	2021	0.9														0.9
	2026	1.2														1.2
Total	2011	80.1	29.6	14.9	1.1	0.5	0.0	0.0	1.4	0.0	0.0	0.1	1.7	1.8	5.3	0.3
	2016	160.4	55.9	28.6	2.7	2.1	0.0	0.1	5.1	0.0	0.1	3.2	3.8	6.1	9.4	0.6
	2021	208.7	69.6	31.3	3.7	5.1	0.0	0.1	7.9	0.0	0.1	6.8	5.3	13.3	12.2	0.9
	2026	261.2	82.3	33.5	4.8	9.4	0.0	0.2	10.9	0.0	0.2	11.9	7.2	23.1	13.8	1.2

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) In the above Exhibit, a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures.

Exhibit 6.14: Summary of Annual Electricity Savings for the Labrador Interconnected Service Region by End Use and Sub Sector, Upper Achievable Potential (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneaous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.6	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	
	2021	1.1	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	
	2026	1.6	0.4	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.1	
Non-food Retail	2011	2.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.1	
	2016	4.3	3.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.1	
	2021	5.0	3.8	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.1	
	2026	5.8	4.0	0.1	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.1	
Food Retail	2011	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	
	2021	0.9	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	
	2026	1.2	0.5	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.1	0.1	
Healthcare	2011	1.6	0.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.4	
	2016	2.6	0.2	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.7	
	2021	3.5	0.2	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.4	0.8	
	2026	4.2	0.2	1.1	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.5	0.9	
Schools	2011	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	
	2016	0.8	0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	
	2021	1.2	0.4	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.1	
	2026	1.6	0.5	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.1	
Accomodations	2011	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	
	2016	0.7	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
	2021	0.8	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	
	2026	0.9	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3	
University/College	2011	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.5	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	
	2021	0.7	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	
	2026	1.0	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	
Warehouse/Wholesale	2011	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	
	2021	0.7	0.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	
	2026	1.1	0.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	
Small Commercial	2011	1.7														
	2016	2.9														
	2021	3.5														
	2026	4.0														
Other Buildings	2011	0.7														
	2016	1.1														
	2021	1.3														
	2026	1.5														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Other Institutional	2011	1.8														
	2016	3.0														
	2021	3.7														
	2026	4.2														
Streetlighting	2011	0.0														0.0
	2016	0.0														0.0
	2021	0.0														0.0
	2026	0.0														0.0
Total	2011	9.3	2.5	0.6	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.4	0.1	0.3	0.8	0.0
	2016	17.5	4.9	1.2	0.2	0.6	0.0	0.0	0.1	0.0	0.0	0.9	0.2	0.8	1.3	0.0
	2021	22.4	5.9	1.5	0.3	1.2	0.0	0.0	0.2	0.0	0.0	1.5	0.3	1.3	1.6	0.0
	2026	27.2	6.7	1.7	0.3	2.2	0.0	0.1	0.2	0.0	0.0	2.1	0.4	2.0	1.7	0.0

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) In the above Exhibit, a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures.

Exhibit 6.15: Summary of Annual Electricity Savings for the Labrador Interconnected Service Region by End Use and Sub Sector, Lower Achievable Potential (GWh/yr.)

Building Type	Milestone Year	Total	General Lighting	Secondary Lighting	Outdoor Lighting	Computer Equipment	Other Plug Loads	Food Service Equipment	Refrigeration	Elevators	Miscellaneaous	Space Heating	Space Cooling	HVAC Fans and Pumps	Domestic Hot Water	Street Lighting
Office	2011	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	
	2021	0.6	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	
	2026	0.8	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	
Non-food Retail	2011	1.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	
	2016	3.6	3.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	
	2021	4.0	3.3	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.1	
	2026	4.5	3.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.1	
Food Retail	2011	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
	2021	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	
	2026	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	
Healthcare	2011	1.2	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.3	
	2016	2.0	0.2	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.5	
	2021	2.5	0.2	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.7	
	2026	3.0	0.2	1.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.7	
Schools	2011	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	
	2016	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	
	2021	0.8	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	
	2026	1.0	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	
Accomodations	2011	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	
	2016	0.6	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
	2021	0.7	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
	2026	0.7	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
University/College	2011	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	
	2021	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	
	2026	0.5	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	
Warehouse/Whole sale	2011	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2016	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	2021	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	
	2026	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	
Small Commercial	2011	1.3														
	2016	2.3														
	2021	2.5														
	2026	2.7														
Other Buildings	2011	0.5														
	2016	0.9														
	2021	1.0														
	2026	1.0														
Non Buildings	2011	0.0														
	2016	0.0														
	2021	0.0														
	2026	0.0														
Other Institutional	2011	1.4														
	2016	2.4														
	2021	2.7														
	2026	2.9														
Streetlighting	2011	0.0														0.0
	2016	0.0														0.0
	2021	0.0														0.0
	2026	0.0														0.0
Total	2011	7.2	2.1	0.5	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.2	0.6	0.0
	2016	13.4	4.2	1.0	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.6	0.2	0.4	1.0	0.0
	2021	16.2	5.0	1.2	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.9	0.2	0.7	1.3	0.0
	2026	18.8	5.6	1.4	0.2	0.5	0.0	0.0	0.2	0.0	0.0	1.3	0.3	1.0	1.4	0.0

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) In the above Exhibit, a value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures.

Exhibit 6.16: Savings by Major End Use, Upper Achievable – Island and Isolated Service Region 2026 (%)

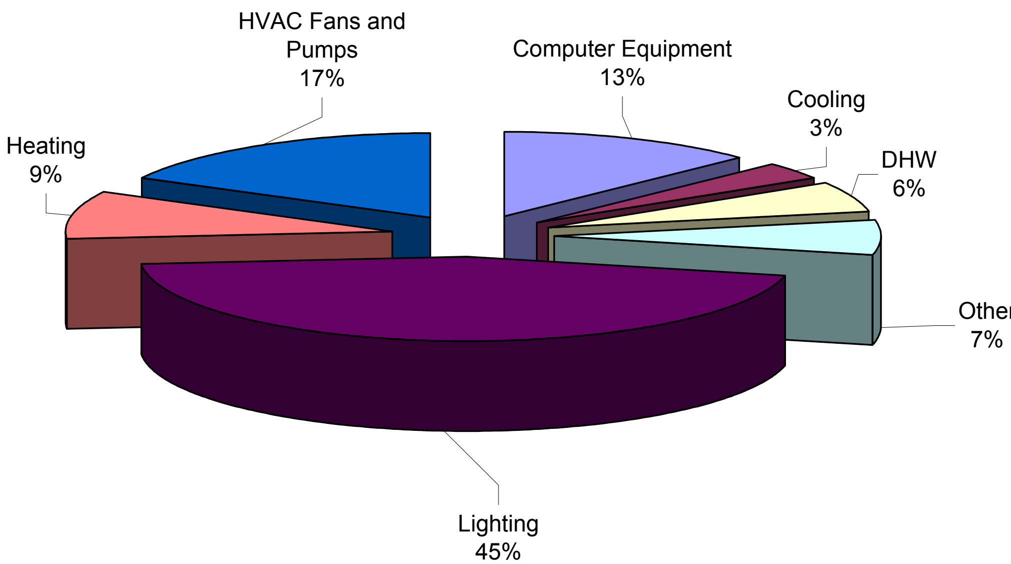


Exhibit 6.17: Savings by Major End Use, Lower Achievable – Island and Isolated Service Region 2026 (%)

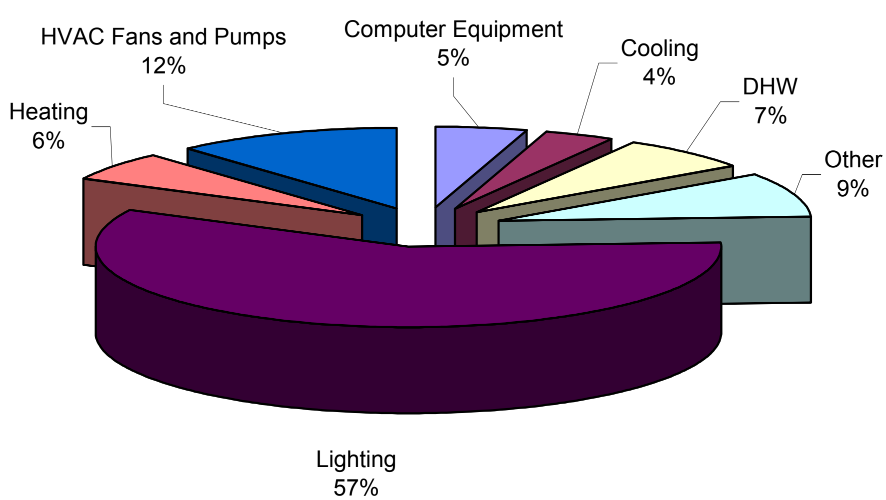


Exhibit 6.18: Savings by Major End Use, Upper Achievable – Labrador Interconnected Service Region 2026 (%)

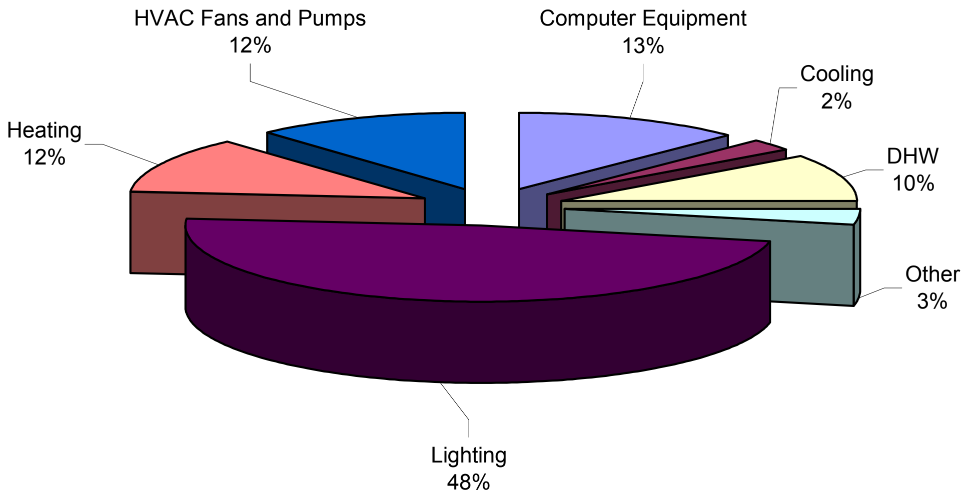


Exhibit 6.19: Savings by Major End Use, Lower Achievable – Labrador Interconnected Service Region 2026 (%)

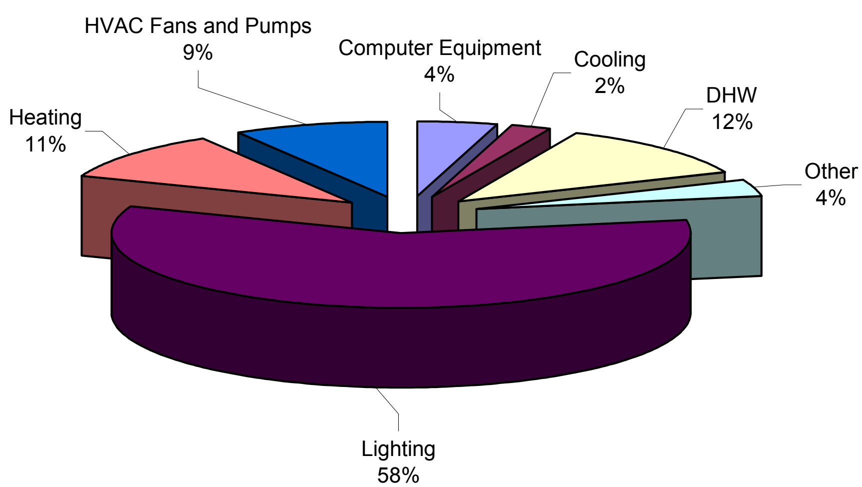
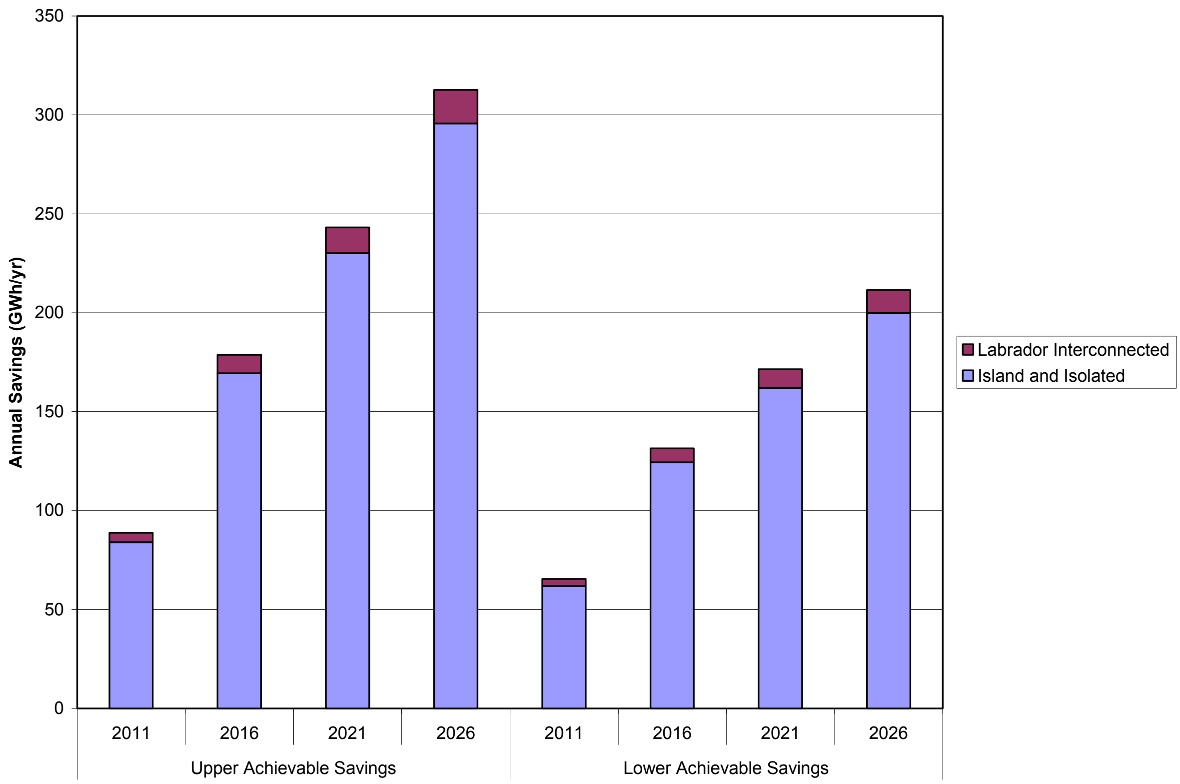


Exhibit 6.20: Savings by Scenario, Milestone Year and Service Region



6.6 PEAK LOAD IMPACTS

The electricity (electric energy) savings (GWh) contained in the preceding scenarios also result in a reduction in electric demand (MW).[55]

The conversion of electricity savings to hourly demand requires the following steps:

- Annual electricity savings for each combination of sub sector and end use are disaggregated *by month*
- Monthly electricity savings are then further disaggregated *by day type* (weekday, weekend day and peak day)
- Finally, each day type is disaggregated *by hour*.

The above steps that convert electricity to electric demand require the development and application of the following four factors (sets of ratios).

[55] Peak load savings were modelled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

- **Monthly Usage Factor**

This factor represents the percentage of annual electricity use that occurs in each month of the year. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. This allocation factor can be obtained from either (in decreasing order of priority): (a) monthly consumption statistics from end-use load studies; (b) monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months; or (c) heating or cooling degree days on an appropriate base.

- **Weekend to Weekday Factor**

This factor is a ratio that describes the distribution of electricity use between weekends and weekdays

- **Peak Day Factor**

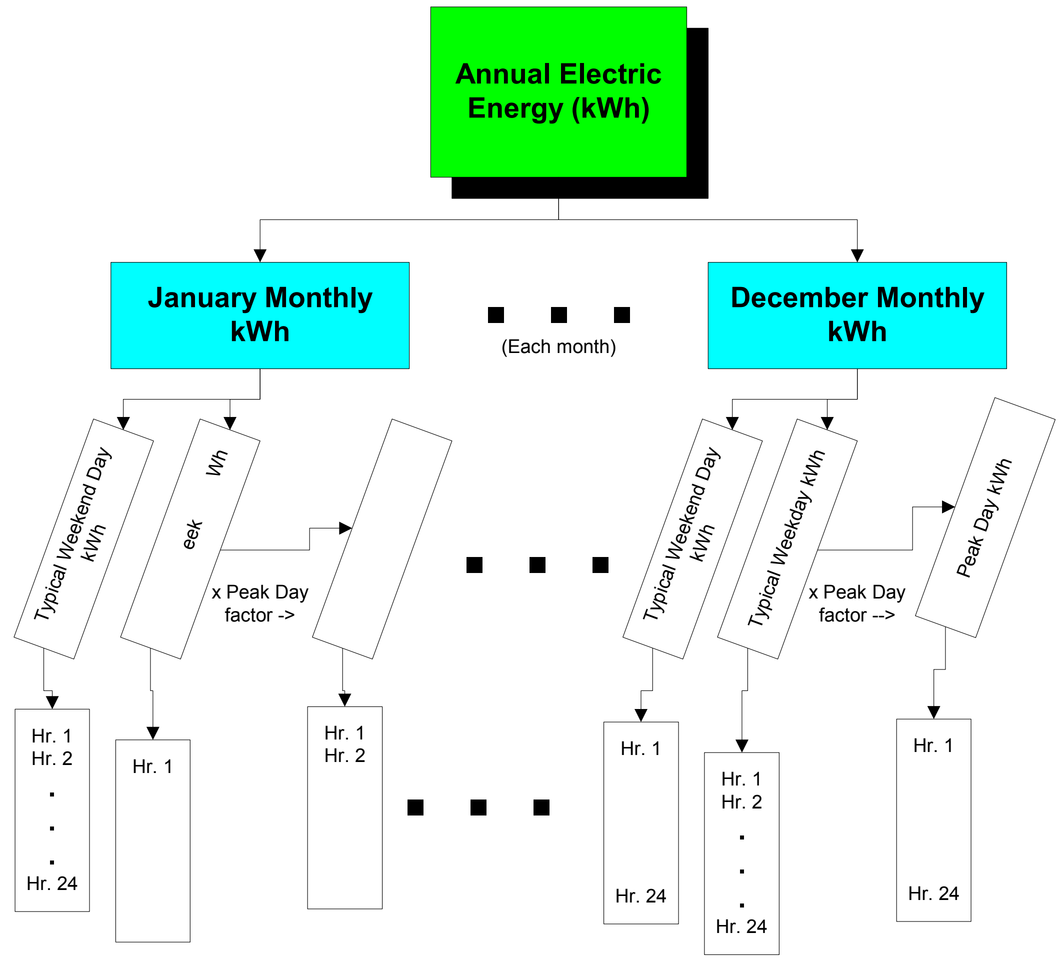
This factor defines the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.

- **Hourly Factor**

This factor describes the typical distribution of daily electricity use for each day type (weekday, weekend day, peak day) and for each month. It reflects the operating hours of the electric equipment or end use by sub sector. For example, for lighting, this would be affected by time of day and season (affected by daylight).

Exhibit 6.21 provides an illustration of the sequential application of the above factors to convert annual electricity to hourly demand. Further description is provided in Appendix E.

Exhibit 6.21: Illustration of Electricity to Peak load Calculation



For the purposes of this study, the peak load period was defined as

> *The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.*

Exhibit 6.22 presents a summary of the peak load reductions that would occur during the peak period noted above as a result of the electricity savings contained in Upper and Lower Achievable scenarios. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case.

Exhibit 6.22: Peak load Reductions (MW) Relative to Reference Case by Milestone Year, Service Region and Achievable Scenario

Service Region	Milestone Year	Peak Load Reduction (MW)	
		Upper Achievable	Lower Achievable
Island and Isolated	2011	16	11
	2016	31	23
	2021	41	29
	2026	53	34
Labrador Interconnected	2011	0.8	0.7
	2016	2.0	1.6
	2021	2.6	1.9
	2026	3.2	2.2

7. CONCLUSIONS AND NEXT STEPS

This study has confirmed the existence of significant cost-effective CDM potential within Newfoundland and Labrador's commercial sector. The study results provide:

- Specific estimates of the potential CDM savings opportunities, defined by sector, sub sector, end use and, in several cases, specific technology(s)
- A baseline set of energy technology penetrations and energy use practices that can assist in the design of specific programs.

The next step[56] in this process involves the selection of a cost-effective portfolio of CDM programs and the setting of specific CDM targets and spending levels. To provide a preliminary reference point for this next step in the program development process, the study team conducted a brief literature search in an attempt to identify typical CDM spending levels in other jurisdictions. The literature search identified two (relatively) recent studies that had addressed similar issues on behalf of other Canadian utilities. The two studies are:

- *Demand-Side Management: Determining Appropriate Spending Levels and Cost-Effectiveness Testing,* which was prepared by Summit Blue Consulting and the Regulatory Assistance Project for the Canadian Association of Members of Public Utility Tribunals (CAMPUT). The study was completed January 30, 2006.
- *Planning and Budgeting for Energy Efficiency/Demand-Side Management Programs,* which was prepared by Navigant Consulting for Union Gas (Ontario) Limited. The study was completed in July 2005.

The CAMPUT study, which included a review of U.S. and Canadian jurisdictions, concluded that an annual CDM expenditure equal to about 1.5% of annual electricity revenues might be appropriate for a utility (or jurisdiction) that is in the early stages of CDM[57] programming. This level of funding recognizes that it takes time to properly introduce programs into the market place.

The same study found that once program delivery experience is gained, a ramping up to a level of about 3% of annual electricity revenues is appropriate. The study also notes that higher percentages may be warranted if rapid growth in electricity demand is expected or if there is an increasing gap between demand and supply due to such things as plant retirements or siting limitations. The current emphasis on climate change mitigation measures would presumably also fall into a similar category of potential CDM drivers.

The CAMPUT study also notes that even those states with 3% of annual revenues as their CDM target have found that there are more cost-effective CDM opportunities than could be met by the 3% funding. The finding is consistent with the situation in British Columbia. In the case of BC Hydro, CDM expenditures over the past few years have been about 3.3% of electricity

[56] Full treatment of these next steps is beyond the scope of the current project.
[57] The CAMPUT study uses the term DSM (demand-side management); DSM is used interchangeably with CDM in this section.

revenues.[58] However, the results of BC Hydro's recently completed study (Conservation Potential Review (CPR) 2007) identified over 20,000 GWh of remaining cost-effective CDM opportunities by 2026. The magnitude of remaining cost-effective CDM opportunities combined with the aggressive targets set out in British Columbia's provincial Energy Plan suggest that BC Hydro's future CDM expenditures are likely to increase significantly if the new targets are to be met.

- **Additional notes:**

- Neither of the studies noted above found any one single, simple model for setting CDM spending levels and targets. Rather, the more general conclusion is that utilities use a number of different approaches that are reasonable for their context. In fact, the CAMPUT report identified seven approaches to setting CDM spending levels.

  - Based on cost-effective CDM potential estimates
  - Based on percentages of utility revenues
  - Based on Mills/kWh of utility electric sales
  - Levels set through resource planning process
  - Levels set through the restructuring process
  - Tied to projected load growth
  - Case-by-case approach.

- The CAMPUT study also notes that, although not always explicit, a key issue in most jurisdictions is resolving the trade off between wanting to procure all cost-effective energy-efficiency measures and concerns about the resulting short-term effect on rates. The study concludes that CDM budgets based on findings from an Integrated Resource Plan or a benefit-cost assessment tend to accept whatever rate effects are necessary to secure the overall resource plan, inclusive of the cost-effective energy-efficiency measures.

[58] CAMPUT, 2006. p. 14.

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9. TERMS USED IN BUILDING PROFILES

Profile Term	Explanation
Building Envelope	Defines the thermal characteristics of a building's exterior components
U-value	The rate of heat loss, in Btu per hour per square foot per degree Fahrenheit (BTU/hr. f^2.°F) through walls, roofs and windows. The U-value is the reciprocal of the R-value
Shading coefficient (SC)	Is a measure of the total amount of heat passing through the glazing compared with that through a single clear glass
Window-to-wall ratio	Defines the ratio of window to insulated exterior wall area
General Lighting	Defines the lighting types that are used within the main areas of a building, e.g., for a school, the area is classrooms and the lighting type is fluorescent; for a Food Retail store, the main area is the retail floor and the lighting types are fluorescent and metal halide.
LPD	Lighting power density expressed in terms of W/ft^2
Lux	The amount of visible light per square meter incident on a surface ($lumen/m^2$)
Inc	Incandescent lamps
CFL	Compact fluorescent lamps
T12	T12 fluorescent lamps with magnetic ballasts
T8	T8 fluorescent lamps with electronic ballasts
MH	Metal halide lamps
HPS	High-pressure sodium lamps
HID	High-intensity discharge lighting includes both MH and HPS
Secondary Lighting	Defines the lighting types that are used within the secondary areas of a building, e.g., for a school, the secondary areas are corridors, lobbies, foyers, etc., and the lighting type is fluorescent.
Tertiary Lighting	Defines the lighting types that are used within special purpose areas of a building, e.g., for a school, the tertiary area is a gymnasium and the lighting type is metal halide.
Outdoor Lighting	Defines the outdoor lighting including parking lot and façade
Overall LPD	The total floor weighted LPD that includes general, secondary, tertiary, and outdoor.
Fans	Defines mix of air handling systems
CAV	Constant air volume
VAV	Variable air volume
Space Heating	Defines the mix of heating equipment types found within the stock of buildings
ASHP	Air source heat pump
WSHP	Water source heat pump
Resistance	Electric resistance heating equipment including boilers and baseboard heaters
Natural Gas	Natural gas heating equipment including packaged rooftop units and boilers
Space Cooling	Defines the mix of cooling equipment types found within the stock of buildings
Centrifugal	Standard centrifugal chillers with a full load performance of 0.75 kW/ton
Centri HE	High-efficiency centrifugal chillers assumed to have a performance of <0.65 kW/ton
Recip Open	Semi-hermetic reciprocating chillers
DX	Direct expansion cooling equipment that use small tonnage hermetic R-22 compressors

NEWFOUNDLAND and LABRADOR

CONSERVATION AND DEMAND MANAGEMENT (CDM) POTENTIAL STUDY

–Appendices–

Commercial Sector

Submitted to:

**Newfoundland and Labrador Hydro &
Newfoundland Power**

Prepared by:

Marbek Resource Consultants Ltd.

In association with:

CBCL Ltd.

January, 2008

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MARBEK
Resource Consultants Ltd.

APPENDIX A

Building Profiles

Existing Building Profiles – Island & Isolated
Existing Building Profiles – Labrador Interconnected
New Building Profiles – Island & Isolated
New Building Profiles – Labrador Interconnected

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Existing Office – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Office	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.71	W/m².°C	0.12	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.48	W/m².°C	0.09	Btu/hr.ft² .°F	Typical Footprint (m²)	1,239	m²	13,333	ft²
Glazing U value (W/m².°C)	3.97	W/m².°C	0.70	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.36								
Shading Coefficient (SC)	0.58				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	75%				25%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA	21.86%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: L/s.m² | CFM/ft² | operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.59	L/s.m²	0.71	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	1,072,567	
Peak Zone Sensible Load	467,269	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	21,737	
Total air circulation or Design air	3.59	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	16.1	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**
	INC	CFL	T12	T8	MH	HPS	Other	TOTAL
System Present (%)			70.0%	30.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.55	0.55	0.55	
Efficacy (L/W)	15	50	72	88	65	90	90	

EUI	kWh/ft².yr	5.7
	MJ/m².yr	221

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	33.4	W/m²	3.1	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	MH	HPS	Other	TOTAL
System Present (%)	50%	45%			5%			100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.55	0.55	0.55	
Efficacy (L/W)	15	50	72	84	65	90	90	

EUI	kWh/ft².yr	1.7
	MJ/m².yr	64

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 17.87 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	285

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.9		0.9		0.15		0.1		0.06			
Connected Load	1.9	W/m²	1.8	W/m²	0.6	W/m²	0.8	W/m²	0.5	W/m²	1.5	W/m²
	0.2	W/ft²	0.2	W/ft²	0.05	W/ft²	0.07	W/ft²	0.05	W/ft²	0.14	W/ft²
Diversity Occupied Period	80%		80%		80%		80%		100%		80%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		2500	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		6260	

Total end-use load (occupied period)	5.8	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	3.8	W/m²	0.4	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	66%			

Computer Equipment	EUI	kWh/ft².yr	2.77
		MJ/m².yr	107.44
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Natural Gas EUI			All Electric EUI	
EUI	kWh/ft².yr	0.1	EUI	kWh/ft².yr	0.1
	MJ/m².yr	5.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.1
	MJ/m².yr	4.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)	21%						79%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	58.6	W/m²	18.6	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	389	MJ/m².yr	10.0	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 79.0% Gas Fuel Share 21.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	10.0
MJ/m².yr	389

Natural Gas EUI	
kWh/ft².yr	14.3
MJ/m².yr	555

Market Composite EUI	
kWh/ft².yr	10.9
MJ/m².yr	424

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)	20.0%				80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	85	W/m²	27	Btu/hr.ft²	448	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	111.7	MJ/m².yr	2.9	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.2
MJ/m².yr	46

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.2
MJ/m².yr	46

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	25.5

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.6	L/s.m²	0.71	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	6.1	W/m²	0.57	W/ft²
Fan Design Load VAV	6.1	W/m²	0.57	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	75%	25%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.66	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.81	W/m²	0.08	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0054	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.6	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	45.6	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption	0.4	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.6	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.5
	MJ/m².yr	175.6

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**26.1** kWh/ft².yr	**1,011.1** MJ/m².yr	**Gas:**	**3.1** kWh/ft².yr	**119.7** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.7	221.1
ARCHITECTURAL LIGHTING	1.7	63.9
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	4.5	175.6
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.5	20.0
COMPUTER EQUIPMENT	2.8	107.4
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.9	307.2	3.0	116.6
SPACE COOLING	1.0	36.8		
DOMESTIC HOT WATER	0.6	22.5	0.1	3.0
FOOD SERVICE EQUIPMENT	0.1	4.0		

Existing Non Food Retail – Island and Isolated

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.55	W/m².°C	0.10	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.40	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	4.17	W/m².°C	0.73	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.75				Typical # Stories	1			
					Floor to Floor Height (m)	5.0	m	16.5	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25 m²/person	269 ft²/person	%OA	17.83%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	20 L/s.person	42 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.25	
Total Air Circulation or Design Air Flow	4.49 L/s.m²	0.88 CFM/ft²
Infiltration Rate	0.42 L/s.m²	0.08 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m²	CFM/ft²
Operation occupied period	50%	
Operation unoccupied period	50%	

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	612,608	
Peak Zone Sensible Load	303,906	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	14,138	
Total air circulation or Design air	4.49	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	26.9	W/m²	2.5	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	20%	2%	55%		20%	3%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 11.7; MJ/m².yr 451

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	35.7	W/m²	3.3	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	35%	5%	50%		10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 1.1; MJ/m².yr 41

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 27.31 W/m² — EUI TOTAL kWh/ft².yr 13; MJ/m².yr 493

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.36	0.36	0.01	0.01	0.02	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.5 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment EUI kWh/ft².yr 0.90; MJ/m².yr 34.97

Plug Loads EUI kWh/ft².yr 0.64; MJ/m².yr 24.92

FOOD SERVICE EQUIPMENT 5

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Small restaurants, food courts, kitchenettes

Natural Gas EUI: EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

All Electric EUI: EUI kWh/ft².yr 0.3; MJ/m².yr 10.0

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 0.2; MJ/m².yr 8.6

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	38%						62%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 56.8 W/m² — 18.0 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 333 MJ/m².yr — 8.6 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 62.0% — Gas Fuel Share: 38.0% — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	8.6
MJ/m².yr	333

Natural Gas EUI	
kWh/ft².yr	12.3
MJ/m².yr	476

Market Composite EUI	
kWh/ft².yr	10.0
MJ/m².yr	387

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)	10.0%			5.0%	85.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	14.0 °C	57.2 °F

Peak Cooling Load: 97 W/m² — 31 Btu/hr.ft² — 392 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 130.9 MJ/m².yr — 3.4 kWh/ft².yr

Sizing Factor: 1.00

A/C Saturation (Incidence of A/C): 70.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.3
MJ/m².yr	52

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.3
MJ/m².yr	52

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					10%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	10%		90%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	0.6
MJ/m².yr	23

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	19.4

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.5	L/s.m²	0.88	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	6.4	W/m²	0.59	W/ft²
Fan Design Load VAV	6.4	W/m²	0.59	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.93	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0061	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	53.8	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	5.2
	MJ/m².yr	202.1

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **27.8** kWh/ft².yr **1,077.0** MJ/m².yr **Gas:** **4.7** kWh/ft².yr **183.0** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	11.7	451.5
ARCHITECTURAL LIGHTING	1.1	41.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.6	24.9
HVAC FANS & PUMPS	5.2	202.1
REFRIGERATION	0.2	8.6
MISCELLANEOUS	0.3	10.0
COMPUTER EQUIPMENT	0.9	35.0
ELEVATORS/ESCALATORS		
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	5.3	206.4	4.7	180.7
SPACE COOLING	0.9	36.3		
DOMESTIC HOT WATER	0.4	17.1	0.1	2.3
FOOD SERVICE EQUIPMENT	0.3	10.0		

Existing Food Retail – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.55	W/m².°C	0.10	Btu/hr.ft² .°F	Typical Building Size	2,788	m²	30,000	ft²
Roof U value (W/m².°C)	0.40	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	2,788	m²	30,000	ft²
Glazing U value (W/m².°C)	4.17	W/m².°C	0.73	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.06								
Shading Coefficient (SC)	0.69				Typical # Stories	1			
					Floor to Floor Height (m)	4.6	m	15.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45	m²/person	484	ft²/person	%OA 13.60%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right:

If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² — 0.10 CFM/ft² — 50% operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	3.27	L/s.m²	0.64	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	533,944	
Peak Zone Sensible Load	276,692	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	12,872	
Total air circulation or Design air	3.27	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	18.7	W/m²	1.7	W/ft²
Occ. Period(Hrs./yr.)	5000			
Unocc. Period(Hrs./yr.)	3760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	4%	1%	40%		15%	40%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	9.0
	MJ/m².yr	348

ARCHITECTURAL LIGHTING (CORRIDORS)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	16.3	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	4100			
Unocc. Period(Hrs./yr.)	4660			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			50%		30%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	1.3
	MJ/m².yr	51

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 18.42 W/m²

EUI TOTAL	kWh/ft².yr	10
	MJ/m².yr	399

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.65		0.65		0.01		0.01		0.03			
Connected Load	0.8	W/m²	0.7	W/m²	0.0	W/m²	0.0	W/m²	0.1	W/m²	1.5	W/m²
	0.1	W/ft²	0.1	W/ft²	0.00	W/ft²	0.00	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	2.9	W/m²	0.3	W/ft²
Total end-use load (unocc. period)	1.7	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	58%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.88
		MJ/m².yr	34.0
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.5

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: ___ Electricity Fuel Share: 100.0%

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	2.6	kWh/ft².yr	1.5
	MJ/m².yr	100.0	MJ/m².yr	60.0

REFRIGERATION

Provide description below:

Commercial refrigeration display cases

EUI	kWh/ft².yr	31.0
	MJ/m².yr	1200.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	33%						67%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	35.7	W/m²	11.3	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	196	MJ/m².yr	5.1	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 67.0% Gas Fuel Share 33.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	5.1	7.2	5.8
MJ/m².yr	196	281	224

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)				10.0%	90.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	56	W/m²	18	Btu/hr.ft²	674	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	77.8	MJ/m².yr	2.0	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 60.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.9		0.9
MJ/m².yr	34		34

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					30%
Eff./COP	65.00				0.75

	Fossil		Elec. Res.
Fuel Share	30%		70%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 45.5

Wetting Use Percentage 90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	1.3	1.6	1.4
MJ/m².yr	50	61	53.2

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.64	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	5.1	W/m²	0.47	W/ft²
Fan Design Load VAV	5.1	W/m²	0.47	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.12	W/m²	0.10	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0036	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	44.7	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	1.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.5
	MJ/m².yr	173.8

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**55.4** kWh/ft².yr	**2,147.4** MJ/m².yr	**Gas:**	**2.9** kWh/ft².yr	**110.8** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	END USE:	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	9.0	347.8					
ARCHITECTURAL LIGHTING (CORF	1.3	51.3	SPACE HEATING	3.4	131.6	2.4	92.6
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.5	20.5		
OTHER PLUG LOADS	0.8	32.5	SERVICE HOT WATER	0.9	35.0	0.5	18.2
HVAC FANS & PUMPS	4.5	173.8	FOOD SERVICE EQUIPMENT	1.5	60.0		
REFRIGERATION	31.0	1,200.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	34.0					
ELEVATORS							
OUTDOOR LIGHTING	1.3	50.9					

Existing Healthcare – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F
Window/Wall Ratio (WIWAR) (%)	0.15			
Shading Coefficient (SC)	0.65			

Typical Building Size	8,829	m²	95,000	ft²
Typical Footprint (m²)	1,750	m²	18,830	ft²
Footprint Aspect Ratio (L:W)	2			
Percent Conditioned Space	100%			
Percent Conditioned Space Defined as Exterior Zone	45%			
Typical # Stories	3			
Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	80%				20%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period	75%			
Fresh Air Requirements or Outside Air	45	L/s.person	95	CFM/person

%OA 33.69%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	4			
Total Air Circulation or Design Air Flow	4.45	L/s.m²	0.88	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) L/s.m² CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	447,626	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H.	13.2	ft³/lbm
Design CFM	20,824	
Total air circulation or Design air flo	4.45	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	250 Lux	23.2	ft-candles
Floor Fraction (GLFF)	0.40		
Connected Load	8.8 W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	8760		
Unocc. Period(Hrs./yr.)			
Usage During Occupied Period	40%		
Usage During Unoccupied Period			
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	50	100	200	300	Total
% Distribution			50%	50%	100%
Weighted Average					**250**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%	45%		45%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 1.1; MJ/m².yr 44

SECONDARY LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60		
Connected Load	17.6 W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	8760		
Unocc. Period(Hrs./yr.)			
Usage During Occupied Period	65%		
Usage During Unoccupied Period	20%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	600	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%	50%		40%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 5.6; MJ/m².yr 217

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level	250.00 Lux	23.2	ft-candles
Floor Fraction (HBLFF)			
Connected Load	11.9 W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	200	300	500	700	Total
% Distribution	50%	50%			100%
Weighted Average					**250**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	15%	20%		50%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LPD 14.09 W/m² — EUI TOTAL kWh/ft².yr 7; MJ/m².yr 261

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	40%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment EUI kWh/ft².yr 1.1; MJ/m².yr 43.1

Plug Loads EUI kWh/ft².yr 1.7; MJ/m².yr 67.3

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: [ ] Electricity Fuel Share: 100.0%

Commercial food services

Natural Gas EUI: EUI kWh/ft².yr 3.1; MJ/m².yr 120.0

All Electric EUI: EUI kWh/ft².yr 2.1; MJ/m².yr 80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	77%						23%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	36.5	W/m²	11.6	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	782	MJ/m².yr	20.2	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 23.0% Gas Fuel Share 77.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	20.2	782
Natural Gas EUI	28.8	1117
Market Composite EUI	26.9	1040

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	70.0%				30.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	67	W/m²	21	Btu/hr.ft²	561	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	111.4	MJ/m².yr	2.9	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 75.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.0	38
Natural Gas EUI		
Market Composite EUI	1.0	38

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					70%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	70%		30%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 118.3

Wetting Use Percentage 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	3.4	130
Natural Gas EUI	4.1	158
Market Composite EUI	3.9	149.4

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.5	L/s.m²	0.88	CFM/ft²
System Static Pressure CAV	875	Pa	3.5	wg
System Static Pressure VAV	875	Pa	3.5	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	8.8	W/m²	0.82	W/ft²
Fan Design Load VAV	8.8	W/m²	0.82	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.12	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.8	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.09	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.63	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.89	W/m²	0.08	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0043	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.6	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	62.6	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.4	kWh/m².yr
Condenser Pump Energy Consumption	1.1	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	3.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	6.9
	MJ/m².yr	266.1

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**26.6** kWh/ft².yr	**1,031.5** MJ/m².yr	**Gas:**	**25.1** kWh/ft².yr	**970.8** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	1.1	44.2
SECONDARY LIGHTING	5.6	217.0
TERTIARY LIGHTING		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	6.9	266.1
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
COMPUTER EQUIPMENT	1.1	43.1
ELEVATORS	0.2	7.7
OUTDOOR LIGHTING	0.9	33.9

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	4.6	179.9	22.2	860.4
SPACE COOLING	0.7	28.2		
DOMESTIC HOT WATER	1.0	39.0	2.9	110.4
FOOD SERVICE EQUIPMENT	2.1	80.0		

Existing School – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Schools	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	3,717	m²	40,000	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.13								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person	%OA	10.05%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	3	L/s.person	6	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	2.98	L/s.m²	0.59	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	692,650	
Peak Zone Sensible Load	388,605	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	18,078	
Total air circulation or Design air	2.98	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18.8	°C	65.84	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	14.2	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			50%		50%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	3.0
	MJ/m².yr	118

ARCHITECTURAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	22.8	W/m²	2.1	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	10%	15%		10%	50%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI		
	kWh/ft².yr	0.9
	MJ/m².yr	35

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	10%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 15.46 W/m²

EUI TOTAL		
	kWh/ft².yr	4
	MJ/m².yr	152

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.05		0.05		0.02		0.02		0.01			
Connected Load	0.3	W/m²	0.3	W/m²	0.2	W/m²	0.4	W/m²	0.1	W/m²	0.2	W/m²
	0.0	W/ft²	0.0	W/ft²	0.02	W/ft²	0.04	W/ft²	0.01	W/ft²	0.02	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		100%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		5760	

Total end-use load (occupied period)	1.3	W/m²	0.1	W/ft²
Total end-use load (unocc. period)	0.8	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

	EUI		
Computer Equipment	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.69
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

	Natural Gas EUI			All Electric EUI	
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	8.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

EUI		
	kWh/ft².yr	0.1
	MJ/m².yr	3.0

MISCELLANEOUS

EUI		
	kWh/ft².yr	0.1
	MJ/m².yr	3

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	26%						74%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	55.8	W/m²	17.7	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	291	MJ/m².yr	7.5	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share: 74.0% Gas Fuel Share: 26.0% Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.5
MJ/m².yr	291

Natural Gas EUI	
kWh/ft².yr	10.7
MJ/m².yr	415

Market Composite EUI	
kWh/ft².yr	8.3
MJ/m².yr	323

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Recprocting Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	55	W/m²	17	Btu/hr.ft²	693	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	80.7	MJ/m².yr	2.1	kWh/ft².yr		

Sizing Factor: 1.00 Operation (occ. perio 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C):

Electric Fuel Share: 100.0% Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenand

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.0
MJ/m².yr	39

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.0
MJ/m².yr	39

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					20%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	20%		80%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	0.6
MJ/m².yr	23

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	19.8

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.0	L/s.m²	0.59	CFM/ft²
System Static Pressure CAV	250	Pa	1.0	wg
System Static Pressure VAV	250	Pa	1.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	1.4	W/m²	0.13	W/ft²
Fan Design Load VAV	1.4	W/m²	0.13	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.09	W/m²	0.10	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0035	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	5.2	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.8	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	2000	hrs./year
Circulating Pump Energy Consumption	0.2	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.6
	MJ/m².yr	24.2

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**11.9** kWh/ft².yr	**462.6** MJ/m².yr		**Gas:**	**2.9** kWh/ft².yr	**112.5** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	3.0	117.7					
ARCHITECTURAL LIGHTING	0.9	34.6	SPACE HEATING	5.6	215.0	2.8	107.9
SPECIAL PURPOSE LIGHTING			SPACE COOLING				
OTHER PLUG LOADS	0.1	4.2	DOMESTIC HOT WATER	0.4	15.2	0.1	4.6
HVAC FANS & PUMPS	0.6	24.2	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	0.1	3.0					
MISCELLANEOUS	0.1	3.0					
COMPUTER EQUIPMENT	0.6	24.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing Accommodations – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Hotel/Motel	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F		
Roof U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F		
Glazing U value (W/m².°C)	3.84 W/m².°C	0.68 Btu/hr.ft² .°F		
Window/Wall Ratio (WIWAR) (%)	0.28			
Shading Coefficient (SC)	0.57			

Typical Building Size	3,717 m²	40,000 ft²
Typical Footprint (m²)	1,239 m²	13,333 ft²
Footprint Aspect Ratio (L:W)	4	
Percent Conditioned Space	100%	
Percent Conditioned Space Defined as Exterior Zone	45%	
Typical # Stories	3	
Floor to Floor Height (m)	3.7 m	12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46 m²/person	495 ft²/person	%OA 5.35%
Occupancy Schedule Occ. Period	50%		
Occupancy Schedule Unocc. Period	80%		
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4	
Total Air Circulation or Design Air Flow	3.05 L/s.m²	0.60 CFM/ft²
Infiltration Rate	1.00 L/s.m²	0.20 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m² / CFM/ft²
Operation occupied period	50%
Operation unoccupied period	50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	497,840	
Peak Zone Sensible Load	368,662	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	17,150	
Total air circulation or Design air	3.05	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	100	125	150	300				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**125**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	70%	20%	5%		5%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	2.8
	MJ/m².yr	108

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	25.1	W/m²	2.3	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	45%	10%	35%		10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI		
	kWh/ft².yr	3.2
	MJ/m².yr	123

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 16.98 W/m²

EUI TOTAL		
	kWh/ft².yr	6
	MJ/m².yr	231

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.3		0.3		0.05		0.033		0.02			
Connected Load	0.4	W/m²	0.3	W/m²	0.1	W/m²	0.1	W/m²	0.1	W/m²	1.5	W/m²
	0.0	W/ft²	0.0	W/ft²	0.01	W/ft²	0.01	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		70%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		25%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2500		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6260		5760	

Total end-use load (occupied period)	2.0	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.0	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	48%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.55
		MJ/m².yr	21.19
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: ____ Electricity Fuel Share: 100.0%

Kitchen services

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	2.6	kWh/ft².yr	1.3
	MJ/m².yr	100.0	MJ/m².yr	50.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI		
	kWh/ft².yr	0.8
	MJ/m².yr	30.0

MISCELLANEOUS

EUI		
	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	26%						74%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	59.7	W/m²	18.9	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	310	MJ/m².yr	8.0	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 74.0% Gas Fuel Share 26.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	8.0	11.4	8.9
MJ/m².yr	310	443	345

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	30.0%				70.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	33	W/m²	11	Btu/hr.ft²	1134	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	68.1	MJ/m².yr	1.8	kWh/ft².yr		

Sizing Factor 0.85 Operation (occ. perioc 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 50.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.6		0.6
MJ/m².yr	25		25

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					20%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	20%		80%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 236.6

Wetting Use Percentage 90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	6.7	8.1	7.0
MJ/m².yr	260	315	271.1

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.0	L/s.m²	0.60	CFM/ft²
System Static Pressure CAV	338	Pa	1.4	wg
System Static Pressure VAV	338	Pa	1.4	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	2.9	W/m²	0.27	W/ft²
Fan Design Load VAV	2.9	W/m²	0.27	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.78	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0021	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	21.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.4	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	2.3
	MJ/m².yr	88.8

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**23.8** kWh/ft².yr	**921.0** MJ/m².yr	**Gas:**	**4.6** kWh/ft².yr	**178.2** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING (SUITES)	2.8	108.5					
LOBBY, BALLROOMS, CORRIDORS,	3.2	122.7	SPACE HEATING	5.9	229.4	3.0	115.1
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.3	12.4		
OTHER PLUG LOADS	0.5	19.1	DOMESTIC HOT WATER	5.4	208.0	1.6	63.1
HVAC FANS & PUMPS	2.3	88.8	FOOD SERVICE EQUIPMENT	1.3	50.0		
REFRIGERATION	0.8	30.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	21.2					
ELEVATORS	0.1	3.9					
OUTDOOR LIGHTING	0.4	17.0					

Existing University/College – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F		
Roof U value (W/m².°C)	0.38 W/m².°C	0.07 Btu/hr.ft² .°F		
Glazing U value (W/m².°C)	3.58 W/m².°C	0.63 Btu/hr.ft² .°F		
Window/Wall Ratio (WIWAR) (%)	0.30			
Shading Coefficient (SC)	0.65			

Typical Building Size	6,506 m²	70,000 ft²
Typical Footprint (m²)	3,253 m²	35,000 ft²
Footprint Aspect Ratio (L:W)	7	
Percent Conditioned Space	100%	
Percent Conditioned Space Defined as Exterior Zone	50%	
Typical # Stories	2	
Floor to Floor Height (m)	3.7 m	12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14 m²/person	151 ft²/person	%OA 17.31%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	10 L/s.person	21 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.6	
Total Air Circulation or Design Air Flow	4.13 L/s.m²	0.81 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	764,320	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	35,556	
Total air circulation or Design air	4.13	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			60%		35%	5%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	5.5
	MJ/m².yr	212

ARCHITECTURAL LIGHTING CORRIDORS

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	14.2	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	5%	50%		30%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	33

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 14.33 W/m²

EUI TOTAL	kWh/ft².yr	6
	MJ/m².yr	244

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9 W/m²	0.4 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Usage during occupied period 100%
Usage during unoccupied period 55%

Computer Equipment	EUI	kWh/ft².yr	1.43
		MJ/m².yr	55.41
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: | Electricity Fuel Share: 100.0%

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	0.5	kWh/ft².yr	0.4
	MJ/m².yr	20.0	MJ/m².yr	15.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas Boilers Stan.	Natural Gas Boilers High	Natural Gas Packaged Unit	Electric A/A HP	Electric W. S. HP	Electric H/R Chiller	Electric Resistance	Total
System Present (%)	89%						11%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load 52.2 W/m² 16.5 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 294 MJ/m².yr 7.6 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 11.0% Gas Fuel Share 89.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.6
MJ/m².yr	294

Natural Gas EUI	
kWh/ft².yr	10.9
MJ/m².yr	421

Market Composite EUI	
kWh/ft².yr	10.5
MJ/m².yr	407

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	50.0%				50.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load 80 W/m² 25 Btu/hr.ft² 471 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 113.9 MJ/m².yr 2.9 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. perioc 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 10.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.2
MJ/m².yr	47

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.2
MJ/m².yr	47

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					50%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	50%		50%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	27.7

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.1	L/s.m²	0.81	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	6.4	W/m²	0.60	W/ft²
Fan Design Load VAV	6.4	W/m²	0.60	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	90%	10%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.024	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.89	W/m²	0.18	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0051	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	46.6	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	1.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	6000	hrs./year
Circulating Pump Energy Consumption	3.7	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.9
	MJ/m².yr	189.5

EUI SUMMARY										
TOTAL ALL END-USES:	**Electricity:**		**16.3** kWh/ft².yr	**629.8** MJ/m².yr		**Gas:**		**10.1** kWh/ft².yr	**389.5** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity		Gas	
				kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	5.5	211.6					
ARCHITECTURAL LIGHTING CORRI	0.8	32.6	SPACE HEATING	0.8	32.4	9.7	374.3
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.1	4.7		
OTHER PLUG LOADS	0.7	25.2	SERVICE HOT WATER	0.3	12.5	0.4	15.2
HVAC FANS & PUMPS	4.9	189.5	FOOD SERVICE EQUIPMENT	0.4	15.0		
REFRIGERATION	0.5	20.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	1.4	55.4					
ELEVATORS	0.1	3.9					
OUTDOOR LIGHTING	0.4	17.0					

Existing Warehouse/Wholesale – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS: Warehouse/Wholesale Baseline | **SIZE:** > 50 kW | **VINTAGE:** | **REGION:** Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	5,576	m²	60,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	5,576	m²	60,000	ft²
Glazing U value (W/m².°C)	3.84	W/m².°C	0.68	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA	5.72%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	1.75	L/s.m²	0.34	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	566,121	
Peak Zone Sensible Load	443,959	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	20,653	
Total air circulation or Design air	1.75	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

HIGH BAY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	13.8	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			20%		10%	60%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	5.0
	MJ/m².yr	192

OTHER, OFFICE LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	20.9	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	5%	60%		25%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI		
	kWh/ft².yr	0.8
	MJ/m².yr	29

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 14.54 W/m²

EUI TOTAL		
	kWh/ft².yr	5.7
	MJ/m².yr	221

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	39%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.46
		MJ/m².yr	17.72
Plug Loads	EUI	kWh/ft².yr	0.83
		MJ/m².yr	32.15

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

A saturation of 25% should be considered in the macro model

	Natural Gas EUI			All Electric EUI	
EUI	kWh/ft².yr	0.2	EUI	kWh/ft².yr	0.1
	MJ/m².yr	6.0		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Process

EUI		
	kWh/ft².yr	1.5
	MJ/m².yr	60.0

MISCELLANEOUS

EUI		
	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	44%						56%	100%
Eff./COP	70%	70%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.43	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	40.4 W/m²	12.8 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	235 MJ/m².yr	6.1 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	56.0%	Gas Fuel Share 44.0%	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	6.1	235
Natural Gas EUI	8.7	336
Market Composite EUI	7.2	280

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	30 W/m²	9 Btu/hr.ft²	1272 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	48.4 MJ/m².yr	1.2 kWh/ft².yr	

Sizing Factor 1.00 — Operation (occ. perioc 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 5.0%

Electric Fuel Share 100.0% — Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	20
Natural Gas EUI		
Market Composite EUI	0.5	20

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					20%
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share	20%		80%
Blended Efficiency	0.75		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.0

Wetting Use Percentage 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.5	19
Natural Gas EUI	0.6	23
Market Composite EUI	0.5	19.5

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	1.7	L/s.m²	0.34	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.1	W/m²	0.10	W/ft²
Fan Design Load VAV	1.1	W/m²	0.10	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.0	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.1	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.59	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0019	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	50	kPa	17	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.1	W/m²	0.01	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	8.4	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.4	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.0
	MJ/m².yr	37.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**14.1** kWh/ft².yr	**547.3** MJ/m².yr	**Gas:**	**3.9** kWh/ft².yr	**152.5** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
HIGH BAY LIGHTING	5.0	192.3					
OTHER, OFFICE LIGHTING	0.8	29.1	SPACE HEATING	3.4	131.8	3.8	148.0
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.0	1.0		
OTHER PLUG LOADS	0.8	32.1	DOMESTIC HOT WATER	0.4	14.9	0.1	4.5
HVAC FANS & PUMPS	1.0	37.3	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	1.5	60.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	17.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing Office – Labrador Interconnected

COMMERCIAL SECTOR BUILDING PROFILE

EXISTING BUILDINGS:	SIZE:	VINTAGE:	REGION:
Office	> 50 kW		Labrador
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Building Size	929 m²	10,000	ft²
Roof U value (W/m².°C)	0.24	W/m².°C	0.04	Btu/hr.ft² .°F	Typical Footprint (m²)	929 m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	45%		
Window/Wall Ratio (WIWAR) (%)	0.36							
Shading Coefficient (SC)	0.58				Typical # Stories	1		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	75%				25%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA	7.33%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation — L/s.m² — CFM/ft² — operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	4.01	L/s.m²	0.79	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² / CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	192,550	
Peak Zone Sensible Load	130,576	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	6,074	
Total air circulation or Design air	4.01	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	550	Lux	51.1	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	16.1	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	450	550	650					Total
% Distribution	10%	80%	10%					100%
Weighted Average								**550**
	INC	CFL	T12	T8	MH	HPS	Other	TOTAL
System Present (%)			70.0%	30.0%				100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.55	0.55	0.55	
Efficacy (L/W)	15	50	72	88	65	90	90	

EUI	kWh/ft².yr	5.7
	MJ/m².yr	221

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	33.4	W/m²	3.1	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12	T8	MH	HPS	Other	TOTAL
System Present (%)	50%	45%			5%			100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.55	0.55	0.55	
Efficacy (L/W)	15	50	72	84	65	90	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	1.7
	MJ/m².yr	64

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 17.87 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	285

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.06	
Connected Load	1.9 W/m²	1.8 W/m²	0.6 W/m²	0.8 W/m²	0.5 W/m²	1.5 W/m²
	0.2 W/ft²	0.2 W/ft²	0.05 W/ft²	0.07 W/ft²	0.05 W/ft²	0.14 W/ft²
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	3.8 W/m²	0.4 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	66%	

Computer Equipment	EUI	kWh/ft².yr	2.77
		MJ/m².yr	107.44
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Lunch room/cafeteria/restaurant

	Natural Gas EUI		All Electric EUI
EUI	kWh/ft².yr	0.1	0.1
	MJ/m².yr	5.0	4.0

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.1
	MJ/m².yr	4.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 60.3 W/m² — 19.1 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 495 MJ/m².yr — 12.8 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	12.8
MJ/m².yr	495

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	12.8
MJ/m².yr	495

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	WSHP	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)	20.0%				80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	14.0 °C	57.2 °F

Peak Cooling Load: 61 W/m² — 19 Btu/hr.ft² — 623 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 73.6 MJ/m².yr — 1.9 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period): 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 50.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Tank					Boiler
System Present (%)						
Eff./COP	0.65					0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.0	L/s.m²	0.79	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	3.2	W/m²	0.30	W/ft²
Fan Design Load VAV	3.2	W/m²	0.30	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	75%	25%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.19	W/m²	0.11	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	90	kPa	30	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.58	W/m²	0.05	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0039	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	21.5	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.8	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.2
	MJ/m².yr	86.2

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**		**28.0**	kWh/ft².yr	**1,086.1**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	5.7	221.1					
ARCHITECTURAL LIGHTING	1.7	63.9	SPACE HEATING	12.8	494.7		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.4	15.1		
OTHER PLUG LOADS	0.7	27.7	DOMESTIC HOT WATER	0.6	25.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	2.2	86.2	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	0.1	4.0					
MISCELLANEOUS	0.5	20.0					
COMPUTER EQUIPMENT	2.8	107.4					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing Non Food Retail – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F
Window/Wall Ratio (WIWAR) (%)	0.10			
Shading Coefficient (SC)	0.75			

Typical Building Size	929	m²	10,000	ft²
Typical Footprint (m²)	929	m²	10,000	ft²
Footprint Aspect Ratio (L:W)	5			
Percent Conditioned Space	100%			
Percent Conditioned Space Defined as Exterior Zone	45%			
Typical # Stories	1			
Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	18	L/s.person	38	CFM/person

%OA 16.73%

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	4.30	L/s.m²	0.85	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	321,967	
Peak Zone Sensible Load	182,198	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	8,476	
Total air circulation or Design air	4.30	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	26.9	W/m²	2.5	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	20%	2%	55%		20%	3%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 10.7; MJ/m².yr 415

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	35.7	W/m²	3.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	30%	40%	30%					100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	35%	5%	50%		10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 1.0; MJ/m².yr 40

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 27.31 W/m² — EUI TOTAL kWh/ft².yr 12; MJ/m².yr 454

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.36	0.36	0.01	0.01	0.02	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.5 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment EUI kWh/ft².yr 0.9; MJ/m².yr 35.0

Plug Loads EUI kWh/ft².yr 0.6; MJ/m².yr 24.9

FOOD SERVICE EQUIPMENT 5

Provide description below: Gas Fuel Share: ___ Electricity Fuel Share: 100.0%

Small restaurants, food courts, kitchenettes

Natural Gas EUI: EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

All Electric EUI: EUI kWh/ft².yr 0.3; MJ/m².yr 10.0

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 0.2; MJ/m².yr 8.6

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Rooftop					
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	47.8	W/m²	15.2	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	454	MJ/m².yr	11.7	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.7
MJ/m².yr	454

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	11.7
MJ/m².yr	454

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	102	W/m²	32	Btu/hr.ft²	373	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	99.9	MJ/m².yr	2.6	kWh/ft².yr		

Sizing Factor 1.00

A/C Saturation (Incidence of A/C) 25.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.1
MJ/m².yr	41

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.1
MJ/m².yr	41

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.3	L/s.m²	0.85	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.9	W/m²	0.27	W/ft²
Fan Design Load VAV	2.9	W/m²	0.27	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	90%	10%	90%	10%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.03	W/m²	0.19	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0064	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	24.1	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.5
	MJ/m².yr	96.8

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**29.9**	kWh/ft².yr	**1,156.5**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity		Gas	
				kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	10.7	414.7					
ARCHITECTURAL LIGHTING	1.0	39.8	SPACE HEATING	11.7	453.6		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.3	10.2		
OTHER PLUG LOADS	0.6	24.9	DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	2.5	96.8	FOOD SERVICE EQUIPMENT	0.3	10.0		
REFRIGERATION	0.2	8.6					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	35.0					
ELEVATORS/ESCALATORS							
OUTDOOR LIGHTING	0.9	33.9					

Existing Food Retail – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.06								
Shading Coefficient (SC)	0.69				Typical # Stories	1			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45	m²/person	484	ft²/person	%OA 23.05%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	30	L/s.person	64	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor: 1
Total Air Circulation or Design Air Flow: 2.89 L/s.m² 0.57 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Infiltration Rate: 0.70 L/s.m² 0.14 CFM/ft²
(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	248,681	
Peak Zone Sensible Load	122,425	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	5,695	
Total air circulation or Design air	2.89	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	18.7	W/m²	1.7	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	4%	1%	40%		15%	40%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	8.4
	MJ/m².yr	324

ARCHITECTURAL LIGHTING (CORRIDORS)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	16.3	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			50%		30%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	1.0
	MJ/m².yr	39

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 18.42 W/m²

EUI TOTAL	kWh/ft².yr	9
	MJ/m².yr	362

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.65		0.65		0.01		0.01		0.03			
Connected Load	0.8	W/m²	0.7	W/m²	0.0	W/m²	0.0	W/m²	0.1	W/m²	1.5	W/m²
	0.1	W/ft²	0.1	W/ft²	0.00	W/ft²	0.00	W/ft²	0.01	W/ft²	0.14	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		90%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2600		4100	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6160		4660	

Total end-use load (occupied period)	2.9	W/m²	0.3	W/ft²
Total end-use load (unocc. period)	1.7	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	58%			

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Computer Equipment	EUI	kWh/ft².yr	0.88
		MJ/m².yr	34.0
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.5

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	2.6	kWh/ft².yr	1.5
	MJ/m².yr	100.0	MJ/m².yr	60.0

REFRIGERATION

Provide description below:

Commercial refrigeration display cases

EUI	kWh/ft².yr	25.8
	MJ/m².yr	1000.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	35.4	W/m²	11.2	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	575	MJ/m².yr	14.8	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% | Gas Fuel Share | Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	14.8	575
Natural Gas EUI		
Market Composite EUI	14.8	575

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load	78	W/m²	25	Btu/hr.ft²	483	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	58.9	MJ/m².yr	1.5	kWh/ft².yr		

Sizing Factor 1.00 | Operation (occ. period) 4000 hrs/year | Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 15.0%

Electric Fuel Share 100.0% | Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.7	27
Natural Gas EUI		
Market Composite EUI	0.7	27

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	65.00				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 45.5

Wetting Use Percentage 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	1.3	50
Natural Gas EUI	#DIV/0!	#DIV/0!
Market Composite EUI	#DIV/0!	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.9	L/s.m²	0.57	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	2.1	W/m²	0.20	W/ft²
Fan Design Load VAV	2.1	W/m²	0.20	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.04	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.57	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0050	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	18.5	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.1
	MJ/m².yr	80.9

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**58.3** kWh/ft².yr	**2,259.8** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity		Gas	
				kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	8.4	323.6					
ARCHITECTURAL LIGHTING (CORF	1.0	38.8	SPACE HEATING	14.8	575.1		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.1	4.0		
OTHER PLUG LOADS	0.8	32.5	SERVICE HOT WATER	1.3	50.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	2.1	80.9	FOOD SERVICE EQUIPMENT	1.5	60.0		
REFRIGERATION	25.8	1,000.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	34.0					
ELEVATORS							
OUTDOOR LIGHTING	1.3	50.9					

Existing Healthcare – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F	Typical Footprint (m²)	1,750	m²	18,830	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.15								
Shading Coefficient (SC)	0.65				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	80%				20%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	22.25%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	3			
Total Air Circulation or Design Air Flow	2.25	L/s.m²	0.44	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	671,277	
Peak Zone Sensible Load	301,280	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H.	13.2	ft³/lbm
Design CFM	14,016	
Total air circulation or Design air flo	2.25	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	250	Lux	23.2	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	8.8	W/m²	0.8	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				

Light Level (Lux)	50	100	200	300	Total
% Distribution			50%	50%	100%
Weighted Average					**250**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%	45%		45%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI: kWh/ft².yr 1.1; MJ/m².yr 44

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	17.6	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period	20%			

Light Level (Lux)	300	500	600	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%	50%		40%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI: kWh/ft².yr 5.6; MJ/m².yr 217

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level	250.00	Lux	23.2	ft-candles
Floor Fraction (HBLFF)				
Connected Load	11.9	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	200	300	500	700	Total
% Distribution	50%	50%			100%
Weighted Average					**250**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	15%	20%		50%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Fixture Cleaning:
Incidence of Practice
Interval — years

Relamping Strategy & Incidence of Practice: Group | Spot

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LPD 14.09 W/m² — EUI TOTAL: kWh/ft².yr 7; MJ/m².yr 261

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²

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Usage during occupied period 100%
Usage during unoccupied period 40%

Computer Equipment EUI: kWh/ft².yr 1.1; MJ/m².yr 43.1
Plug Loads EUI: kWh/ft².yr 1.7; MJ/m².yr 67.3

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Commercial food services

Natural Gas EUI: kWh/ft².yr 3.1; MJ/m².yr 120.0
All Electric EUI: kWh/ft².yr 2.1; MJ/m².yr 80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI: kWh/ft².yr 0.4; MJ/m².yr 15.0

MISCELLANEOUS

EUI: kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas Boilers Stan.	Natural Gas Boilers High	Natural Gas Packaged Unit	Electric A/A HP	Electric W. S. HP	Electric H/R Chiller	Electric Resistance	Total
System Present (%)	10%						90%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	36.9	W/m²	11.7	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	439	MJ/m².yr	11.3	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 90.0% Gas Fuel Share 10.0% Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	11.3	439
Natural Gas EUI	16.2	627
Market Composite EUI	11.8	458

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	22	W/m²	7	Btu/hr.ft²	1698	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	47.5	MJ/m².yr	1.2	kWh/ft².yr		

Sizing Factor 1.00 Operation (occ. perioc 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 35.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	0.4	15
Natural Gas EUI		
Market Composite EUI	0.4	15

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 118.3

Wetting Use Percentage 90%

EUI	kWh/ft².yr	MJ/m².yr
All Electric EUI	3.4	130
Natural Gas EUI	#DIV/0!	#DIV/0!
Market Composite EUI	#DIV/0!	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.2	L/s.m²	0.44	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	3.8	W/m²	0.35	W/ft²
Fan Design Load VAV	3.8	W/m²	0.35	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.12	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.8	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.37	W/m²	0.03	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.001	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.30	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0014	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	27.0	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.4	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption	0.1	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.2
	MJ/m².yr	122.5

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**30.1**	kWh/ft².yr	**1,166.9**	MJ/m².yr	**Gas:**	**#DIV/0!**	kWh/ft².yr	**#DIV/0!**	MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	1.1	44.2					
SECONDARY LIGHTING	5.6	217.0	SPACE HEATING	10.2	394.9	1.6	62.7
TERTIARY LIGHTING			SPACE COOLING	0.1	5.1		
OTHER PLUG LOADS	1.7	67.3	DOMESTIC HOT WATER	3.4	130.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	3.2	122.5	FOOD SERVICE EQUIPMENT	2.1	80.0		
REFRIGERATION	0.4	15.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	1.1	43.1					
ELEVATORS	0.1	3.9					
OUTDOOR LIGHTING	0.9	33.9					

Existing School – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F
Window/Wall Ratio (WIWAR) (%)	0.13			
Shading Coefficient (SC)	0.65			

Typical Building Size	3,717	m²	40,000	ft²
Typical Footprint (m²)	3,717	m²	40,000	ft²
Footprint Aspect Ratio (L:W)	5			
Percent Conditioned Space	100%			
Percent Conditioned Space Defined as Exterior Zone	50%			
Typical # Stories	1			
Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	6	L/s.person	13	CFM/person

%OA 18.16%

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.30	L/s.m²	0.65	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	953,093	
Peak Zone Sensible Load	430,318	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	20,018	
Total air circulation or Design air	3.30	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18.8	°C	65.84	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85		
Connected Load	14.2 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500		
Unocc. Period(Hrs./yr.)	6260		
Usage During Occupied Period	85%		
Usage During Unoccupied Period	15%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			50%		50%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Relamping Strategy & Incidence of Practice	Group	Spot

EUI kWh/ft².yr 3.4
MJ/m².yr 133

ARCHITECTURAL LIGHTING

Light Level	400 Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15		
Connected Load	22.8 W/m²	2.1	W/ft²
Occ. Period(Hrs./yr.)	2500		
Unocc. Period(Hrs./yr.)	6260		
Usage During Occupied Period	90%		
Usage During Unoccupied Period	15%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	10%	15%		10%	50%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Relamping Strategy & Incidence of Practice	Group	Spot

EUI kWh/ft².yr 1.0
EUI = Load X Hrs. X SF X GLFF — MJ/m².yr 39

SPECIAL PURPOSE LIGHTING

Light Level	300.00 Lux	27.9	ft-candles
Floor Fraction (HBLFF)			
Connected Load	W/m²		W/ft²
Occ. Period(Hrs./yr.)	3000		
Unocc. Period(Hrs./yr.)	5760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	10%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

Relamping Strategy & Incidence of Practice	Group	Spot

EUI kWh/ft².yr
MJ/m².yr

TOTAL LIGHTING — Overall LP 15.46 W/m² — EUI TOTAL kWh/ft².yr 4; MJ/m².yr 172

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.05	0.05	0.02	0.02	0.01	
Connected Load	0.3 W/m²	0.3 W/m²	0.2 W/m²	0.4 W/m²	0.1 W/m²	0.2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.02 W/ft²	0.04 W/ft²	0.01 W/ft²	0.02 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5760

Total end-use load (occupied period)	1.3 W/m²	0.1 W/ft²
Total end-use load (unocc. period)	0.8 W/m²	0.1 W/ft²

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Usage during occupied period	100%
Usage during unoccupied period	59%

Computer Equipment	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.69
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

	Natural Gas EUI	All Electric EUI
EUI kWh/ft².yr	0.2	0.1
MJ/m².yr	8.0	4.0

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 0.03
MJ/m².yr 1.1

MISCELLANEOUS

EUI kWh/ft².yr 0.1
MJ/m².yr 3

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)	25%						75%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load	41.1 W/m²	13.0 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	415 MJ/m².yr	10.7 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	75.0%	Gas Fuel Share 25.0%	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	10.7	15.3	11.9
MJ/m².yr	415	593	460

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	75 W/m²	24 Btu/hr.ft²	504 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	70.2 MJ/m².yr	1.8 kWh/ft².yr	

Sizing Factor 1.00 — Operation (occ. perioc 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C)

Electric Fuel Share 100.0% — Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.9		0.9
MJ/m².yr	33		33

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.5	#DIV/0!	#DIV/0!
MJ/m².yr	19	#DIV/0!	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.65	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.2	W/m²	0.20	W/ft²
Fan Design Load VAV	2.2	W/m²	0.20	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.50	W/m²	0.14	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0048	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.6	W/m²	0.06	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	11.8	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	1.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	2000	hrs./year
Circulating Pump Energy Consumption	0.3	kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	1.3
	MJ/m².yr	49.1

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**15.6** kWh/ft².yr	**605.7** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	3.4	132.9					
ARCHITECTURAL LIGHTING	1.0	39.2	SPACE HEATING	8.0	311.5	3.8	148.4
SPECIAL PURPOSE LIGHTING			SPACE COOLING				
OTHER PLUG LOADS	0.1	4.2	DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	1.3	49.1	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	0.0	1.1					
MISCELLANEOUS	0.1	3.0					
COMPUTER EQUIPMENT	0.6	24.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing Accommodations – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,394	m²	15,000	ft²
Roof U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Footprint (m²)	1,394	m²	15,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.28								
Shading Coefficient (SC)	0.57				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	46	m²/person	495	ft²/person	%OA	5.23%
Occupancy Schedule Occ. Period	50%					
Occupancy Schedule Unocc. Period	80%					
Fresh Air Requirements or Outside Air	8	L/s.person	16	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:	15%			
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation	0.5	L/s.m²	0.10	CFM/ft²
	50%	operation (%)		

Sizing Factor	1.3			
Total Air Circulation or Design Air Flow	3.12	L/s.m²	0.61	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	200,704	
Peak Zone Sensible Load	152,262	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	7,083	
Total air circulation or Design air	3.12	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	18	°C	64.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	100	125	150	300				Total
% Distribution	25%	50%	25%					100%
Weighted Average								**125**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	70%	20%	5%		5%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	2.8
	MJ/m².yr	108

LOBBY, BALLROOMS, CORRIDORS, BACK OF HOUSE OTHER

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	25.1	W/m²	2.3	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	45%	10%	35%		10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	3.2
	MJ/m².yr	123

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 16.98 W/m²

EUI TOTAL	kWh/ft².yr	6
	MJ/m².yr	231

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.4 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	50%	50%	50%	50%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.0	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.48
		MJ/m².yr	18.49
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: [ ] Electricity Fuel Share: 100.0%

Kitchen services

	Natural Gas EUI			All Electric EUI	
EUI	kWh/ft².yr	1.0	EUI	kWh/ft².yr	0.5
	MJ/m².yr	40.0		MJ/m².yr	20.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 56.6 W/m² — 18.0 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 457 MJ/m².yr — 11.8 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% Gas Fuel Share: Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.8
MJ/m².yr	457

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	11.8
MJ/m².yr	457

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load: 36 W/m² — 11 Btu/hr.ft² — 1055 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 49.0 MJ/m².yr — 1.3 kWh/ft².yr

Sizing Factor: 0.85 Operation (occ. perioc 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 50.0%

Electric Fuel Share: 100.0% Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 236.6

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.1	L/s.m²	0.61	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	2.6	W/m²	0.24	W/ft²
Fan Design Load VAV	2.6	W/m²	0.24	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.72	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0023	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	19.3	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.4	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	2.0
	MJ/m².yr	79.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**29.5** kWh/ft².yr	**1,141.9** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING (SUITES)	2.8	108.5					
LOBBY, BALLROOMS, CORRIDORS,	3.2	122.7	SPACE HEATING	11.8	456.9		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.3	10.0		
OTHER PLUG LOADS	0.5	19.1	DOMESTIC HOT WATER	6.7	260.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	2.0	79.3	FOOD SERVICE EQUIPMENT	0.5	20.0		
REFRIGERATION	0.5	20.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	18.5					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing University/College – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F
Roof U value (W/m².°C)	0.33	W/m².°C	0.06	Btu/hr.ft² .°F
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F
Window/Wall Ratio (WIWAR) (%)	0.30			
Shading Coefficient (SC)	0.65			

Typical Building Size	6,506	m²	70,000	ft²
Typical Footprint (m²)	3,253	m²	35,000	ft²
Footprint Aspect Ratio (L:W)	7			
Percent Conditioned Space	100%			
Percent Conditioned Space Defined as Exterior Zone	50%			
Typical # Stories	2			
Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14	m²/person	151	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person

%OA 16.61%

Fresh Air Control Type *(enter a 1, 2 or 3) — 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² — 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.6			
Total Air Circulation or Design Air Flow	4.30	L/s.m²	0.85	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) — L/s.m² — CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	796,465	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	37,052	
Total air circulation or Design air	4.30	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	14.3	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			60%		35%	5%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 5.5; MJ/m².yr 212

ARCHITECTURAL LIGHTING CORRIDORS

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	14.2	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	15%	5%	50%		30%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 0.8; MJ/m².yr 33

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Light Level	300.00	Lux	27.9	ft-candles
Floor Fraction (HBLFF)				
Connected Load	14.0	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 14.33 W/m² — EUI TOTAL kWh/ft².yr 6; MJ/m².yr 244

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9 W/m²	0.4 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²

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Usage during occupied period 100%

Usage during unoccupied period 55%

Computer Equipment EUI kWh/ft².yr 1.43; MJ/m².yr 55.41

Plug Loads EUI kWh/ft².yr 0.65; MJ/m².yr 25.18

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Natural Gas EUI: EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

All Electric EUI: EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

REFRIGERATION

Provide description below:

EUI kWh/ft².yr 0.5; MJ/m².yr 20.0

MISCELLANEOUS

EUI kWh/ft².yr 0.8; MJ/m².yr 30

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load: 49.6 W/m² — 15.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 460 MJ/m².yr — 11.9 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.9
MJ/m².yr	460

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	11.9
MJ/m².yr	460

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load: 82 W/m² — 26 Btu/hr.ft² — 463 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 78.4 MJ/m².yr — 2.0 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period) 3000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 25.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.9
MJ/m².yr	34

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.9
MJ/m².yr	34

SERVICE HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.3	L/s.m²	0.85	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	4.5	W/m²	0.42	W/ft²
Fan Design Load VAV	4.5	W/m²	0.42	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	90%	10%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.63	W/m²	0.15	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.006	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0052	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.7	W/m²	0.07	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	32.3	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	1.6	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	6000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	3.2
	MJ/m².yr	123.8

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**26.5**	kWh/ft².yr	**1,024.7**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	5.5	211.6					
ARCHITECTURAL LIGHTING CORR	0.8	32.6	SPACE HEATING	11.9	460.5		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.2	8.5		
OTHER PLUG LOADS	0.7	25.2	SERVICE HOT WATER	0.6	25.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	3.2	123.8	FOOD SERVICE EQUIPMENT	0.4	15.0		
REFRIGERATION	0.5	20.0					
MISCELLANEOUS	0.8	30.0					
COMPUTER EQUIPMENT	1.4	55.4					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

Existing Warehouse/Wholesale – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.38	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	3.52	W/m².°C	0.62	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	20.1	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA	5.92%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	2.53	L/s.m²	0.50	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	273,398	
Peak Zone Sensible Load	214,450	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	9,976	
Total air circulation or Design air	2.53	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

HIGH BAY LIGHTING

Light Level	400 Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.90		
Connected Load	13.8 W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	3500		
Unocc. Period(Hrs./yr.)	5260		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	15%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)			20%		10%	60%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 5.0; MJ/m².yr 192

OTHER, OFFICE LIGHTING

Light Level	500 Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10		
Connected Load	20.9 W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	3000		
Unocc. Period(Hrs./yr.)	5760		
Usage During Occupied Period	100%		
Usage During Unoccupied Period	15%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	5%	60%		25%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 0.8; MJ/m².yr 29

EUI = Load X Hrs. X SF X GLFF

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level	Lux		ft-candles
Floor Fraction (HBLFF)			
Connected Load	W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000		
Unocc. Period(Hrs./yr.)	4760		
Usage During Occupied Period	0%		
Usage During Unoccupied Period	100%		
Fixture Cleaning:			
Incidence of Practice			
Interval	years		
Relamping Strategy & Incidence of Practice	Group	Spot	

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 14.54 W/m² — EUI TOTAL kWh/ft².yr 5.7; MJ/m².yr 221

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	39%	

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		kWh/ft².yr	MJ/m².yr
Computer Equipment	EUI	0.46	17.72
Plug Loads	EUI	0.83	32.15

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

A saturation of 25% should be considered in the macro model

	Natural Gas EUI	All Electric EUI
EUI kWh/ft².yr	0.2	0.1
MJ/m².yr	6.0	4.0

REFRIGERATION

Provide description below:

Process

EUI kWh/ft².yr 1.5; MJ/m².yr 60.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	70%	70%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.43	1.43	0.59	0.33	0.22	1.00	

Peak Heating Load 47.8 W/m² 15.2 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 414 MJ/m².yr 10.7 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI		
	kWh/ft².yr	10.7
	MJ/m².yr	414

Natural Gas EUI		
	kWh/ft².yr	
	MJ/m².yr	

Market Composite EUI		
	kWh/ft².yr	10.7
	MJ/m².yr	414

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.6	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.38	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load 43 W/m² 14 Btu/hr.ft² 878 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 37.0 MJ/m².yr 1.0 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C)

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI		
	kWh/ft².yr	0.4
	MJ/m².yr	16

Natural Gas EUI		
	kWh/ft².yr	
	MJ/m².yr	

Market Composite EUI		
	kWh/ft².yr	0.4
	MJ/m².yr	16

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Avg. Tank				Boiler
System Present (%)					
Eff./COP	0.65				0.75

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.0

Wetting Use Percentage 90%

All Electric EUI		
	kWh/ft².yr	0.5
	MJ/m².yr	19

Natural Gas EUI		
	kWh/ft².yr	#DIV/0!
	MJ/m².yr	#DIV/0!

Market Composite EUI		
	kWh/ft².yr	#DIV/0!
	MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.5	L/s.m²	0.50	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.6	W/m²	0.15	W/ft²
Fan Design Load VAV	1.6	W/m²	0.15	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	80%	20%	80%	20%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.86	W/m²	0.08	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0027	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	50	kPa	17	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	12.2	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.2	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	1.4
	MJ/m².yr	52.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**21.9** kWh/ft².yr	**847.3** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
HIGH BAY LIGHTING	5.0	192.3					
OTHER, OFFICE LIGHTING	0.8	29.1	SPACE HEATING	10.7	414.1		
SPECIAL PURPOSE LIGHTING			SPACE COOLING				
OTHER PLUG LOADS	0.8	32.1	DOMESTIC HOT WATER	0.5	18.7	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	1.4	52.3	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	1.5	60.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	17.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

New Office – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Office	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.42	W/m².°C	0.07	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.35								
Shading Coefficient (SC)	0.58				Typical # Stories	2			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26	m²/person	274	ft²/person	%OA	19.58%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: L/s.m² / CFM/ft² / operation (%)

Sizing Factor	1.5			
Total Air Circulation or Design Air Flow	4.01	L/s.m²	0.79	CFM/ft²
Infiltration Rate	0.70	L/s.m²	0.14	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m²	CFM/ft²
Operation occupied period	50%	
Operation unoccupied period	50%	

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	528,694	
Peak Zone Sensible Load	226,045	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	10,516	
Total air circulation or Design air	4.01	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.9	W/m²	1.2	W/ft²

Occ. Period(Hrs./yr.)	3300	
Unocc. Period(Hrs./yr.)	5460	
Usage During Occupied Period	95%	
Usage During Unoccupied Period	20%	
Fixture Cleaning:		
Incidence of Practice		
Interval		years
Relamping Strategy & Incidence of Practice	Group	Spot

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					100%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	4.6
	MJ/m².yr	177

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	16.6	W/m²	1.5	W/ft²

Occ. Period(Hrs./yr.)	3400	
Unocc. Period(Hrs./yr.)	5360	
Usage During Occupied Period	95%	
Usage During Unoccupied Period	40%	
Fixture Cleaning:		
Incidence of Practice		
Interval		years
Relamping Strategy & Incidence of Practice	Group	Spot

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	30%			40%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	32

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²

Floor fraction check: should = 1.00 | 1.00

Occ. Period(Hrs./yr.)	4000	
Unocc. Period(Hrs./yr.)	4760	
Usage During Occupied Period	0%	
Usage During Unoccupied Period	100%	
Fixture Cleaning:		
Incidence of Practice		
Interval		years
Relamping Strategy & Incidence of Practice	Group	Spot

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 13.29 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	209

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		50			
Density (device/occupant)	0.9		0.9		0.15		0.1		0.26			
Connected Load	1.9	W/m²	1.8	W/m²	0.6	W/m²	0.8	W/m²	0.5	W/m²	1.5	W/m²
	0.2	W/ft²	0.2	W/ft²	0.05	W/ft²	0.07	W/ft²	0.05	W/ft²	0.14	W/ft²
Diversity Occupied Period	80%		80%		80%		80%		100%		80%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		2500	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		6260	

Total end-use load (occupied period)	5.8	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	3.8	W/m²	0.4	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	66%			

Computer Equipment	EUI	kWh/ft².yr	2.77
		MJ/m².yr	107.44
Plug Loads	EUI	kWh/ft².yr	0.72
		MJ/m².yr	27.70

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Kitchen

Natural Gas EUI			All Electric EUI		
EUI	kWh/ft².yr	0.1	EUI	kWh/ft².yr	0.10
	MJ/m².yr	5.0		MJ/m².yr	4.00

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI	kWh/ft².yr	0.10
	MJ/m².yr	4.00

MISCELLANEOUS

EUI	kWh/ft².yr	0.52
	MJ/m².yr	20.00

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				Total
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load 55.4 W/m² 17.6 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 321 MJ/m².yr 8.3 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	8.3
MJ/m².yr	321

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	8.3
MJ/m².yr	321

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load 83 W/m² 26 Btu/hr.ft² 454 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 122.1 MJ/m².yr 3.2 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

All Electric EUI	
kWh/ft².yr	1.2
MJ/m².yr	48

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.2
MJ/m².yr	48

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	24

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.0	L/s.m²	0.79	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	6.8	W/m²	0.63	W/ft²
Fan Design Load VAV	6.8	W/m²	0.63	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.2	L/s.m²	0.04	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.06	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.49	W/m²	0.14	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.89	W/m²	0.08	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0053	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.5	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	41.4	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.8	kWh/m².yr
Condenser Pump Energy Consumption	1.1	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	4.2
	MJ/m².yr	161.7

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**24.6**	kWh/ft².yr	**954.4**	MJ/m².yr		
	Gas:	**#DIV/0!**	kWh/ft².yr	**#DIV/0!**	MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.6	176.9
ARCHITECTURAL LIGHTING	0.8	32.2
SPECIAL PURPOSE LIGHTING		
OTHER PLUG LOADS	0.7	27.7
HVAC FANS & PUMPS	4.2	161.7
REFRIGERATION	0.1	4.0
MISCELLANEOUS	0.5	20.0
COMPUTER EQUIPMENT	2.8	107.4
ELEVATORS		
OUTDOOR LIGHTING	0.8	32.2

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.3	321.2		
SPACE COOLING	1.1	42.8		
DOMESTIC HOT WATER	0.6	24.2	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	0.1	4.0		

New Non Food Retail – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Non-Food Retail	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	18.71%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	4.27	L/s.m²	0.84	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)		L/s.m²		CFM/ft²
Operation occupied period	50%			
Operation unoccupied period	50%			

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	567,202	
Peak Zone Sensible Load	258,500	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	12,025	
Total air circulation or Design air	4.27	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.6	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	5%			55%	30%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	8.9
	MJ/m².yr	346

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	26.1	W/m²	2.4	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	10%			20%	60%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	30

SPECIAL PURPOSE LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 20.88 W/m²

EUI TOTAL	kWh/ft².yr	10
	MJ/m².yr	376

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.36	0.36	0.01	0.01	0.02	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.5	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	58%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.90
		MJ/m².yr	34.97
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT 5

Provide description below: Gas Fuel Share: | Electricity Fuel Share: 100.0%

Small restaurants, food courts, kitchenettes

	Natural Gas EUI		All Electric EUI
EUI	kWh/ft².yr	0.4	kWh/ft².yr 0.3
	MJ/m².yr	15.0	MJ/m².yr 10.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				Total
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load	39.7	W/m²	12.6	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	220	MJ/m².yr	5.7	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	5.7
MJ/m².yr	220

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	5.7
MJ/m².yr	220

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	89	W/m²	28	Btu/hr.ft²	423	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	142.4	MJ/m².yr	3.7	kWh/ft².yr		

Sizing Factor 1.00

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.2
MJ/m².yr	47

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.2
MJ/m².yr	47

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.3	L/s.m²	0.84	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	6.1	W/m²	0.56	W/ft²
Fan Design Load VAV	6.1	W/m²	0.56	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.79	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0057	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	48.2	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	1.5	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.6	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	4.7
	MJ/m².yr	181.1

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**25.3** kWh/ft².yr	**979.1** MJ/m².yr		**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	8.9	346.3					
ARCHITECTURAL LIGHTING	0.8	30.1	SPACE HEATING	5.7	219.7		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	1.1	42.2		
OTHER PLUG LOADS	0.6	24.9	DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	4.7	181.1	FOOD SERVICE EQUIPMENT	0.3	10.0		
REFRIGERATION	0.3	10.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	35.0					
ELEVATORS/ESCALATORS							
OUTDOOR LIGHTING	1.3	50.9					

Fuel Specific EUIs for Heating Cooling & DHW

New Food Retail – Island and Isolated

hl

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Food Retail	> 50 kW	New	Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft² .°F	Typical Building Size	2,788 m² / 30,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	1,225 m² / 13,181 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	40%
Window/Wall Ratio (WIWAR) (%)	0.11			
Shading Coefficient (SC)	0.69		Typical # Stories	1
			Floor to Floor Height (m)	6.0 m / 19.7 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45 m²/person	484 ft²/person	%OA	14.35%
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	20 L/s.person	42 CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	3	
Total Air Circulation or Design Air Flow	3.10 L/s.m²	0.61 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	244,121	
Peak Zone Sensible Load	131,093	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	6,098	
Total air circulation or Design air	3.10	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	16.2	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	5000			
Unocc. Period(Hrs./yr.)	3760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	2%	3%			55%	40%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	7.8
	MJ/m².yr	302

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	15.0	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	5000			
Unocc. Period(Hrs./yr.)	3760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					80%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	1.0
	MJ/m².yr	37

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000	Total
% Distribution					
Weighted Average					

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)							0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI		
	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING Overall LP 16.08 W/m²

EUI TOTAL		
	kWh/ft².yr	9
	MJ/m².yr	339

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.65	0.65	0.01	0.01	0.03	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.0 W/m²	0.1 W/m²	1.5 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.00 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	2.9 W/m²	0.3 W/ft²
Total end-use load (unocc. period)	1.7 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

	EUI		
Computer Equipment	EUI	kWh/ft².yr	0.88
		MJ/m².yr	33.97
Plug Loads	EUI	kWh/ft².yr	0.84
		MJ/m².yr	32.51

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

	Natural Gas EUI		All Electric EUI
EUI	kWh/ft².yr	2.6	1.5
	MJ/m².yr	100.0	60.0

REFRIGERATION

Provide description below:

Commercial refrigeration display cases

EUI		
	kWh/ft².yr	29.0
	MJ/m².yr	1125.0

MISCELLANEOUS

EUI		
	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	80%	88%	95%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.25	1.14	1.05	0.31	0.33	0.22	1.00	

Peak Heating Load 31.7 W/m² 10.1 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 172 MJ/m².yr 4.4 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	4.4
MJ/m².yr	172

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	4.4
MJ/m².yr	172

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	HE	Screw Chillers	Reciprocating Chillers Open	DX	Absorption Chillers W. H.	CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.2	4.4	3.2	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.31	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load 26 W/m² 8 Btu/hr.ft² 1475 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 89.0 MJ/m².yr 2.3 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. period) 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.9
MJ/m².yr	34

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.9
MJ/m².yr	34

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 45.5

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	1.3
MJ/m².yr	50

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.1	L/s.m²	0.61	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	4.8	W/m²	0.45	W/ft²
Fan Design Load VAV	4.8	W/m²	0.45	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.51	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.001	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0016	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	42.4	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	4.3
	MJ/m².yr	165.4

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**53.3**	kWh/ft².yr	**2,065.9**	MJ/m².yr	**Gas:**	**#DIV/0!**	kWh/ft².yr	**#DIV/0!**	MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	7.8	301.8					
SECONDARY LIGHTING	1.0	37.1	SPACE HEATING	4.4	172.1		
TERTIARY LIGHTING			SPACE COOLING	0.7	27.6		
OTHER PLUG LOADS	0.8	32.5	DOMESTIC HOT WATER	1.3	50.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	4.3	165.4	FOOD SERVICE EQUIPMENT	1.5	60.0		
REFRIGERATION	29.0	1,125.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	34.0					
ELEVATORS							
OUTDOOR LIGHTING	1.3	50.4					

New Healthcare – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Health Care	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,400	m²	15,064	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.20								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	25.34%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	45	L/s.person	95	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 15%

If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	6			
Total Air Circulation or Design Air Flow	5.92	L/s.m²	1.17	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	396,746	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H.	13.2	ft³/lbm
Design CFM	18,457	
Total air circulation or Design air flo	5.92	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	24	°C	75.2	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (PATIENT ROOMS)

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	10.1	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

							Total
Light Level (Lux)	50	100	200	300			Total
% Distribution				100%			100%
Weighted Average							**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	10%			85%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 1.3; MJ/m².yr 51

SECONDARY LIGHTING (NURSING STATIONS, EXAMINATION ROOMS, LABORATORIES, ICU, RECOVERY)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	16.4	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

							Total
Light Level (Lux)	300	500	700	1000			Total
% Distribution		100%					100%
Weighted Average							**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%			90%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 5.2; MJ/m².yr 202

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING (CORRIDORS, OTHER)

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

							Total
Light Level (Lux)							Total
% Distribution							
Weighted Average							

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%			90%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING Overall LPD 13.87 W/m² EUI TOTAL kWh/ft².yr 7; MJ/m².yr 253

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	40%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment EUI kWh/ft².yr 1.11; MJ/m².yr 43.10

Plug Loads EUI kWh/ft².yr 1.74; MJ/m².yr 67.29

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Commercial food services

Natural Gas EUI: EUI kWh/ft².yr 3.1; MJ/m².yr 120.0

All Electric EUI: EUI kWh/ft².yr 2.1; MJ/m².yr 80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	88%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.14	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load	39.0	W/m²	12.4	Btu/hr.ft²
Seasonal Heating Load (Tertiary Load)	437	MJ/m².yr	11.3	kWh/ft².yr
Sizing Factor	1.00			

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	11.3
MJ/m².yr	437

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	11.3
MJ/m².yr	437

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	6.1	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.16	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load	36	W/m²	11	Btu/hr.ft²	1054	ft²/Ton
Seasonal Cooling Load (Tertiary Load)	126.5	MJ/m².yr	3.3	kWh/ft².yr		

Sizing Factor 0.65 Operation (occ. period 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.9
MJ/m².yr	36

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.9
MJ/m².yr	36

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	88.000	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 118.3

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	3.4
MJ/m².yr	130

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.9	L/s.m²	1.17	CFM/ft²
System Static Pressure CAV	875	Pa	3.5	wg
System Static Pressure VAV	875	Pa	3.5	wg
Fan Efficiency	55%			
Fan Motor Efficiency	89%			
Sizing Factor	1.00			
Fan Design Load CAV	10.6	W/m²	0.98	W/ft²
Fan Design Load VAV	10.6	W/m²	0.98	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.13	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.9	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.59	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	60%			
Pump Motor Efficiency	88%			
Sizing Factor	1.0			
Pump Connected Load	0.36	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0023	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	60%					
Pump Motor Efficiency	88%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	74.3	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.5	kWh/m².yr
Condenser Pump Energy Consumption	0.5	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	7.6
	MJ/m².yr	294.7

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**36.2**	kWh/ft².yr	**1,400.4**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (PATIENT ROC	1.3	51.0
SECONDARY LIGHTING (NURSING !	5.2	201.5
TERTIARY LIGHTING (CORRIDORS,		
OTHER PLUG LOADS	1.7	67.3
HVAC FANS & PUMPS	7.6	294.7
REFRIGERATION	0.4	15.0
MISCELLANEOUS	0.3	10.0
COMPUTER EQUIPMENT	1.1	43.1
ELEVATORS	0.2	7.7
OUTDOOR LIGHTING	0.9	34.9

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	11.3	436.8		
SPACE COOLING	0.7	28.5		
DOMESTIC HOT WATER	3.4	130.0	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	2.1	80.0		

New School – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
School	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	2,300	m²	24,748	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.15								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.2	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person	%OA	8.70%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	3	L/s.person	6	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	2.5			
Total Air Circulation or Design Air Flow	3.45	L/s.m²	0.68	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	421,716	
Peak Zone Sensible Load	233,603	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	10,867	
Total air circulation or Design air	3.45	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	19.5	°C	67.1	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					100%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	2.8
	MJ/m².yr	107

SECONDARY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	16.8	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	20%			10%	50%	0%	85.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	0.7
	MJ/m².yr	26

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 13.50 W/m²

EUI TOTAL	kWh/ft².yr	3
	MJ/m².yr	133

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers		Monitors		Printers		Copiers		Servers		Plug Loads	
Measured Power (W/device)	55		51		100		200		217			
Density (device/occupant)	0.05		0.05		0.02		0.02		0.01			
Connected Load	0.3	W/m²	0.3	W/m²	0.2	W/m²	0.4	W/m²	0.1	W/m²	0.2	W/m²
	0.0	W/ft²	0.0	W/ft²	0.02	W/ft²	0.04	W/ft²	0.01	W/ft²	0.02	W/ft²
Diversity Occupied Period	90%		90%		90%		90%		100%		100%	
Diversity Unoccupied Period	50%		50%		50%		50%		100%		50%	
Operation Occ. Period (hrs./year)	2000		2000		2000		2000		2000		3000	
Operation Unocc. Period (hrs./year)	6760		6760		6760		6760		6760		5760	

Total end-use load (occupied period)	1.3	W/m²	0.1	W/ft²
Total end-use load (unocc. period)	0.8	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	59%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.69
Plug Loads	EUI	kWh/ft².yr	0.11
		MJ/m².yr	4.23

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Cafeteria

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	0.2	kWh/ft².yr	0.1
	MJ/m².yr	8.0	MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Unknown

EUI	kWh/ft².yr	0.1
	MJ/m².yr	3.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.1
	MJ/m².yr	3

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	73%	83%	75%	2.60	3.10	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.37	1.20	1.33	0.38	0.32	0.22	1.00	

Peak Heating Load: 46.6 W/m² — 14.8 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 239 MJ/m².yr — 6.2 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	6.2
MJ/m².yr	239

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	6.2
MJ/m².yr	239

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	3	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.33	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load: 33 W/m² — 11 Btu/hr.ft² — 1138 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 99.8 MJ/m².yr — 2.6 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period): 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 10.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.1
MJ/m².yr	42

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.1
MJ/m².yr	42

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.4	L/s.m²	0.68	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	2.0	W/m²	0.18	W/ft²
Fan Design Load VAV	2.0	W/m²	0.18	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.66	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.20	W/m²	0.02	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0021	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	7.2	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.9	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.7	kWh/m².yr
Circulating Pump Yearly Operation	3000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.8
	MJ/m².yr	31.7

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**12.3** kWh/ft².yr	**475.9** MJ/m².yr		**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr			

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	2.8	107.3					
SECONDARY LIGHTING	0.7	25.5	SPACE HEATING	6.2	239.1		
TERTIARY LIGHTING			SPACE COOLING	0.1	4.2		
OTHER PLUG LOADS	0.1	4.2	DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	0.8	31.7	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	0.1	3.0					
MISCELLANEOUS	0.1	3.0					
COMPUTER EQUIPMENT	0.6	24.7					
ELEVATORS							
OUTDOOR LIGHTING	0.3	10.2					

New Accommodations – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Hotel/Motel	> 50 kW		Island Interconnected
Baseline			

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,500	m²	16,140	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.30								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	3.7	m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50	m²/person	538	ft²/person	%OA 9.00%
Occupancy Schedule Occ. Period	50%				
Occupancy Schedule Unocc. Period	80%				
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	3.33	L/s.m²	0.66	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	679,276	
Peak Zone Sensible Load	403,029	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	18,749	
Total air circulation or Design air	3.33	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	10.4	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300				Total
% Distribution		75%	25%					100%
Weighted Average								**125**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	40%	50%			10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 2.0; MJ/m².yr 79

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	19.4	W/m²	1.8	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	30%	15%			55%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 3.1; MJ/m².yr 120

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 12.65 W/m² — EUI TOTAL kWh/ft².yr 5; MJ/m².yr 199

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load	0.3 W/m²	0.3 W/m²	0.1 W/m²	0.1 W/m²	0.1 W/m²	1.5 W/m²
	0.0 W/ft²	0.0 W/ft²	0.01 W/ft²	0.01 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.9	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	0.9	W/m²	0.1	W/ft²

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Usage during occupied period 100%
Usage during unoccupied period 48%

Computer Equipment	EUI	kWh/ft².yr	0.51
		MJ/m².yr	19.79
Plug Loads	EUI	kWh/ft².yr	0.49
		MJ/m².yr	19.12

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Kitchen services

	Natural Gas EUI	All Electric EUI
EUI kWh/ft².yr	1.3	0.6
MJ/m².yr	50.0	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4; MJ/m².yr 15.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3; MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load	49.6 W/m²	15.7 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	260 MJ/m².yr	6.7 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Gas Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load	46 W/m²	14 Btu/hr.ft²	831 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	83.0 MJ/m².yr	2.1 kWh/ft².yr	

Sizing Factor 0.85 — Operation (occ. period) 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% — Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.8
MJ/m².yr	32

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.8
MJ/m².yr	32

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 236.6

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.3	L/s.m²	0.66	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	1.00			
Fan Design Load CAV	3.2	W/m²	0.29	W/ft²
Fan Design Load VAV	3.2	W/m²	0.29	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.99	W/m²	0.09	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.004	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0029	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	21.1	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	2.3
	MJ/m².yr	87.7

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**24.3** kWh/ft².yr	**942.7** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING (SUITES)	2.0	79.0					
SECONDARY LIGHTING	3.1	120.1	SPACE HEATING	6.7	260.4		
TERTIARY LIGHTING			SPACE COOLING	0.7	25.6		
OTHER PLUG LOADS	0.5	19.1	DOMESTIC HOT WATER	6.7	260.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	2.3	87.7	FOOD SERVICE EQUIPMENT	0.6	25.0		
REFRIGERATION	0.4	15.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	19.8					
ELEVATORS	0.1	3.9					
OUTDOOR LIGHTING	0.4	17.0					

New University/College – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
University/College Baseline	> 50 kW		Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	6,506 m²	70,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	4,500 m²	48,420	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	50%		
Window/Wall Ratio (WIWAR) (%)	0.30				Typical # Stories	2		
Shading Coefficient (SC)	0.65				Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14	m²/person	151	ft²/person	%OA 14.01%
Occupancy Schedule Occ. Period	90%				
Occupancy Schedule Unocc. Period					
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 34%

If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.6			
Total Air Circulation or Design Air Flow	5.10	L/s.m²	1.00	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.40	L/s.m²	0.08	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	944,410	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	43,934	
Total air circulation or Design air	5.10	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.2	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					95%	5%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	4.6
	MJ/m².yr	180

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	10.4	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	15%			80%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	24

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)								Total
% Distribution								
Weighted Average								

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP	12.01 W/m²	EUI TOTAL	kWh/ft².yr	5
			MJ/m².yr	204

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9	W/m²	0.4	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²

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Usage during occupied period	100%
Usage during unoccupied period	55%

Computer Equipment	EUI	kWh/ft².yr	1.43
		MJ/m².yr	55.41
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: | Electricity Fuel Share: 100.0%

Natural Gas EUI			All Electric EUI		
EUI	kWh/ft².yr	0.5	EUI	kWh/ft².yr	0.4
	MJ/m².yr	20.0		MJ/m².yr	15.0

REFRIGERATION

Provide description below:

Unknown

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)							100%	100%
Eff./COP	75%	83%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.20	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load: 37.7 W/m² — 12.0 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 191 MJ/m².yr — 4.9 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	4.9
MJ/m².yr	191

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	4.9
MJ/m².yr	191

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)		25.0%			75.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load: 106 W/m² — 34 Btu/hr.ft² — 357 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 130.9 MJ/m².yr — 3.4 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period: 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 70.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.6
MJ/m².yr	61

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.6
MJ/m².yr	61

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 22.8

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.1	L/s.m²	1.00	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	8.0	W/m²	0.74	W/ft²
Fan Design Load VAV	8.0	W/m²	0.74	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%

Comments:

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.0	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.1	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.12	W/m²	0.20	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.006	L/s.m²	0.008	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.005	L/s.m²	0.0067	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.9	W/m²	0.08	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	37.8	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.2	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.8	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	3.7
	MJ/m².yr	143.2

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**19.4**	kWh/ft².yr	**751.5**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.6	179.8
SECONDARY LIGHTING	0.6	23.8
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	3.7	143.2
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.3	10.0
COMPUTER EQUIPMENT	1.4	55.4
ELEVATORS	0.1	3.9
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	4.9	190.8		
SPACE COOLING	1.1	42.4		
DOMESTIC HOT WATER	0.6	25.0	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	0.4	15.0		

New Warehouse/Wholesale – Island and Isolated

COMMERCIAL SECTOR BUILDING PROFILE

NEW BUILDINGS:	SIZE:	VINTAGE:	REGION:
Warehouse/Wholesale Baseline	> 50 kW		Island Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,253	m²	35,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	3,253	m²	35,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	40%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA	11.85%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) | 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	1.69	L/s.m²	0.33	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m²	CFM/ft²
Operation occupied period	50%	
Operation unoccupied period	50%	

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	385,114	
Peak Zone Sensible Load	250,057	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	11,633	
Total air circulation or Design air	1.69	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	14.1	W/m²	1.3	W/ft²
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					15%	75%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	5.3
	MJ/m².yr	207

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	10.1	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	10%			85%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	0.2
	MJ/m².yr	7

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 13.91 W/m²

EUI TOTAL	kWh/ft².yr	5.5
	MJ/m².yr	214

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m²	0.3 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.19 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m²	0.2 W/ft²
Total end-use load (unocc. period)	1.0 W/m²	0.1 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	39%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	0.46
		MJ/m².yr	17.72
Plug Loads	EUI	kWh/ft².yr	0.83
		MJ/m².yr	32.15

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: ____ Electricity Fuel Share: 100.0%

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr		kWh/ft².yr	0.1
	MJ/m².yr		MJ/m².yr	4.0

REFRIGERATION

Provide description below:

Large refrigeration storage

EUI	kWh/ft².yr	1.5
	MJ/m².yr	60.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Hot Water System						Electric	
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	75%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.33	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load: 33.8 W/m² — 10.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 183 MJ/m².yr — 4.7 kWh/ft².yr
Sizing Factor: 1.00
Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	4.7
MJ/m².yr	183

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	4.7
MJ/m².yr	183

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load: 35 W/m² — 11 Btu/hr.ft² — 1091 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 59.3 MJ/m².yr — 1.5 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. perioc 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 10.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 18.2

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	1.7	L/s.m²	0.33	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.1	W/m²	0.10	W/ft²
Fan Design Load VAV	1.1	W/m²	0.10	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.69	W/m²	0.06	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0022	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	6.5	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.3	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	0.8
	MJ/m².yr	29.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**15.2** kWh/ft².yr	**590.1** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	5.3	206.9					
SECONDARY LIGHTING	0.2	7.0	SPACE HEATING	4.7	183.5		
TERTIARY LIGHTING			SPACE COOLING	0.1	2.5		
OTHER PLUG LOADS	0.8	32.1	DOMESTIC HOT WATER	0.5	20.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	0.8	29.3	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	1.5	60.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	17.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

New Office – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.42 W/m².°C	0.07 Btu/hr.ft² .°F	Typical Building Size	1,394 m²	15,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	697 m²	7,500 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2	
			Percent Conditioned Space	100%	
			Percent Conditioned Space Defined as Exterior Zone	45%	
Window/Wall Ratio (WIWAR) (%)	0.35				
Shading Coefficient (SC)	0.58		Typical # Stories	2	
			Floor to Floor Height (m)	3.7 m	12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	26 m²/person	274 ft²/person	%OA 6.64%
Occupancy Schedule Occ. Period	90%		
Occupancy Schedule Unocc. Period			
Fresh Air Requirements or Outside Air	8 L/s.person	16 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: L/s.m² CFM/ft² operation (%)

Sizing Factor	1.5	
Total Air Circulation or Design Air Flow	4.43 L/s.m²	0.87 CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.40 L/s.m²	0.08 CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	280,505	
Peak Zone Sensible Load	187,543	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	8,725	
Total air circulation or Design air	4.43	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				98%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	23	°C	73.4	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	23	°C	73.4	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	3300			
Unocc. Period(Hrs./yr.)	5460			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					100%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI: 4.6 kWh/ft².yr; 177 MJ/m².yr

ARCHITECTURAL LIGHTING

Light Level	350	Lux	32.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	16.6	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	3400			
Unocc. Period(Hrs./yr.)	5360			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	40%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	200	300	400	500				Total
% Distribution	10%	40%	40%	10%				100%
Weighted Average								**350**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	30%			40%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI: 0.8 kWh/ft².yr; 32 MJ/m².yr

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								

	INC	CFL	T12	T8		MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI: kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 13.29 W/m² — EUI TOTAL: 5 kWh/ft².yr; 209 MJ/m².yr

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	50	
Density (device/occupant)	0.9	0.9	0.15	0.1	0.26	
Connected Load (W/m²)	1.9	1.8	0.6	0.8	0.5	1.5
Connected Load (W/ft²)	0.2	0.2	0.05	0.07	0.05	0.14
Diversity Occupied Period	80%	80%	80%	80%	100%	80%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	2500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	6260

Total end-use load (occupied period)	5.8	W/m²	0.5	W/ft²
Total end-use load (unocc. period)	3.8	W/m²	0.4	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	66%			

Computer Equipment EUI: 2.77 kWh/ft².yr; 107.44 MJ/m².yr

Plug Loads EUI: 0.72 kWh/ft².yr; 27.70 MJ/m².yr

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Kitchen

Natural Gas EUI: 0.1 kWh/ft².yr; 5.0 MJ/m².yr

All Electric EUI: 0.10 kWh/ft².yr; 4.00 MJ/m².yr

REFRIGERATION

Provide description below:

Lunch room/cafeteria/restaurant

EUI: 0.10 kWh/ft².yr; 4.00 MJ/m².yr

MISCELLANEOUS

EUI: 0.52 kWh/ft².yr; 20.00 MJ/m².yr

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				Total
	Boilers		Packaged	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
	Stan.	High	Unit					
System Present (%)							100%	100%
Eff./COP	70%	80%	75%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.43	1.25	1.33	0.59	0.33	0.22	1.00	

Peak Heating Load 56.5 W/m² 17.9 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 479 MJ/m².yr 12.4 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	12.4
MJ/m².yr	479

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	12.4
MJ/m².yr	479

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		WSHP	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE		Open	DX	W. H.	CW	
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	3.5	3.5	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.29	0.29	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load 59 W/m² 19 Btu/hr.ft² 642 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 77.0 MJ/m².yr 2.0 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 90.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.8
MJ/m².yr	30

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.94

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	24

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.4	L/s.m²	0.87	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	52%			
Fan Motor Efficiency	85%			
Sizing Factor	1.00			
Fan Design Load CAV	5.0	W/m²	0.47	W/ft²
Fan Design Load VAV	5.0	W/m²	0.47	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.3	L/s.m²	0.06	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.4	L/s.m²	0.08	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	40%			
Fan Motor Efficiency	80%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.018	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.06	W/m²	0.10	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33.333333	ft
Pump Efficiency	55%			
Pump Motor Efficiency	90%			
Sizing Factor	1.0			
Pump Connected Load	0.63	W/m²	0.06	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0037	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	150	kPa	50	ft		
Pump Efficiency	55%					
Pump Motor Efficiency	90%					
Sizing Factor	0.5					
Pump Connected Load	0.4	W/m²	0.04	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	30.4	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.3	kWh/m².yr
Condenser Pump Energy Consumption	0.7	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	5000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	3.1
	MJ/m².yr	121.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**27.3**	kWh/ft².yr	**1,056.3**	MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	4.6	176.9					
ARCHITECTURAL LIGHTING	0.8	32.2	SPACE HEATING	12.4	479.4		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.7	27.1		
OTHER PLUG LOADS	0.7	27.7	DOMESTIC HOT WATER	0.6	24.2	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	3.1	121.3	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	0.1	4.0					
MISCELLANEOUS	0.5	20.0					
COMPUTER EQUIPMENT	2.8	107.4					
ELEVATORS							
OUTDOOR LIGHTING	0.8	32.2					

New Non Food Retail – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929	m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	929	m²	10,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.10								
Shading Coefficient (SC)	0.78				Typical # Stories	1			
					Floor to Floor Height (m)	6.0	m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	25	m²/person	269	ft²/person	%OA	10.33%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	15	L/s.person	32	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	1.4			
Total Air Circulation or Design Air Flow	5.81	L/s.m²	1.14	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA)	L/s.m²	CFM/ft²
Operation occupied period	50%	
Operation unoccupied period	50%	

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	293,537	
Peak Zone Sensible Load	175,641	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	8,171	
Total air circulation or Design air	5.81	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	20.6	W/m²	1.9	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	5%			55%	30%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	8.9
	MJ/m².yr	346

ARCHITECTURAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	26.1	W/m²	2.4	W/ft²
Occ. Period(Hrs./yr.)	4500			
Unocc. Period(Hrs./yr.)	4260			
Usage During Occupied Period	95%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	10%	10%			20%	60%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	0.8
	MJ/m².yr	30

SPECIAL PURPOSE LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000	Total
% Distribution					
Weighted Average					

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)								
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LP 20.88 W/m²

EUI TOTAL	kWh/ft².yr	10
	MJ/m².yr	376

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.36	0.36	0.01	0.01	0.02	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.1 W/m²	0.1 W/m²	1.15 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.01 W/ft²	0.01 W/ft²	0.11 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	4660

Total end-use load (occupied period)	2.6	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	1.5	W/m²	0.1	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	58%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

	EUI		
Computer Equipment	EUI	kWh/ft².yr	0.90
		MJ/m².yr	34.97
Plug Loads	EUI	kWh/ft².yr	0.64
		MJ/m².yr	24.92

FOOD SERVICE EQUIPMENT

5

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Small restaurants, food courts, kitchenettes

	Natural Gas EUI		All Electric EUI	
EUI	kWh/ft².yr	0.4	kWh/ft².yr	0.3
	MJ/m².yr	15.0	MJ/m².yr	10.0

REFRIGERATION

Provide description below:

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.50	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.29	0.22	1.00	

Peak Heating Load: 49.4 W/m² — 15.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 394 MJ/m².yr — 10.2 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	10.2
MJ/m².yr	394

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	10.2
MJ/m².yr	394

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Recprocting Chillers Open	Recprocting Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.8	5.4	4.4	3.7	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.27	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	14.0	57.2

Peak Cooling Load: 93 W/m² — 29 Btu/hr.ft² — 409 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 95.2 MJ/m².yr — 2.5 kWh/ft².yr

Sizing Factor: 1.00

A/C Saturation (Incidence of A/C): 90.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

All Electric EUI	
kWh/ft².yr	0.8
MJ/m².yr	31

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.8
MJ/m².yr	31

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 17.3

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	19

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.8	L/s.m²	1.14	CFM/ft²
System Static Pressure CAV	500	Pa	2.0	wg
System Static Pressure VAV	500	Pa	2.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	5.5	W/m²	0.51	W/ft²
Fan Design Load VAV	5.5	W/m²	0.51	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	50	L/s.washroom	106	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.85	W/m²	0.17	W/ft²

Condenser Pump

Pump Design Flow		L/s.KW		U.S. gpm/Ton
Pump Design Flow per unit floor area		L/s.m²		U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0059	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5500	hrs./year
Supply Fan Unocc. Period	3260	hrs./year
Supply Fan Energy Consumption	43.7	kWh/m².yr
Exhaust Fan Occ. Period	5500	hrs./year
Exhaust Fan Unocc. Period	3260	hrs./year
Exhaust Fan Energy Consumption	2.0	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	4.3
	MJ/m².yr	165.9

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**29.0** kWh/ft².yr	**1,124.5** MJ/m².yr		**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	8.9	346.3					
ARCHITECTURAL LIGHTING	0.8	30.1	SPACE HEATING	10.2	394.1		
SPECIAL PURPOSE LIGHTING			SPACE COOLING	0.7	28.3		
OTHER PLUG LOADS	0.6	24.9	DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	4.3	165.9	FOOD SERVICE EQUIPMENT	0.3	10.0		
REFRIGERATION	0.3	10.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	35.0					
ELEVATORS/ESCALATORS							
OUTDOOR LIGHTING	1.3	50.9					
Fuel Specific EUIs for Heating Cooling & DHW							

New Food Retail – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	929 m²	10,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,225 m²	13,181	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	40%		
Window/Wall Ratio (WIWAR) (%)	0.11							
Shading Coefficient (SC)	0.69				Typical # Stories	1		
					Floor to Floor Height (m)	6.0 m	19.7	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	45	m²/person	484	ft²/person	%OA	4.02%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	3			
Total Air Circulation or Design Air Flow	11.05	L/s.m²	2.18	CFM/ft²
Infiltration Rate (air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)	0.70	L/s.m²	0.14	CFM/ft²

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	268,904	
Peak Zone Sensible Load	155,876	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	7,251	
Total air circulation or Design air	11.05	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	16.2	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	5000			
Unocc. Period(Hrs./yr.)	3760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	600	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	2%	3%			55%	40%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 7.8
MJ/m².yr 302

SECONDARY LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	15.0	W/m²	1.4	W/ft²
Occ. Period(Hrs./yr.)	5000			
Unocc. Period(Hrs./yr.)	3760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					80%	20%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 1.0
MJ/m².yr 37

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 | 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)							0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr
MJ/m².yr

TOTAL LIGHTING Overall LP 16.08 W/m²

EUI TOTAL kWh/ft².yr 9
MJ/m².yr 339

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.65	0.65	0.01	0.01	0.03	
Connected Load	0.8 W/m²	0.7 W/m²	0.0 W/m²	0.0 W/m²	0.1 W/m²	1.5 W/m²
	0.1 W/ft²	0.1 W/ft²	0.00 W/ft²	0.00 W/ft²	0.01 W/ft²	0.14 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	2.9 W/m²	0.3 W/ft²
Total end-use load (unocc. period)	1.7 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	58%	

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Computer Equipment EUI kWh/ft².yr 0.88
MJ/m².yr 33.97

Plug Loads EUI kWh/ft².yr 0.84
MJ/m².yr 32.51

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: | Electricity Fuel Share: 100.0%

Natural Gas EUI: EUI kWh/ft².yr 2.6; MJ/m².yr 100.0

All Electric EUI: EUI kWh/ft².yr 1.5; MJ/m².yr 60.0

REFRIGERATION

Provide description below:

Commercial refrigeration display cases

EUI kWh/ft².yr 25.8
MJ/m².yr 1000.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3
MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	80%	88%	95%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.25	1.14	1.05	0.31	0.33	0.22	1.00	

Peak Heating Load: 31.7 W/m² — 10.1 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load): 260 MJ/m².yr — 6.7 kWh/ft².yr
Sizing Factor: 1.00

Electric Fuel Share: 100.0% — Gas Fuel Share: — Oil Fuel Share:

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	4.7	5.2	4.4	3.2	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.31	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	13.0	°C	55.4	°F

Peak Cooling Load: 85 W/m² — 27 Btu/hr.ft² — 446 ft²/Ton
Seasonal Cooling Load (Tertiary Load): 61.8 MJ/m².yr — 1.6 kWh/ft².yr

Sizing Factor: 1.00 — Operation (occ. period) 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C): 80.0%

Electric Fuel Share: 100.0% — Gas Fuel Share:

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.7
MJ/m².yr	27

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.7
MJ/m².yr	27

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load): 45.5

Wetting Use Percentage: 90%

All Electric EUI	
kWh/ft².yr	1.3
MJ/m².yr	50

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	11.0	L/s.m²	2.18	CFM/ft²
System Static Pressure CAV	350	Pa	1.4	wg
System Static Pressure VAV	350	Pa	1.4	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	8.1	W/m²	0.75	W/ft²
Fan Design Load VAV	8.1	W/m²	0.75	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	100%		100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.2	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.3	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.4	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.70	W/m²	0.16	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.004	L/s.m²	0.007	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.004	L/s.m²	0.0054	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	5000	hrs./year
Supply Fan Unocc. Period	3760	hrs./year
Supply Fan Energy Consumption	70.6	kWh/m².yr
Exhaust Fan Occ. Period	5000	hrs./year
Exhaust Fan Unocc. Period	3760	hrs./year
Exhaust Fan Energy Consumption	3.1	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	6.9
	MJ/m².yr	266.3

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**54.8** kWh/ft².yr	**2,123.9** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	7.8	301.8					
SECONDARY LIGHTING	1.0	37.1	SPACE HEATING	6.7	260.0		
TERTIARY LIGHTING			SPACE COOLING	0.6	21.7		
OTHER PLUG LOADS	0.8	32.5	DOMESTIC HOT WATER	1.3	50.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	6.9	266.3	FOOD SERVICE EQUIPMENT	1.5	60.0		
REFRIGERATION	25.8	1,000.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.9	34.0					
ELEVATORS							
OUTDOOR LIGHTING	1.3	50.4					

New Healthcare – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	8,829	m²	95,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,400	m²	15,064	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	2			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	45%			
Window/Wall Ratio (WIWAR) (%)	0.20								
Shading Coefficient (SC)	0.65				Typical # Stories	3			
					Floor to Floor Height (m)	4.3	m	14.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	30	m²/person	323	ft²/person	%OA	23.95%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period	75%					
Fresh Air Requirements or Outside Air	35	L/s.person	74	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² | 0.10 CFM/ft² | 50% operation (%)

Sizing Factor	5			
Total Air Circulation or Design Air Flow	4.87	L/s.m²	0.96	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² | CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	391,725	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.H.	13.2	ft³/lbm
Design CFM	18,223	
Total air circulation or Design air flo	4.87	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	14	°C	57.2	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	24	°C	75.2	°F	16.5	°C	61.7	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	22	°C	71.6	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (PATIENT ROOMS)

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (GLFF)	0.40			
Connected Load	10.1	W/m²	0.9	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	40%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300	Total
% Distribution				100%	100%
Weighted Average					**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	10%			85%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	1.3
	MJ/m².yr	51

SECONDARY LIGHTING (NURSING STATIONS, EXAMINATION ROOMS, LABORATORIES, ICU, RECOVERY)

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (ALFF)	0.60			
Connected Load	16.4	W/m²	1.5	W/ft²
Occ. Period(Hrs./yr.)	8760			
Unocc. Period(Hrs./yr.)				
Usage During Occupied Period	65%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution		100%			100%
Weighted Average					**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%			90%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI = Load X Hrs. X SF X GLFF

EUI	kWh/ft².yr	5.2
	MJ/m².yr	202

TERTIARY LIGHTING (CORRIDORS, OTHER)

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)					Total
% Distribution					
Weighted Average					

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	5%			90%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING

Overall LPD 13.87 W/m²

EUI TOTAL	kWh/ft².yr	7
	MJ/m².yr	253

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.48	0.48	0.02	0.02	0.04	
Connected Load	0.9 W/m²	0.8 W/m²	0.1 W/m²	0.1 W/m²	0.3 W/m²	3.85 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.01 W/ft²	0.02 W/ft²	0.36 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	4100
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	4660

Total end-use load (occupied period)	5.4 W/m²	0.5 W/ft²
Total end-use load (unocc. period)	2.2 W/m²	0.2 W/ft²
Usage during occupied period	100%	
Usage during unoccupied period	40%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	1.11
		MJ/m².yr	43.10
Plug Loads	EUI	kWh/ft².yr	1.74
		MJ/m².yr	67.29

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Commercial food services

Natural Gas EUI			All Electric EUI		
EUI	kWh/ft².yr	3.1	EUI	kWh/ft².yr	2.1
	MJ/m².yr	120.0		MJ/m².yr	80.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI	kWh/ft².yr	0.4
	MJ/m².yr	15.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	88%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.14	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load 32.4 W/m² 10.3 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 646 MJ/m².yr 16.7 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	16.7
MJ/m².yr	646

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	16.7
MJ/m².yr	646

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		50.0%			50.0%			100.0%
COP	4.7	6.1	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.16	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7	°C	44.6	°F
Condenser Water	30	°C	86	°F
Supply Air	14.0	°C	57.2	°F

Peak Cooling Load 30 W/m² 9 Btu/hr.ft² 1266 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 66.1 MJ/m².yr 1.7 kWh/ft².yr

Sizing Factor 0.65 Operation (occ. period) 3000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	88.000	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 118.3

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	3.4
MJ/m².yr	130

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.9	L/s.m²	0.96	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	55%			
Fan Motor Efficiency	89%			
Sizing Factor	1.00			
Fan Design Load CAV	7.5	W/m²	0.69	W/ft²
Fan Design Load VAV	7.5	W/m²	0.69	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	80%	20%	100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	75%	25%	75%	25%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.5	L/s.m²	0.10	CFM/ft²
Total Building Exhaust	0.6	L/s.m²	0.13	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.9	W/m²	0.08	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.017	kW/kW	0.06	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.49	W/m²	0.05	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.002	U.S. gpm/ft²
Pump Head Pressure	100	kPa	33	ft
Pump Efficiency	60%			
Pump Motor Efficiency	88%			
Sizing Factor	1.0			
Pump Connected Load	0.30	W/m²	0.03	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.001	L/s.m²	0.0019	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	60%					
Pump Motor Efficiency	88%					
Sizing Factor	0.8					
Pump Connected Load	0.2	W/m²	0.02	W/ft²		

Supply Fan Occ. Period	4000	hrs./year
Supply Fan Unocc. Period	4760	hrs./year
Supply Fan Energy Consumption	52.3	kWh/m².yr
Exhaust Fan Occ. Period	4000	hrs./year
Exhaust Fan Unocc. Period	4760	hrs./year
Exhaust Fan Energy Consumption	6.5	kWh/m².yr
Condenser Pump Energy Consumption	0.3	kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	5.5
	MJ/m².yr	213.9

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**39.0**	kWh/ft².yr	**1,512.1**	MJ/m².yr	**Gas:**	**#DIV/0!**	kWh/ft².yr	**#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity		Gas	
				kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING (PATIENT ROC	1.3	51.0					
SECONDARY LIGHTING (NURSING S	5.2	201.5	SPACE HEATING	16.7	645.8		
TERTIARY LIGHTING (CORRIDORS,			SPACE COOLING	0.4	15.7		
OTHER PLUG LOADS	1.7	67.3	DOMESTIC HOT WATER	3.4	130.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	5.5	213.9	FOOD SERVICE EQUIPMENT	2.1	80.0		
REFRIGERATION	0.4	15.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	1.1	43.1					
ELEVATORS	0.1	3.9					
OUTDOOR LIGHTING	0.9	34.9					

New School – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	3,717	m²	40,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	2,300	m²	24,748	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	5			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	50%			
Window/Wall Ratio (WIWAR) (%)	0.15								
Shading Coefficient (SC)	0.65				Typical # Stories	1			
					Floor to Floor Height (m)	3.7	m	12.2	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	10	m²/person	108	ft²/person	%OA	12.99%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	4	L/s.person	8	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3) (1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air): 1

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	2			
Total Air Circulation or Design Air Flow	3.08	L/s.m²	0.61	CFM/ft²
Infiltration Rate	0.42	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	493,895	
Peak Zone Sensible Load	260,673	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	12,127	
Total air circulation or Design air	3.08	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	21	°C	69.8	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	19.5	°C	67.1	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.85			
Connected Load	12.9	W/m²	1.2	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					100%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 2.8; MJ/m².yr 107

SECONDARY LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (ALFF)	0.15			
Connected Load	16.8	W/m²	1.6	W/ft²
Occ. Period(Hrs./yr.)	2000			
Unocc. Period(Hrs./yr.)	6760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	400	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**400**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	20%			10%	50%	0%	85.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 0.7; MJ/m².yr 26

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Floor fraction check: should = 1.00 — 1.00

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period				
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)						Total
% Distribution						
Weighted Average						

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr; MJ/m².yr

TOTAL LIGHTING — Overall LP 13.50 W/m² — EUI TOTAL kWh/ft².yr 3; MJ/m².yr 133

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.05	0.05	0.02	0.02	0.01	
Connected Load	0.3 W/m²	0.3 W/m²	0.2 W/m²	0.4 W/m²	0.1 W/m²	0.2 W/m²
	0.0 W/ft²	0.0 W/ft²	0.02 W/ft²	0.04 W/ft²	0.01 W/ft²	0.02 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5760

Total end-use load (occupied period)	1.3	W/m²	0.1	W/ft²
Total end-use load (unocc. period)	0.8	W/m²	0.1	W/ft²

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Usage during occupied period 100%
Usage during unoccupied period 59%

Computer Equipment EUI kWh/ft².yr 0.64; MJ/m².yr 24.69
Plug Loads EUI kWh/ft².yr 0.11; MJ/m².yr 4.23

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: — Electricity Fuel Share: 100.0%

Cafeteria

Natural Gas EUI: EUI kWh/ft².yr 0.2; MJ/m².yr 8.0

All Electric EUI: EUI kWh/ft².yr 0.1; MJ/m².yr 4.0

REFRIGERATION

Provide description below:

Unknown

EUI kWh/ft².yr 0.1; MJ/m².yr 3.0

MISCELLANEOUS

EUI kWh/ft².yr 0.1; MJ/m².yr 3

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	73%	83%	75%	2.60	3.10	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.37	1.20	1.33	0.38	0.32	0.22	1.00	

Peak Heating Load	46.6 W/m²	14.8 Btu/hr.ft²	
Seasonal Heating Load (Tertiary Load)	346 MJ/m².yr	8.9 kWh/ft².yr	
Sizing Factor	1.00		
Electric Fuel Share	100.0%	Gas Fuel Share	Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	8.9		8.9
MJ/m².yr	346		346

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)					100.0%			100.0%
COP	2.5	5.4	4.4	3.6	3	0.9	1	
Performance (1 / COP) (kW/kW)	0.40	0.19	0.23	0.28	0.33	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load	39 W/m²	12 Btu/hr.ft²	972 ft²/Ton
Seasonal Cooling Load (Tertiary Load)	73.7 MJ/m².yr	1.9 kWh/ft².yr	

Sizing Factor 1.00 — Operation (occ. perio 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 10.0%

Electric Fuel Share 100.0% — Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenand

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.8		0.8
MJ/m².yr	32		32

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 17.3

Wetting Use Percentage 90%

	All Electric EUI	Natural Gas EUI	Market Composite EUI
kWh/ft².yr	0.5	#DIV/0!	#DIV/0!
MJ/m².yr	19	#DIV/0!	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	3.1	L/s.m²	0.61	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	88%			
Sizing Factor	1.00			
Fan Design Load CAV	1.7	W/m²	0.16	W/ft²
Fan Design Load VAV	1.7	W/m²	0.16	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	25%	75%	25%	75%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.78	W/m²	0.07	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure	45	kPa	15	ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load	0.23	W/m²	0.02	W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0025	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.3	W/m²	0.03	W/ft²		

Supply Fan Occ. Period	2000	hrs./year
Supply Fan Unocc. Period	6760	hrs./year
Supply Fan Energy Consumption	6.5	kWh/m².yr
Exhaust Fan Occ. Period	2000	hrs./year
Exhaust Fan Unocc. Period	6760	hrs./year
Exhaust Fan Energy Consumption	0.9	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	3000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI		
	kWh/ft².yr	0.7
	MJ/m².yr	28.3

EUI SUMMARY

TOTAL ALL END-USES: **Electricity:** **14.9** kWh/ft².yr **578.5** MJ/m².yr **Gas:** **#DIV/0!** kWh/ft².yr **#DIV/0!** MJ/m².yr

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	2.8	107.3
SECONDARY LIGHTING	0.7	25.5
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.1	4.2
HVAC FANS & PUMPS	0.7	28.3
REFRIGERATION	0.1	3.0
MISCELLANEOUS	0.1	3.0
COMPUTER EQUIPMENT	0.6	24.7
ELEVATORS		
OUTDOOR LIGHTING	0.3	10.2

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	8.9	346.2		
SPACE COOLING	0.1	3.2		
DOMESTIC HOT WATER	0.5	19.0	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	0.1	4.0		

New Accommodations – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28 W/m².°C	0.05 Btu/hr.ft² .°F	Typical Building Size	1,859 m² / 20,000 ft²
Roof U value (W/m².°C)	0.19 W/m².°C	0.03 Btu/hr.ft² .°F	Typical Footprint (m²)	1,500 m² / 16,140 ft²
Glazing U value (W/m².°C)	2.80 W/m².°C	0.49 Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	4
			Percent Conditioned Space	100%
			Percent Conditioned Space Defined as Exterior Zone	45%
Window/Wall Ratio (WIWAR) (%)	0.30			
Shading Coefficient (SC)	0.65		Typical # Stories	2
			Floor to Floor Height (m)	3.7 m / 12.0 ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	FCoils	IU	100% O.A	TOTAL
System Present (%)	90%				10%				100%
Min. Air Flow (%)					60%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	50 m²/person	538 ft²/person	%OA 6.26%
Occupancy Schedule Occ. Period	50%		
Occupancy Schedule Unocc. Period	80%		
Fresh Air Requirements or Outside Air	15 L/s.person	32 CFM/person	

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)
If Fresh Air Control Type = "2" enter % FA. to the right: 15%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² / 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1.4	
Total Air Circulation or Design Air Flow	4.79 L/s.m²	0.94 CFM/ft²
Infiltration Rate	0.70 L/s.m²	0.14 CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² / CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	474,086	
Peak Zone Sensible Load	289,922	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	13,487	
Total air circulation or Design air	4.79	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional		PI / PID	Total
Control Mode				
	Fixed Discharge		Reset	
Control Strategy				

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	15	°C	59	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING (SUITES)

Light Level	125	Lux	11.6	ft-candles
Floor Fraction (GLFF)	0.75			
Connected Load	10.4	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	2500			
Unocc. Period(Hrs./yr.)	6260			
Usage During Occupied Period	50%			
Usage During Unoccupied Period	25%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	50	100	200	300	Total
% Distribution		75%	25%		100%
Weighted Average					**125**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	40%	50%			10%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 2.0
MJ/m².yr 79

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.25			
Connected Load	19.4	W/m²	1.8	W/ft²
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	85%			
Usage During Unoccupied Period	75%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000	Total
% Distribution	100%				100%
Weighted Average					**300**

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	30%	15%			55%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr 3.1
EUI = Load X Hrs. X SF X GLFF MJ/m².yr 120

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 — 1.00

Light Level (Lux)					Total
% Distribution					
Weighted Average					

	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft².yr
MJ/m².yr

TOTAL LIGHTING — Overall LP 12.65 W/m² — EUI TOTAL kWh/ft².yr 5; MJ/m².yr 199

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	55	51	100	200	217	
Density (device/occupant)	0.3	0.3	0.05	0.033	0.02	
Connected Load (W/m²)	0.3	0.3	0.1	0.1	0.1	1.5
Connected Load (W/ft²)	0.0	0.0	0.01	0.01	0.01	0.14
Diversity Occupied Period	90%	90%	90%	90%	100%	70%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2500	3000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6260	5760

Total end-use load (occupied period)	1.9	W/m²	0.2	W/ft²
Total end-use load (unocc. period)	0.9	W/m²	0.1	W/ft²

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Usage during occupied period 100%
Usage during unoccupied period 48%

Computer Equipment EUI kWh/ft².yr 0.51; MJ/m².yr 19.79
Plug Loads EUI kWh/ft².yr 0.49; MJ/m².yr 19.12

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: ___ Electricity Fuel Share: 100.0%

Kitchen services

	Natural Gas EUI	All Electric EUI
EUI kWh/ft².yr	1.3	0.6
MJ/m².yr	50.0	25.0

REFRIGERATION

Provide description below:

Walk-in coolers/freezers, reach-in coolers/freezers, refrigerated buffet cases

EUI kWh/ft².yr 0.4
MJ/m².yr 15.0

MISCELLANEOUS

EUI kWh/ft².yr 0.3
MJ/m².yr 10

SPACE HEATING

Heating Plant Type

	Natural Gas Boilers Stan.	Natural Gas Boilers High	Natural Gas Packaged Unit	Electric A/A HP	Electric W. S. HP	Electric H/R Chiller	Electric Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	80%	75%	3.20	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.25	1.33	0.31	0.33	0.22	1.00	

Peak Heating Load 51.2 W/m² — 16.2 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 399 MJ/m².yr — 10.3 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% — Gas Fuel Share — Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	10.3
MJ/m².yr	399

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	10.3
MJ/m².yr	399

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		20.0%			80.0%			100.0%
COP	4.7	5.4	4.4	3.5	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.29	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load 64 W/m² — 20 Btu/hr.ft² — 596 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 60.3 MJ/m².yr — 1.6 kWh/ft².yr

Sizing Factor 0.85 — Operation (occ. period) 4000 hrs/year — Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 80.0%

Electric Fuel Share 100.0% — Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 236.6

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	6.7
MJ/m².yr	260

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	4.8	L/s.m²	0.94	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	45%			
Fan Motor Efficiency	70%			
Sizing Factor	1.00			
Fan Design Load CAV	4.6	W/m²	0.42	W/ft²
Fan Design Load VAV	4.6	W/m²	0.42	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	60%	40%	100%	
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.1	L/s.m²	0.03	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.05	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.022	kW/kW	0.08	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	1.38	W/m²	0.13	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.003	L/s.m²	0.005	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.003	L/s.m²	0.0040	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	33	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.5	W/m²	0.05	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	30.4	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	2.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.4	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	3.1
	MJ/m².yr	120.6

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**28.5** kWh/ft².yr	**1,104.3** MJ/m².yr		**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr	

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING (SUITES)	2.0	79.0					
SECONDARY LIGHTING	3.1	120.1	SPACE HEATING	10.3	399.0		
TERTIARY LIGHTING			SPACE COOLING	0.5	19.7		
OTHER PLUG LOADS	0.5	19.1	DOMESTIC HOT WATER	6.7	260.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	3.1	120.6	FOOD SERVICE EQUIPMENT	0.6	25.0		
REFRIGERATION	0.4	15.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	19.8					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

New University/College – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	6,506 m²	70,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	4,500 m²	48,420	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	7		
					Percent Conditioned Space	100%		
					Percent Conditioned Space Defined as Exterior Zone	50%		
Window/Wall Ratio (WIWAR) (%)	0.30							
Shading Coefficient (SC)	0.65				Typical # Stories	2		
					Floor to Floor Height (m)	3.7 m	12.0	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	50%				50%				100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	14	m²/person	151	ft²/person
Occupancy Schedule Occ. Period	90%			
Occupancy Schedule Unocc. Period				
Fresh Air Requirements or Outside Air	10	L/s.person	21	CFM/person

%OA 13.97%

Fresh Air Control Type *(enter a 1, 2 or 3) 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right: 34%
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation 0.5 L/s.m² 0.10 CFM/ft²
50% operation (%)

Sizing Factor	1.6			
Total Air Circulation or Design Air Flow	5.11	L/s.m²	1.01	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA) L/s.m² CFM/ft²
Operation occupied period 50%
Operation unoccupied period 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	#######	
Peak Zone Sensible Load	947,002	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	44,054	
Total air circulation or Design air	5.11	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	24	°C	75.2	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	22	°C	71.6	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning Changes/Year

Incidence of Annual Room Controls Maintenance

Incidence of Annual HVAC Controls Maintenance

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	500	Lux	46.5	ft-candles
Floor Fraction (GLFF)	0.90			
Connected Load	12.2	W/m²	1.1	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	90%			
Usage During Unoccupied Period	20%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution		100%						100%
Weighted Average								**500**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					95%	5%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	4.6
	MJ/m².yr	180

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.10			
Connected Load	10.4	W/m²	1.0	W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	50%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	15%			80%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	0.6
	MJ/m².yr	24

EUI = Load X Hrs. X SF X GLFF

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m²		W/ft²
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)								Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%				100%	0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI	kWh/ft².yr	
	MJ/m².yr	

TOTAL LIGHTING — Overall LP 12.01 W/m²

EUI TOTAL	kWh/ft².yr	5
	MJ/m².yr	204

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.31	0.31	0.02	0.02	0.01	
Connected Load	1.2 W/m²	1.1 W/m²	0.1 W/m²	0.3 W/m²	0.1 W/m²	1.3 W/m²
	0.1 W/ft²	0.1 W/ft²	0.01 W/ft²	0.03 W/ft²	0.01 W/ft²	0.12 W/ft²
Diversity Occupied Period	90%	90%	90%	90%	100%	100%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	50%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2600	2000
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6160	6760

Total end-use load (occupied period)	3.9	W/m²	0.4	W/ft²
Total end-use load (unocc. period)	2.2	W/m²	0.2	W/ft²
Usage during occupied period	100%			
Usage during unoccupied period	55%			

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment	EUI	kWh/ft².yr	1.43
		MJ/m².yr	55.41
Plug Loads	EUI	kWh/ft².yr	0.65
		MJ/m².yr	25.18

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: [ ] Electricity Fuel Share: 100.0%

	Natural Gas EUI			All Electric EUI	
EUI	kWh/ft².yr	0.5	EUI	kWh/ft².yr	0.4
	MJ/m².yr	20.0		MJ/m².yr	15.0

REFRIGERATION

Provide description below:

Unknown

EUI	kWh/ft².yr	0.5
	MJ/m².yr	20.0

MISCELLANEOUS

EUI	kWh/ft².yr	0.3
	MJ/m².yr	10

SPACE HEATING

Heating Plant Type

	Natural Gas			Electric				
	Boilers Stan.	Boilers High	Packaged Unit	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	83%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.20	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load 37.7 W/m² 12.0 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 278 MJ/m².yr 7.2 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.2
MJ/m².yr	278

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	7.2
MJ/m².yr	278

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers Standard	Centrifugal Chillers HE	Screw Chillers	Reciprocating Chillers Open	Reciprocating Chillers DX	Absorption Chillers W. H.	Absorption Chillers CW	Total
System Present (%)		25.0%			75.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.7	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.37	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

Chilled Water	7 °C	44.6 °F
Condenser Water	30 °C	86 °F
Supply Air	13.0 °C	55.4 °F

Peak Cooling Load 106 W/m² 34 Btu/hr.ft² 357 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 88.1 MJ/m².yr 2.3 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. perio 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 70.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	1.1
MJ/m².yr	43

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	1.1
MJ/m².yr	43

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 22.8

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.6
MJ/m².yr	25

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	5.1	L/s.m²	1.01	CFM/ft²
System Static Pressure CAV	750	Pa	3.0	wg
System Static Pressure VAV	750	Pa	3.0	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	8.0	W/m²	0.74	W/ft²
Fan Design Load VAV	8.0	W/m²	0.74	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	50%	50%	100%	
Operation	Continuou	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit are	0.0	L/s.m²	0.01	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.1	L/s.m²	0.03	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.2	W/m²	0.02	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	2.12	W/m²	0.20	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.006	L/s.m²	0.008	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.005	L/s.m²	0.0067	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure	100	kPa	50	ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load	0.9	W/m²	0.08	W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	37.7	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.2	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.5	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	3.7
	MJ/m².yr	141.9

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**21.2** kWh/ft².yr	**821.4** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr
GENERAL LIGHTING	4.6	179.8
SECONDARY LIGHTING	0.6	23.8
TERTIARY LIGHTING		
OTHER PLUG LOADS	0.7	25.2
HVAC FANS & PUMPS	3.7	141.9
REFRIGERATION	0.5	20.0
MISCELLANEOUS	0.3	10.0
COMPUTER EQUIPMENT	1.4	55.4
ELEVATORS		
OUTDOOR LIGHTING	0.4	17.0

END USE:	Electricity		Gas	
	kWh/ft².yr	MJ/m².yr	kWh/ft².yr	MJ/m².yr
SPACE HEATING	7.2	278.0		
SPACE COOLING	0.8	30.3		
DOMESTIC HOT WATER	0.6	25.0	#DIV/0!	#DIV/0!
FOOD SERVICE EQUIPMENT	0.4	15.0		

New Warehouse/Wholesale – Labrador Interconnected

CONSTRUCTION

Wall U value (W/m².°C)	0.28	W/m².°C	0.05	Btu/hr.ft² .°F	Typical Building Size	1,859	m²	20,000	ft²
Roof U value (W/m².°C)	0.19	W/m².°C	0.03	Btu/hr.ft² .°F	Typical Footprint (m²)	1,859	m²	20,000	ft²
Glazing U value (W/m².°C)	2.80	W/m².°C	0.49	Btu/hr.ft² .°F	Footprint Aspect Ratio (L:W)	1			
					Percent Conditioned Space	100%			
					Percent Conditioned Space Defined as Exterior Zone	40%			
Window/Wall Ratio (WIWAR) (%)	0.05								
Shading Coefficient (SC)	0.80				Typical # Stories	1			
					Floor to Floor Height (m)	6.1	m	19.9	ft

VENTILATION SYSTEM, BUILDING CONTROLS & INDOOR CONDITIONS

Ventilation System Type

	CAV	CAVR	DDMZ	DDMZVV	VAV	VAVR	IU	100% O.A	TOTAL
System Present (%)	100%								100%
Min. Air Flow (%)					50%				

(Minimum Throttled Air Volume as Percent of Full Flow)

Occupancy or People Density	100	m²/person	1076	ft²/person	%OA	9.01%
Occupancy Schedule Occ. Period	90%					
Occupancy Schedule Unocc. Period						
Fresh Air Requirements or Outside Air	20	L/s.person	42	CFM/person		

Fresh Air Control Type *(enter a 1, 2 or 3): 1
(1 = mixed air control, 2 = Fixed fresh air, 3 100% fresh air)

If Fresh Air Control Type = "2" enter % FA. to the right:
If Fresh Air Control Type = "3" enter Make-up Air Ventilation and operation: 0.5 L/s.m² — 0.10 CFM/ft²; 50% operation (%)

Sizing Factor	1			
Total Air Circulation or Design Air Flow	2.22	L/s.m²	0.44	CFM/ft²
Infiltration Rate	0.40	L/s.m²	0.08	CFM/ft²

(air infiltration is assumed to occur during unoccupied hours only if the ventilation system shuts down)

Separate Make-up air unit (100% OA): L/s.m² — CFM/ft²
Operation occupied period: 50%
Operation unoccupied period: 50%

Economizer

	Enthalpy Based		Dry-Bulb Based		Total
Incidence of Use			100%		100%
Switchover Point		KJ/kg.	18	°C	
		Btu/lbm	64.4	°F	

Summary of Design Parameters		
Peak Design Cooling Load	265,052	
Peak Zone Sensible Load	187,876	
Room air enthalpy	28.2	Btu/lbm
Discharge air enthalpy	23.4	Btu/lbm
Specific volume of air at 55F & 100% R.	13.2	ft³/lbm
Design CFM	8,740	
Total air circulation or Design air	2.22	l/s.m²

Controls Type

System Present (%)	HVAC Equipment	Room Controls
All Pneumatic		
DDC/Pneumatic		
All DDC		
Total (should add-up to 100%)		

Control mode

	Proportional	PI / PID	Total
Control Mode			
	Fixed Discharge	Reset	
Control Strategy			

Indoor Design Conditions

	Room				Supply Air			
Summer Temperature	22	°C	71.6	°F	13	°C	55.4	°F
Summer Humidity (%)	50%				100%			
Enthalpy	65.5	KJ/kg.	28.2	Btu/lbm	54.5	KJ/kg.	23.4	Btu/lbm
Winter Occ. Temperature	21	°C	69.8	°F	16	°C	60.8	°F
Winter Occ. Humidity	30%				45%			
Enthalpy	53	KJ/kg.	22.8	Btu/lbm	45.5	KJ/kg.	19.6	Btu/lbm
Winter Unocc. Temperature	21	°C	69.8	°F				
Winter Unocc. Humidity	30%							
Enthalpy	50	KJ/kg.	21.5	Btu/lbm				

Damper Maintenance

	Incidence (%)	Frequency (years)
Control Arm Adjustment		
Lubrication		
Blade Seal Replacement		

Air Filter Cleaning — Changes/Year:

Incidence of Annual Room Controls Maintenance:

Incidence of Annual HVAC Controls Maintenance:

Annual Maintenance Tasks	Incidence (%)
Calibration of Transmitters	
Calibration of Panel Gauges	
Inspection of Auxiliary Devices	
Inspection of Control Devices	

Annual Maintenance Tasks	Incidence (%)
Inspection/Calibration of Room Thermostat	
Inspection of PE Switches	
Inspection of Auxiliary Devices	
Inspection of Control Devices (Valves, (Dampers, VAV Boxes)	

LIGHTING

GENERAL LIGHTING

Light Level	400	Lux	37.2	ft-candles
Floor Fraction (GLFF)	0.95			
Connected Load	14.1	W/m^2	1.3	W/ft^2
Occ. Period(Hrs./yr.)	3500			
Unocc. Period(Hrs./yr.)	5260			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	50%	50%						100%
Weighted Average								**400**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)					15%	75%	10%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.7	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft^2.yr 5.3
MJ/m^2.yr 207

SECONDARY LIGHTING

Light Level	300	Lux	27.9	ft-candles
Floor Fraction (ALFF)	0.05			
Connected Load	10.1	W/m^2	0.9	W/ft^2
Occ. Period(Hrs./yr.)	3000			
Unocc. Period(Hrs./yr.)	5760			
Usage During Occupied Period	100%			
Usage During Unoccupied Period	15%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Light Level (Lux)	300	500	700	1000				Total
% Distribution	100%							100%
Weighted Average								**300**
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)	5%	10%			85%		0%	100.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft^2.yr 0.2
EUI = Load X Hrs. X SF X GLFF MJ/m^2.yr 7

TERTIARY LIGHTING

Light Level		Lux		ft-candles
Floor Fraction (HBLFF)				
Connected Load		W/m^2		W/ft^2
Occ. Period(Hrs./yr.)	4000			
Unocc. Period(Hrs./yr.)	4760			
Usage During Occupied Period	0%			
Usage During Unoccupied Period	100%			
Fixture Cleaning:				
Incidence of Practice				
Interval		years		
Relamping Strategy & Incidence of Practice	Group	Spot		

Floor fraction check: should = 1.00 | 1.00

Light Level (Lux)	300	500	700	1000				Total
% Distribution								
Weighted Average								
	INC	CFL	T12 ES	T8 Mag	T8 Elec	MH	HPS	TOTAL
System Present (%)		0%					0%	0.0%
CU	0.7	0.7	0.6	0.6	0.6	0.6	0.6	
LLF	0.65	0.65	0.75	0.80	0.80	0.55	0.55	
Efficacy (L/W)	15	50	72	84	88	65	90	

EUI kWh/ft^2.yr
MJ/m^2.yr

TOTAL LIGHTING Overall LP 13.91 W/m^2 EUI TOTAL kWh/ft^2.yr 5.5
MJ/m^2.yr 214

OFFICE EQUIPMENT & PLUG LOADS

Equipment Type	Computers	Monitors	Printers	Copiers	Servers	Plug Loads
Measured Power (W/device)	54.55	51	100	200	217	
Density (device/occupant)	0.59	0.59	0.03	0.03	0.06	
Connected Load	0.3 W/m^2	0.3 W/m^2	0.0 W/m^2	0.1 W/m^2	0.1 W/m^2	2 W/m^2
	0.0 W/ft^2	0.0 W/ft^2	0.00 W/ft^2	0.01 W/ft^2	0.01 W/ft^2	0.19 W/ft^2
Diversity Occupied Period	90%	90%	90%	90%	100%	90%
Diversity Unoccupied Period	50%	50%	50%	50%	100%	25%
Operation Occ. Period (hrs./year)	2000	2000	2000	2000	2000	3500
Operation Unocc. Period (hrs./year)	6760	6760	6760	6760	6760	5260

Total end-use load (occupied period)	2.6 W/m^2	0.2 W/ft^2
Total end-use load (unocc. period)	1.0 W/m^2	0.1 W/ft^2
Usage during occupied period	100%	
Usage during unoccupied period	39%	

to see notes (cells with red indicator in upper right corner, type "SHIFT F2"

Computer Equipment EUI kWh/ft^2.yr 0.46
MJ/m^2.yr 17.72
Plug Loads EUI kWh/ft^2.yr 0.83
MJ/m^2.yr 32.15

FOOD SERVICE EQUIPMENT

Provide description below: Gas Fuel Share: Electricity Fuel Share: 100.0%

Natural Gas EUI: EUI kWh/ft^2.yr; MJ/m^2.yr

All Electric EUI: EUI kWh/ft^2.yr 0.1; MJ/m^2.yr 4.0

REFRIGERATION

Provide description below:
Large refrigeration storage

EUI kWh/ft^2.yr 1.5
MJ/m^2.yr 60.0

MISCELLANEOUS

EUI kWh/ft^2.yr 0.3
MJ/m^2.yr 10

SPACE HEATING

Heating Plant Type

	Hot Water System						Electric	
	Boiler	Unit Heater	Packaged Rooftop	A/A HP	W. S. HP	H/R Chiller	Resistance	Total
System Present (%)							100%	100%
Eff./COP	75%	75%	95%	1.70	3.00	4.50	1.00	
Performance (1 / Eff.) (kW/kW)	1.33	1.33	1.05	0.59	0.33	0.22	1.00	

Peak Heating Load 37.0 W/m² 11.7 Btu/hr.ft²
Seasonal Heating Load (Tertiary Load) 294 MJ/m².yr 7.6 kWh/ft².yr
Sizing Factor 1.00

Electric Fuel Share 100.0% Gas Fuel Share Oil Fuel Share

Boiler Maintenance

Annual Maintenance Tasks	Incidence (%)
Fire Side Inspection	75%
Water Side Inspection for Scale Buildup	100%
Inspection of Controls & Safeties	100%
Inspection of Burner	100%
Flue Gas Analysis & Burner Set-up	90%

All Electric EUI	
kWh/ft².yr	7.6
MJ/m².yr	294

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	7.6
MJ/m².yr	294

SPACE COOLING

A/C Plant Type

	Centrifugal Chillers		Screw	Reciprocating Chillers		Absorption Chillers		Total
	Standard	HE	Chillers	Open	DX	W. H.	CW	
System Present (%)					100.0%			100.0%
COP	4.7	5.4	4.4	3.6	2.9	0.9	1	
Performance (1 / COP) (kW/kW)	0.21	0.19	0.23	0.28	0.34	1.11	1.00	
Additional Refrigerant Related Information								

Control Mode

Incidence of Use	Fixed Setpoint	Reset
Chilled Water		
Condenser Water		

Setpoint

	°C	°F
Chilled Water	7	44.6
Condenser Water	30	86
Supply Air	13.0	55.4

Peak Cooling Load 42 W/m² 13 Btu/hr.ft² 905 ft²/Ton
Seasonal Cooling Load (Tertiary Load) 42.5 MJ/m².yr 1.1 kWh/ft².yr

Sizing Factor 1.00 Operation (occ. perioc 4000 hrs/year Note value cannot be less than 2,900 hrs/year)

A/C Saturation (Incidence of A/C) 10.0%

Electric Fuel Share 100.0% Gas Fuel Share

Chiller Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect Control, Safeties & Purge Unit		
Inspect Coupling, Shaft Sealing and Bearings		
Megger Motors		
Condenser Tube Cleaning		
Vibration Analysis		
Eddy Current Testing		
Spectrochemical Oil Analysis		

Cooling Tower/Air Cooled Condenser Maintenanc

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspection/Clean Spray Nozzles		
Inspect/Service Fan/Fan Motors		
Megger Motors		
Inspect/Verify Operation of Controls		

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	18

Natural Gas EUI	
kWh/ft².yr	
MJ/m².yr	

Market Composite EUI	
kWh/ft².yr	0.5
MJ/m².yr	18

DOMESTIC HOT WATER

Service Hot Water Plant Type

Fossil Fuel SHW	Std. Tank	PV Tank	Cond. Tnk	Std. Boiler	Cnd. Boil.
System Present (%)					
Eff./COP	0.550	0.600	0.900	0.750	0.900

	Fossil		Elec. Res.
Fuel Share			100%
Blended Efficiency	#DIV/0!		0.91

Service Hot Water load (MJ/m².yr) (Tertiary Load) 18.2

Wetting Use Percentage 90%

All Electric EUI	
kWh/ft².yr	0.5
MJ/m².yr	20

Natural Gas EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

Market Composite EUI	
kWh/ft².yr	#DIV/0!
MJ/m².yr	#DIV/0!

HVAC FANS & PUMPS

SUPPLY FANS

System Design Air Flow	2.2	L/s.m²	0.44	CFM/ft²
System Static Pressure CAV	300	Pa	1.2	wg
System Static Pressure VAV	300	Pa	1.2	wg
Fan Efficiency	60%			
Fan Motor Efficiency	80%			
Sizing Factor	1.00			
Fan Design Load CAV	1.4	W/m²	0.13	W/ft²
Fan Design Load VAV	1.4	W/m²	0.13	W/ft²

Ventilation and Exhaust Fan Operation & Control

	Ventilation Fan		Exhaust Fan	
Control	Fixed	Variable Flow	Fixed	Variable Flow
Incidence of Use	100%		100%	
Operation	Continuous	Scheduled	Continuous	Scheduled
Incidence of Use	50%	50%	50%	50%
Comments:				

EXHAUST FANS

Washroom Exhaust	100	L/s.washroom	212	CFM/washroom
Washroom Exhaust per gross unit area	0.1	L/s.m²	0.02	CFM/ft²
Other Exhaust (Smoking/Conference)	0.1	L/s.m²	0.02	CFM/ft²
Total Building Exhaust	0.2	L/s.m²	0.04	CFM/ft²
Exhaust System Static Pressure	250	Pa	1.0	wg
Fan Efficiency	25%			
Fan Motor Efficiency	75%			
Sizing Factor	1.0			
Exhaust Fan Connected Load	0.3	W/m²	0.03	W/ft²

AUXILIARY COOLING EQUIPMENT (Condenser Pump and Cooling Tower/Condenser Fans)

Average Condenser Fan Power Draw	0.020	kW/kW	0.07	kW/Ton
(Cooling Tower/Evap. Condenser/ Air Cooled Condenser)	0.84	W/m²	0.08	W/ft²

Condenser Pump

Pump Design Flow	0.053	L/s.KW	3.0	U.S. gpm/Ton
Pump Design Flow per unit floor area	0.002	L/s.m²	0.003	U.S. gpm/ft²
Pump Head Pressure		kPa		ft
Pump Efficiency	50%			
Pump Motor Efficiency	80%			
Sizing Factor	1.0			
Pump Connected Load		W/m²		W/ft²

CIRCULATING PUMP (Heating & Cooling)

Pump Design Flow @ 5 °C (10 °F) delta T	0.002	L/s.m²	0.0027	U.S. gpm/ft²	2.4	U.S. gpm/Ton
Pump Head Pressure		kPa		ft		
Pump Efficiency	50%					
Pump Motor Efficiency	80%					
Sizing Factor	0.8					
Pump Connected Load		W/m²		W/ft²		

Supply Fan Occ. Period	3500	hrs./year
Supply Fan Unocc. Period	5260	hrs./year
Supply Fan Energy Consumption	8.5	kWh/m².yr
Exhaust Fan Occ. Period	3500	hrs./year
Exhaust Fan Unocc. Period	5260	hrs./year
Exhaust Fan Energy Consumption	1.7	kWh/m².yr
Condenser Pump Energy Consumption		kWh/m².yr
Cooling Tower /Condenser Fans Energy Consumption	0.3	kWh/m².yr
Circulating Pump Yearly Operation	7000	hrs./year
Circulating Pump Energy Consumption		kWh/m².yr

Fans and Pumps Maintenance

Annual Maintenance Tasks	Incidence (%)	Frequency (years)
Inspect/Service Fans & Motors		
Inspect/Adjust Belt Tension on Fan Belts		
Inspect/Service Pump & Motors		

EUI	kWh/ft².yr	1.0
	MJ/m².yr	37.6

EUI SUMMARY

TOTAL ALL END-USES:	**Electricity:**	**18.3** kWh/ft².yr	**708.7** MJ/m².yr	**Gas:**	**#DIV/0!** kWh/ft².yr	**#DIV/0!** MJ/m².yr		

END USE:	kWh/ft².yr	MJ/m².yr	**END USE:**	Electricity kWh/ft².yr	Electricity MJ/m².yr	Gas kWh/ft².yr	Gas MJ/m².yr
GENERAL LIGHTING	5.3	206.9					
SECONDARY LIGHTING	0.2	7.0	SPACE HEATING	7.6	294.5		
TERTIARY LIGHTING			SPACE COOLING	0.0	1.8		
OTHER PLUG LOADS	0.8	32.1	DOMESTIC HOT WATER	0.5	20.0	#DIV/0!	#DIV/0!
HVAC FANS & PUMPS	1.0	37.6	FOOD SERVICE EQUIPMENT	0.1	4.0		
REFRIGERATION	1.5	60.0					
MISCELLANEOUS	0.3	10.0					
COMPUTER EQUIPMENT	0.5	17.7					
ELEVATORS							
OUTDOOR LIGHTING	0.4	17.0					

MARBEK
Resource Consultants Ltd.

APPENDIX B

CDM Measure Profiles

Table of Contents

Exhibit B.1: Energy Efficiency Upgrades - Fluorescent Lighting - T12 Baseline

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Raw Energy Savings	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
								Material	Installation					D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	kWh/year	$/fixture	$/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	T12 lamps ES, magnetic ballast (80W/fixture and operation of 3,000 hrs).	80	3000	240				$26	$15	$41		$0.00	16.7						
Upgrade 1	Relamp & reballast with T8 lamps and electronic ballasts (59W/fixture)	59	3000	177	63	63	63	$26	$15	$41	$0.00	$0.00	16.7	5.4	0.0	6.3	0.0	7.2	0.0
Upgrade 2	Relamp & reballast with T8 lamps and low BF electronic ballasts (51W/fixture)	51	3000	153	87	87	87	$26	$15	$41	$0.00	$0.00	16.7	3.9	0.0	4.6	0.0	5.2	0.0
Upgrade 3	Relamp & reballast with high performanceT8 lighting system (49W/fixture)	49	3000	147	93	93	93	$35	$15	$50	$9.00	-$0.25	16.7	4.2	0.5	4.9	0.7	5.7	0.8

Notes:

Transmission & Distribution Losses: ***0%***

26%
36%
39%

Upgrade 1 Consumption of 59W/fixture for standard T8 lighting system is based on Standard Sylvania Electronic T8 System Quicktronic 32IS (QT2X32/120S). This is based on F32T8 800 lamps with an Instant Start ballast, ballast factor 0.9. Material costs are based on $21.50 for the ballast and $4.50 for two lamps

Upgrade 2 Consumption of 51W/fixture for a T8 lighting system is based Sylvania low BF (0.77) Quicktronic 32LP System. Costs are assumed to be the same as for the standard T8 lighting system.

Upgrade 3 Consumption of 49W/fixture for high performance T8 lighting is based on Sylvania "Extreme System" high performance T8 lamps and ballasts. This is based on FO32 Extended performance Ecologic lamps with a lamp life of 30,000 hours and a higher light output of 3200 lumens/lamp compared to standard T8 systems that provide 3000 Lumens/Lamp. Ballasts are rapid start with a ballast factor of 0.74.
A reduction in O&M costs of $0.25/fixture has been assumed due to the 50% longer lamp life of the extended performance Ecologic lamps over standard T8 lamps.
Material costs are based on $28 for a Sylvania Extreme System ballast and $7 for two FO32/830XPS/ECO lamps.

Exhibit B.2: Energy Efficiency Upgrades - Fluorescent Lighting - T12 Baseline

Type		Connected Load	Hours of Operation	Annual Consumption	Raw Energy Savings	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
								Material	Installation					D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/ft²	hrs/year	kWh/ft².yr	kWh/year	kWh/ft².yr	kWh/ft².yr	$/ft²	$/ft²	Full	Incremental	$/ft²		Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	T12 lamp ES, magnetic ballast 50 ft²/fixture and 50 to 60fc (1.6 W/ft² and 3,000 hrs.).	1.6	3000	4.8				$1.60	$0.60	$2.20		$0.00	16.667						
Upgrade 4	Efficient lighting redesign to 30 to 40fc with standard T8 lamp and ballast at 80 ft²/fixture (0.7 W/ft²).	0.7	3000	2.2	2.6	2.6	2.6	$1.15	$0.43	$1.58	-$0.62	$0.00	16.667	5.1	-2.0	5.9	-2.3	6.8	-2.6
Upgrade 5	Efficient lighting redesign to 30 to 40 fc with high performance T8 lighting system at 80 ft²/fixture (0.6 W/ft²).	0.6	3000	1.8	3.0	3.0	3.0	$1.29	$0.43	$1.72	-$0.48	$0.00	16.667	4.9	-1.3	5.6	-1.6	6.4	-1.8
Upgrade 6	Fully integrated lighting and controls (includes daylighting, occupancy sensors and occupant dimming (0.8 W/ft²).	0.8	2100	1.7	3.1	3.1	3.1	$4.0	$2.7	$6.67	$4.47	$0.00	16.667	17.7	11.9	20.5	13.7	23.5	15.8

Notes:

Transmission & Distribution Losses: ***0%***

54%
62%
65%

Upgrade 4 This upgrade is based on Standard Grade 2x4 Lens Recessed Static Luminaire (see CFI Fluorescent Luminaire "Specline" 2x4 page 44) with two lamps. This fixture will provide an average maintained fc of 42 footcandles in a large open space 30 fc in a 8 x 8 cubicle with 60" partitions.

Costs are based on $80/fixture and $30 for installation plus a 15% charge for engineering/design

Upgrade 5 This upgrade is the same as upgrade 4 but with next generation T8 lighting system such as the Sylvania "Extreme System" .

Costs are based on $90/fixture for the "Sylvania Extreme System" and $30 for installation plus a 15% charge for engineering/design

Upgrade 6 This upgrade is based on a 3-lamp direct/indirect pendant fixture with a consumption of 95W/fixture.
The fixtures are assumed to be installed in a lighting layout equal to 120 ft²/fixture.
The energy savings are estimated to be approximately 65% relative to a T12 baseline. The savings consists of savings from reduced fixture density plus an additional 30% savings from the personal controls (dimming and occupancy - see E-Source New Dimming Controls March 2000.
Costs are estimated to be $800 per fixture installed or $6.67 per square foot.

Exhibit B.3: Energy Efficiency Upgrades - Fluorescent Lighting - T8 Baseline

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Raw Energy Savings	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
														D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	kWh/year	Material $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard T8 lighting system (59W/fixture and operation of 3000 hrs).	59	3000	177				$26	$15	$41		$0.00	16.7						
Upgrade 1	High performance T8 lighting system (49W/fixture)	49	3000	147	30	30	30	$35	$15	$50	$9	-$0.25	16.7	13.1	1.7	15.3	2.1	17.6	2.5

Notes:

Transmission & Distribution Losses: ***0%*** 17%

Upgrade 1 Consumption of 49W/fixture for high performance T8 lighting is based on Sylvania "Extreme System" high performance T8 lamps and ballasts. This is based on FO32 Extended performance Ecologic lamps with a lamp life of 30,000 hours and a higher light output of 3200 lumens/lamp compared to standard T8 systems that provide 3000 Lumens/Lamp. Ballasts are rapid start with a ballast factor of 0.74.
Material costs are based on $28 for a Sylvania Extreme System ballast and $7 for two FO32/830XPS/ECO lamps.

Exhibit B.4: Energy Efficiency Upgrades - Fluorescent Lighting - T8 Baseline

Type	Technology	Connected Load W/ft²	Hours of Operation hrs/year	Annual Consumption kWh/ft².yr	Raw Energy Savings kWh/year	Energy Savings 1 kWh/ft².yr	Energy Savings 2 kWh/ft².yr	Technology Costs Material $/ft²	Technology Costs Installation $/ft²	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M $/ft²	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline	T8 lamp electronic ballast 2-lamp fixture at 50 ft²/fixture and 50 fc (1.2 W/ft² and 3000 hrs).	1.2	3000	3.54				$1.25	$0.47	$1.72		$0.00	16.7						
Upgrade 2	Efficient lighting redesign to 30 to 50 fc with next generation T8 lighting system at 80 ft²/fixture (0.6 W/ft²).	0.6	3000	1.84	1.7	1.70	1.70	$1.29	$0.43	$1.73	$0.01	$0.00	16.7	8.4	0.0	9.8	0.0	11.2	0.0
Upgrade 3	Fully integrated lighting & controls (includes daylighting, occupancy sensors and occupant dimming (0.8 W/ft²).	0.8	2100	1.66	1.9	1.88	1.88	$4.0	$2.7	$6.67	$4.95	$0.00	16.7	29.6	22.0	34.3	25.4	39.3	29.2

Notes:

Transmission & Distribution Losses: ***0%***

48%
53%

Upgrade 2 This upgrade is based on Standard Grade 2x4 Lens Recessed Static Luminaire (see CFI Fluorescent Luminaire "Specline" 2x4 page 44) with next generation T8 lighting system such as the Sylvania Extreme Fifty (50) footcandles in large open spaces and 30 fc in an 8 x 8 cubicle with 60" partitions.

Costs are based on $90/fixture for the "Sylvania Extreme System" and $30 for installation plus a charge of 15% for engineering/design vs $80/fixture and $30/installation for the baseline. Note the upgrade cost is less since there are fewer fixtures.

Upgrade 3 This upgrade is based on a 3-lamp direct/indirect pendant fixture with a consumption of 95W/fixture.
The fixtures are assumed to be installed in a lighting layout equal to 120 ft²/fixture.
The energy savings are estimated to be approximately 53% relative to a standard T8 baseline. The savings consists of savings from reduced fixture density plus an additional 30% savings from the personal controls (dimming and occupancy - see E-Source New Dimming Controls March 2000.
Costs are estimated to be $800 per fixture installed or $6.67 per square foot.

Exhibit B.5: Energy Efficiency Upgrades - Occupancy Sensors

Type	Technology	Annual Consumption	Raw Energy Savings	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/yr	kWh/yr	kWh/yr	Material $	Installation $	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Three standard T8 fixtures (59W/fixture and operation of 3000 hrs).	531				$2.00	$20.00	$22.00		$0.00	10						
Upgrade 1	Replace standard switch with Infra-red occupancy sensor.	372	159	159	159	$50.00	$20.00	$70.00	$48.00	$1.00	10	6.0	4.3	6.6	4.7	7.2	5.1

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 This upgrade consists of replacing an existing wall switch with a passive infra occupancy sensor for the control of 3 standard T8 fixtures at 59 watts per fixture and 3,000 hours per year. Savings based on an estimated 30% reduction in energy consumption.
Costs based on $50 per switch and 20 minutes labour at $60/hour.

Cost data from:
http://www.wescodirect.ca/direct/SearchResults.aspx?category=C90-190-20-10

Exhibit B.6: Energy Efficiency Upgrades - Incandescent Lighting

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Raw Energy Savings	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	kWh/year	Material $/fixture	Installation $/fixture	Full	Incremental	O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard 65 W incandescent reflector flood lamp (3000 hours)	65	3000	195				$2	$3	$5		$0.00	1						
Upgrade 1	20 W CFL reflector	20	3000	60	135	135	135	$19	$3	$22	$17	-$3.50	3	2.7	-1.1	2.9	-1.0	3.2	-0.8
Upgrade 2	23 W induction lamp	23	3000	69	126	126	126	$40	$3	$43	$38	-$4.00	5	4.5	0.4	4.9	0.7	5.4	1.1
Upgrade 3	16 W white LED equivalent	16	3000	48	147	147	147	$40	$3	$43	$38	-$4.57	12	0.1	-3.5	0.4	-3.2	0.8	-2.8
Baseline	Standard 75 W halogen PAR 38 lamp (3000 hours)	75	3000	225				$6	$3	$9		$0.00	0.8						
Upgrade 4	50 W infra red halogen PAR 38 lamp	50	3000	150	75	75	75	$12	$3	$15	$6	-$3.64	1.4	10.1	-4.8	10.5	-4.7	10.8	-4.6
Upgrade 5	25 W PAR ceramic metal halide lamp	35	3000	105	120	120	120	$35	$3	$38	$29	-$6.75	3	4.7	-4.6	5.1	-4.4	5.6	-4.1
Baseline	Standard incandescent exit sign	30	8760	263				$1	$3	$4		$0.00	1						
Upgrade 6	LED exit sign	2	8760	18	245	245	245	$50	$20	$70	$61	-$3.65	11.4	1.7	na	2.0	na	2.4	na

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 — Upgrade 1 is a 20 W R40 reflector CFL that displays 785 lumens, has a service life of 10,000 hrs, and costs $20.

Upgrade 2 — Upgrade 2 is 23 W reflector induction lamp that displays 1100 lumens, has a service life of 15,000 hrs, and costs $40. Based on GE Genura.

Upgrade 3 — Upgrade 3 is a white LED array that provides 800 lumens at 50 lumens per watt, has a life of 35,000 hrs, and a cost of $50/kilo-lumen
www.netl.doe.gov/ssl/faqs.htm

Upgrade 4 — Upgrade 4 is a 50 W halogen infrared (IR) that displays 970 lumens, has a service life of 4200 hours and costs $12. Based on Philips Energy Advantage halogen IR lamps.

Upgrade 5 — Upgrade 5 is a 25 W integrated ceramic MH lamp/ballast providing 10,500 hours, 1220 initial lumens
A mature market cost of $35 per lamp is assumed for this analysis.
Based on Philips Mastercolor integrated 25W PAR 38 ceramic metal halide lamps

Upgrade 6 — Upgrade 6 is a 2 W LED exit sign with a cost of $70 and a service life of 100,000 hrs.
The energy efficiency of exit signs is regulated in Canada and LED technology is the only technology able

Exhibit B.7: Energy Efficiency Upgrades - High Intensity Discharge Lighting

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
													D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	Material $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard 400 W metal halide (3000 hours)	458	3000	1,374			$255	$60	$315		$0.00	16						
Upgrade 1	320 W pulse start metal halide	360	3000	1,080	294	294	$265	$60	$325	$10	$0.00	16	9.5	0.3	10.9	0.3	12.5	0.4
Upgrade 2	Fluorescent high bay with 4-F54T5HO lamps and occupancy sensor	239	2700	645	729	729	$275	$75	$350	$35	$0.00	16	4.1	0.4	4.8	0.5	5.4	0.5

Notes:
Transmission & Distribution Losses: *0%* 21% 53%

Upgrade 1 Upgrade 1 is a pulse start metal halide high bay fixture with a 320 W lamp and 40 W ballast; displaying 26,000 mean lumens; as service life of 20,000 hours and a cost of $265.

Upgrade 2 Upgrade 2 is a fluorescent high bay fixture equipped with four F54T5 HO lamps and a motion sensor (1 for 1 replacement for 400 W metal halide)
www.prolighting.com
The fixture draws 239 W and displays 20,000 initial lumens, has a 20,000 lamp life, and costs $275.

Exhibit B.8: Energy Efficiency Upgrades - Low Temperature Heat Pumps

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	A small commercial building with a combined heating and cooling EUI of 8.5 kWh/ft².yr	8.5			$3.0	$0.0	$3		$0.00	15						
Upgrade 1	Low temperature heat pump with a heating COP of 2.5 and a cooling SEER of 14.	4	5	5	$4.8	$0.0	$4.8	$1.8	$0.10	15	na	5.5	na	6.0	na	6.6
Baseline	A small commercial building with a combined heating and cooling EUI of 11.5 kWh/ft².yr	11.5			$3.0	$0.0	$3	$0	$0.00	15						
Upgrade 1	Low temperature heat pump with a heating COP of 2.5 and a cooling SEER of 14.	5	7	7	$5.5	$0.0	$5.5	$2.5	$0.10	15	na	4.8	na	5.3	na	5.8

Notes:

Transmission & Distribution Losses: ***0%***

56%
59%

Upgrade 1 Low temperature heat pump
www.gogohallowell.com

Cost based on discussion with Mits Air (rep for Hallowell in Canada) for 3 and 3.5 ton split systems installed.

Exhibit B.9: Energy Efficiency Upgrades - Ground Source Heat Pumps

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Commercial building with electric resistance heating and DX cooling and a combined heating and cooling EUI of 9.6 kWh/ft².yr	9.6			$3	$0	$3		$0.00	20						
Upgrade 1	GSHP with a cooling EER of 14.1 and a heating COP of 3.3.	4	5.8	6	$7.9	$0.0	$7.9	$4.9	$0.00	20	na	6.2	na	7.3	na	8.6
Baseline	Commercial building with electric resistance heating and DX cooling and a combined heating and cooling EUI of 12.5 kWh/ft².yr	12.5			$3	$0.0	$3.0	$0	$0.00	20						
Upgrade 1	GSHP with a cooling EER of 14.1 and a heating COP of 3.3.	5	8	8	$7.9	$0.0	$7.9	$4.9	$0.00	20	na	4.5	na	5.4	na	6.3

Notes:

Transmission & Distribution Losses: ***0%***

61%
64%

Baseline
Two baselines: a high and a low heating load have been included to represent the range of small commercial buildings and climate regions.
The base buildings are assumed to have conventional electric resistance heating and DX cooling

Upgrade 1
Ground source heat pump with heating COP of 3.3 and cooling EER of 14.
Heating savings based on COP 3.3 vs 1; and cooling savings based on EER 14 vs 10.
GSHP and HVAC costs based on $85/m2 (www.advancedbuildings.org)
Ground loop costs based on $1000 / ton (Design Issues the application of commercial GSHP in the US)
Existing electric BB and packaged DX cost derived from RS Means
The service life is estimated to be 20 years.

Exhibit B.10: Energy Efficiency Upgrades - Infra Red Heaters

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr	Life	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental	Ann. O&M	(yrs)	Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Small warehouse heated with electric unit heaters and a space heating EUI of 7.6 kWh/ft².yr.	7.6			$0.000	$0.000	$0.000		$0.00	10						
Upgrade 1	Add supplementary infra-red spot heating to 20% of floor area and maintain ambient air temperature at 18 deg. C	6.5	1.1	1.1	$0.360	$0.240	$0.600	$0.60	$0.00	10	6.7	6.7	7.4	7.4	8.1	8.1
Baseline	Small warehouse heated with electric unit heaters and a space heating EUI of 10.7 kWh/ft².yr.	10.7			$0.000	$0.000	$0.000		$0.00	10						
Upgrade 1	Add supplementary infra-red spot heating to 20% of floor area and maintain ambient air temperature at 18 deg. C	9	1.5	1.5	$0.360	$0.240	$0.600	$0.60	$0.00	10	4.8	4.8	5.3	5.3	5.8	5.8

Notes:

Transmission & Distribution Losses: ***0%***

14.5%

Upgrade 1 Installed cost of $750 per heater based on RS Means
Infra-fred heaters are 4 kW units with a 16'X16" coverage.
Savings based on CEEAM model for warehouse maintained at an ambient temperature of 18 C
The service life is 10 years (Source:ASHRAE)

Exhibit B.11: Energy Efficiency Upgrades - High Efficiency Chiller

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Large commercial building with a standard chiller (0.58 kW/ton) a space cooling EUI of 0.8 kWh/ft².yr	0.8			$0.88	$0.25	$1.13		$0.00	25						
Upgrade 1	Smardt oil-less variable speed chiller (IPLV 0.37 kW/ton)	0.6	0.2	0.2	$1.09	$0.25	$1.34	$0.22	$0.00	25	na	6.1	na	7.4	na	8.9

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Large commercial building with a standard chiller (0.58 kW/ton) a space cooling EUI of .0.6 kWh/ft².yr	0.6			$0.88	$0.25	$1.13		$0.00	25						
Upgrade 1	Smardt oil-less variable speed chiller (IPLV 0.37 kW/ton)	0.4	0.2	0.2	$1.09	$0.25	$1.34	$0.22	$0.00	25	na	8.1	na	9.9	na	11.8

29%

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 Baseline building: 100,000 ft2, 400 ft2/ton
Baseline chiller: new standard efficiency (0.58 kW/ton full load and 0.52 kW/ton IPLV), $350 /ton
Upgrade: Smardt variable speed chiller, 0.37 kW/ton IPLV, 25% cost premium, www.smardt.com
Savings 29%
www.smardt.com

Exhibit B.12: Energy Efficiency Upgrades - HE Rooftop AC Unit

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann.	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/yr	kWh/yr	Material $/unit	Installation $/unit	Full	Incremental	O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	A 40,000 ft2 commercial building with a cooling EER of 10.3 and a space cooling EUI of 1.1 kWh/ft2/yr.	44,800			$66,667	$22,222	$88,889		$0.00	15						
Upgrade 1	High efficiency rooftop AC units with an EER of 13.5	34,181	10,619	10,619	$80,000	$22,222	$102,222	$13,333	$0.00	15	na	11.3	na	12.9	na	14.7
Baseline	A 40,000 ft2 commercial building with a cooling EER of 10.3 and a space cooling EUI of 0.72 kWh/ft2/yr.	28,800			$71,111	$17,778	$88,889		$0.00	15						
Upgrade 1	High efficiency rooftop AC units with an EER of 13.5	21,973	6,827	6,827	$85,333	$17,778	$103,111	$14,222	$0.00	15	na	18.7	na	21.5	na	24.3

24%

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 Baseline 40,000 ft2 commercial building, 450 ft2/ton, and a standard EER of 10.3, cost $1,000/ton installed
Global Energy Group 10 ton packaged AC unit with a EER of 13.5
Cost based on a 20% incremental cost over a standard RTU
www.gegsolutions.com

Exhibit B.13: Energy Efficiency Upgrades - Adjustable Speed Drives

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	kWh/yr	Material $/unit	Installation $unit	Full	Incremental	Ann. O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	10 hp centrifugal supply fan equipped with inlet vanes for capacity control (3000 hours)	17,904			$0	$0	$0		$0.00	10						
Upgrade 1	Adjustable speed drive (ASD)	11,190	6,714	6,714	$2,063	$688	$2,750	$2,750	$0.00	10	5.0	5.0	5.6	5.6	6.1	6.1

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 10 hp variable frequency drive operating at an average of 80% speed.
Costs based on RS Means

Exhibit B.14: Energy Efficiency Upgrades - Premium Efficiency Motors

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	kWh/yr	Material $/unit	Installation $unit	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	20 hp standard efficiency motor (3000 hours)	44,760			$809	$100	$909		$0.00	10						
Upgrade 1	Premium efficiency motor	44,082	678	678	$971	$100	$1,071	$162	$0.00	10	19.5	2.9	21.5	3.2	23.5	3.6

Notes:
Transmission & Distribution Losses: *0%*

Upgrade 1 Upgrade 1 is a 20 hp NEMA B 1800 rpm TEFC, 92.4% premium efficiency motor. Cost is based on a 20% premium over standard energy efficient motors.

Exhibit B.15: Energy Efficiency Upgrades - Recommissioning and BAS

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental	O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Existing 40,000 ft² office building with an HVAC EUI of 13.4 kWh/ft².yr and an electric EUI of 26.1	26.1			$0	$0	$0		$0.00	0						
Upgrade 1	Building recommissioning	22.8	3	3	$0.6	$0.0	$0.6	$0.0	$0.00	5	4.0	na	4.3	na	4.5	na
Upgrade 2	Advanced BAS	23.5	3	3	$0.9	$0.0	$0.9	$0.0	$0.00	10	4.3	na	4.7	na	5.1	na

Notes:

Transmission & Distribution Losses: ***0%***

13%
10%

Upgrade 1 Building recommissioning can achieve HVAC energy savings of 10 to 40% (Texas A&M).
Savings of 20% of HVAC (heating, cooling and fan/pump motors) energy use
Costs for recommissioning range from $0.40 to $0.80/ft² (Texas A&M]
A cost of $0.60/ft² is used in the analysis.

Upgrade 2 Installation of an advanced BAS or upgrade with new front-end, automated diagnosis and new control strategies. In this analysis savings of 10% of the whole building EUI are estimated through re-institution of equipment scheduling, expanded control (lighting) and improved self-tuning control strategies.
The costs of an advanced BAS is based on $600 per control point and the addition of 60 new control points to provide DDC room controls (terminal devices), lighting control and augmented control of central plants. This is equivalent to a cost of $36,000 or $0.90/ft².

Exhibit B.16: Energy Efficiency Upgrades - Programmable Thermostats

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Small commercial building with five packaged rooftop units, standard thermostats and an HVAC EUI of 13.4 kWh/ft².yr	13.4			$0.05	$0.05	$0.10		$0.00	10						
Upgrade 1	Programmable thermostats to schedule RTUs	12.1	1.3	1.3	$0.10	$0.10	$0.20	$0.10	$0.00	10	1.8	0.9	2.0	1.0	2.2	1.1

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Small commercial building with five packaged rooftop units, standard thermostats and an HVAC EUI of 15.4 kWh/ft².yr	15.4			$0.05	$0.05	$0.10		$0.00	10						
Upgrade 1	Programmable thermostats to schedule RTUs	13.9	1.5	1.5	$0.10	$0.10	$0.20	$0.10	$0.00	10	1.6	0.8	1.8	0.9	1.9	1.0

10%

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 Baseline building: 10,000 ft2, 400 ft2/ton, 5 RTUs, standard t'stats
Upgrade: programmable thermostats and sheduling of RTUs
Savings 10%
Service life is 10 years.

Exhibit B.17: Energy Efficiency Upgrades - Energy Star Refrigerator/Freezer

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	kWh/yr	Material $/unit	Installation $unit	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard two-door reach in refrigerator	4,300			$2,320	$0	$2,320		$0.00	10						
Upgrade 1	Energy Star refrigerator	3,440	860	860	$2,784	$0	$2,784	$464	$0.00	10	na	6.7	na	7.3	na	8.0

20%

Transmission & Distribution Losses: ***0%***

Notes:

Upgrade 1 Energy Star Fridge/Freezer
Baseline is True two door 49 ft3 solid door cooler, cost of $2,320 (www.missionrs.com); 4,300 kWh/yr (NRCan)
Upgrade is based on a 20% incremental cost Energy Star rated Beverage-Air ER48 series (www.beverageair.com)

Exhibit B.18: Energy Efficiency Upgrades - HE Supermarket Refrigeration

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs			Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full	Incremental	Ann. O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Large Food Retail building with a refrigeration EUI of 31 kWh/ft2/yr	31.0			$0	$0	$0		$0.00	10						
Upgrade 1	Machine room and display case improvements	23.3	7.8	7.8	$2.7	$0.0	$2.7	$2.7	$0.00	10	na	4.3	na	4.7	na	5.2

Notes:
Transmission & Distribution Losses: ***0%*** 25%

Upgrade 1 Ref: Energy Savings Potential for Commercial Refrigeration Equipment, Arthur D Little, June 1996
Ref NRCan

Savings 25%, cost 2.7 /ft2 to reflect both retrofit and new construction.
Measure life is 10 years since food retail experiences a shorth cycle between major renovations and changes in merchandising.

Exhibit B.19: Energy Efficiency Upgrades - Low Flow Shower Head/Faucet Aerator

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	kWh/yr	Material $/unit	Installation $/unit	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Upgrade 1	Low flow aerators and shower heads	850	340	340	$20.0	$20.0	$40.0	$0	$0.00	5	2.6	na	2.8	na	2.9	na

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 The energy use represents the average hot water consumption of a lavatory based on 1 gal/person per day and 15 persons per lavatory.

Exhibit B.20: Energy Efficiency Upgrades – Tankless Water Heaters

Technology	Annual Cons	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R =	4.00%	D.R =	6.00%	D.R =	8.00%
	kWh/year	kWh/yr	kWh/yr	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Commercial building with a DHW EUI of 0.6 kWh/ft^2 served by a central electric tank heater; EF 0.91, first hour capacity 227Gal.	25,873			$ 3,380	$ 1,820	$ 5,200		0	10						
Multiple point of use tankless heaters; EF 0.98, first hour capacity 60 gal. at 108F max temperature rise.	24,024	1,848	1,848	$7,200	$3,600	$10,800	$5,600	$0.00	10.0	na	37.4	na	41.2	na	45.2

7%

ution Losses: ***0%***

Costs for tankless heaters estimated to be $1,200 each.
Tank heater energy factor 0.91, and tankless energy factor 0.98

Exhibit B.21: Energy Efficiency Upgrades - Computer Equipment

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	kWh/yr	Material $/unit	Installation $unit	Full	Incremental	O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard PC with LCD monitor	420			$0	$0	$1,170		$0.00	5						
Upgrade 1	Energy Star PC	110	310	310			$1,170	$0	$0.00	5	na	0.0	na	0.0	na	0.0
Baseline	Standard Server 8500 hrs	1,845			$0	$0	$4,950		$0.00	5						
Upgrade 1	Energy Efficient Server 8500 hrs	1,107	738	738			$5,000	$50	$0.00	5	na	1.5	na	1.6	na	1.7
Baseline	Standard Copier	1,317			$0	$0	$7,500		$0.00	5						
Upgrade 1	Energy Star Copier	730	587	587			$7,500	$0	$0.00	5	na	0.0	na	0.0	na	0.0

Transmission & Distribution Losses: ***0%***

Notes:

PC
Baseline Data from energy star calculator, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_computers.xls
Upgrade 1 Data from energy star calculator, 100% enabled

Server
Baseline Baseline is most common volume server in U.S., Dell 2850, drawing typical power according to "Estimating Total power consumption by servers in the US and the World" J.G. Koomey
Upgrade 1 Upgrade is a collection of server technologies including software (i.e. server virtualization) hardware (i.e. Sun Coolthreads server) and server configuration (i.e. component level cooling and optimal computer room configuration for cooling)
Total savings are estimated at 40%. Some savings are only available for large data centres, i.e. server virtualization.

Copier
Baseline Data from energy star calculator, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_copiers.xls
Upgrade 1 Data from energy star calculator, 100% enabled

Exhibit B.22: Energy Efficiency Upgrades - High Performance Glazings

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	Material $/ft²	Installation $/ft²	Full $/ft²	Incremental $/ft²			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	A 50,000 ft2 commercial building with a window U value of 0.49 Btu/hr.ft2.F and a combined heating and cooling EUI of 9.5 kWh/ft2/yr.	9.5			$0	$0	$0		$0.00	20						
Upgrade 1	High performance glazing systems (>R4)	6.8	2.7	2.7	$2.00	$0	$2.00	$2.00	$0.00	20	na	5.5	na	6.5	na	7.5
Baseline	A 50,000 ft2 commercial building with a window U value of 0.49 Btu/hr.ft2.F and a combined heating and cooling EUI of 13.0 kWh/ft2/yr.	13.0			$0	$0	$0.00		$0.00	20						
Upgrade 1	High performance glazing systems (>R4)	8.6	4.4	4.4	$2.00	$0	$2.00	$2.00	$0.00	20	na	3.3	na	4.0	na	4.6

Notes:
Transmission & Distribution Losses: ***0%***

Baseline — This measure is evaluated at both a high and low heating load (Island and Labrador)

Upgrade 1 — Upgrade 1 is a high performance glazing system with an overall window U value of 0.25 Btu/hr.ft2.F.
Products include Visionwall 3 element and 4 element glazing systems.
An incremental cost of $8 to $13/ft² is used in the analysis (Source: Visionwall). The
cost is equivalent to approximately $2.0/ft² of building floor area based on a WWR of 0.35 — 28%
This measure was evaluated at both a low and high heating load to reflect range of climate conditions. — 34%
This analysis does not include equipment sizing trade-offs.

Exhibit B.23: Energy Efficiency Upgrades - Wall Insulation

Type	Technology	Annual Consumption kWh/ft2.yr	Energy Savings 1 kWh/ft2.yr	Energy Savings 2 kWh/ft2.yr	Technology Costs Material $/ft2	Technology Costs Installation $/ft2	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline	Commercial building with R12 wall insulation and an electric heating heating EUI of 8.1 kWh/ft^2.yr.	8.1			$0.00	$0.00	$0.00		$0.00	25						
Upgrade 1	Upgrade wall insulation to R24	6.6	1.5	1.5	$1.38	$0.00	$1.38	$1.38	$0.00	25	na	6.0	na	7.4	na	8.8

Notes: 18%

Transmission & Distribution Losses: ***0%***

Type	Technology	Annual Consumption kWh/ft2.yr	Energy Savings 1 kWh/ft2.yr	Energy Savings 2 kWh/ft2.yr	Technology Costs Material $/ft2	Technology Costs Installation $/ft2	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline	Commercial building with R12 wall insulation and an electric heating heating EUI of 14.4 kWh/ft^2.yr.	14.4			$0.00	$0.00	$0.00		$0.00	25						
Upgrade 1	Upgrade wall insulation to R24	11.8	2.6	2.6	$1.70	$0.00	$1.70	$1.70	$0.00	25	na	4.2	na	5.1	na	6.1

Baseline — This measure is evaluated at both a high and low heating load (Island and Labrador) 18%

Upgrade 1 — This measure consists of upgrading wall insulation from R12 to R24 at time of recladding.
Savings based on CEEAM model for non-food retail buildings.
Cost of 1.38/ft2 of floor area ($2.50/ft2 of wall area) as per NLH.

Exhibit B.24: Energy Efficiency Upgrades - Roof Insulation

Type	Technology	Annual Consumption kWh/ft2.yr	Energy Savings 1 kWh/ft2.yr	Energy Savings 2 kWh/ft2.yr	Technology Costs Material $/ft2	Technology Costs Installation $/ft2	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline	Single-storey commercial building wth a R20 roof and an electric heating EUI of 7.4 kWh/ft^2.yr.	7.4			$0.00	$0.00	$0.00		$0.00	25						
Upgrade 1	Upgrade roof insulation to R30	6.5	0.9	0.9	$0.80	$0.20	$1.00	$1.00	$0.00	25	na	6.9	na	8.5	na	10.1

Notes: 13%

Transmission & Distribution Losses: ***0%***

Type	Technology	Annual Consumption kWh/ft2.yr	Energy Savings 1 kWh/ft2.yr	Energy Savings 2 kWh/ft2.yr	Technology Costs Material $/ft2	Technology Costs Installation $/ft2	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline	Single-storey commercial building wth a R20 roof and an electric heating EUI of 11.7 kWh/ft^2.yr.	11.7			$0.00	$0.00	$0.00		$0.00	25						
Upgrade 1	Upgrade roof insulation to R30	10.2	1.5	1.5	$0.80	$0.20	$1.00	$1.00	$0.00	25	na	4.4	na	5.3	na	6.4

Baseline This measure is evaluated at both a high and low heating load (Island and Labrador) **13%**

Upgrade 1 This measure consists of adding an additional 50 mm (2 in.) of polystyrene insulation (R5/in.) to a flat roof at the time of roof replacement (R20 to R30).
Savings based on CEEAM model for school and non-food retail buildings.
Costs based on RS Means: material $0.80/ft²; and installation $0.20/ft².

Exhibit B.25: Energy Efficiency Upgrades - Air Curtains

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/yr	kWh/yr	Material $	Installation $	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	A 5,000 ft2 non-food retail building with a "double door" entranceway and an electric heating EUI of 8.6 kWh/ft^2/yr.	43,000			$0	$0	$0		$0	15						
Upgrade 1	Air curtain with rated effectiveness of 90% installed on double door.	39,196	3,804	3,804	$1,650	$500	$2,150	$2,150	$0	15	5.1	5.1	5.8	5.8	6.6	6.6

Notes: 9%

Transmission & Distribution Losses: ***0%***

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/yr	kWh/yr	Material $	Installation $	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	A 5,000 ft2 non-food retail building with a "double door" entranceway and an electric heating EUI of 11.7 kWh/ft^2/yr.	58,500			$0	$0	$0		$0	15						
Upgrade 1	Air curtain with rated effectiveness of 90% installed on double door.	52,697	5,803	5,803	$1,650	$500	$2,150	$2,150	$0	15	3.3	3.3	3.8	3.8	4.3	4.3

Baseline — This measure is evaluated at both a high and low heating load (Island and Labrador)

10%

Upgrade 1 — This upgrade consists of installing an air curtain (Enershield MCS-72) on the main double doors of a non food retail building.
It is assumed that the door is open for at least one hour per day and that the air curtain has an effectiveness of 90%
Installed cost is $2,150 as per supplier information and RS Means
The service life is estimated to be 15 years.

www.enershield.ca

Exhibit B.26: Energy Efficiency Upgrades - New Building Construction

Type	Technology	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr	Life (yrs)	CCEs (¢/kWh)					
											D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
					Material	Installation	Full	Incremental	Ann.							
		kWh/ft².yr	kWh/ft².yr	kWh/ft².yr	$/ft²	$/ft²	$/ft²	$/ft²	O&M		Full	Incr.	Full	Incr.	Full	Incr.
v Bldg. Base	New commercial 40,000 ft² building with an electrical EUI of 26 kWh/ft².yr	26.0			$0	$0	$0		$0.00	30						
Upgrade 1	New commercial building - 25% better than current practice	19.5	6.5	6.5	$1.00	$0	$1	$1.00	$0.00	30	na	0.9	na	1.1	na	1.4
Upgrade 2	New commercial building - 40% better than current practice	15.6	10.4	10.4	$4.50	$0	$5	$4.50	$0.00	30	na	2.5	na	3.1	na	3.8

Notes:

Transmission & Distribution Losses: ***0%***

Upgrade 1 New commercial construction with a performance of 25% better than current practice with an incremental cost of $1 square foot. (Source ACEEE)

Upgrade 2 New commercial construction with a performance of 40% better than current practice with an incremental cost of $1 square foot. This level is performance is consistent with C-2000 standards and is estimated to carry a cost premium of 3% which equates to $4.50 per square foot assuming $150 per square foot for commercial construction.

Exhibit B.27: Energy Efficiency Upgrades - Street Lighting

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
													D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	Material $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard 175 W MH luminaire (4100 hrs)	200	4100	820			$0	$0	$0		$0.00	16						
Upgrade 1	150 W induction luminaire	150	4100	615	205	205	$300	$0	$300	$300	-$4.38	16	na	10.4	na	12.3	na	14.4

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Savings 1	Energy Savings 2	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
													D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	Material $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	Standard 250 W HPS luminaire (4100 hrs)	305	4100	1,251			$0	$0	$0		$0.00	16						
Upgrade 2	Dimming controls	305	2870	875	375	375	$160	$60	$220	$220	$0.00	16	5.0	5.0	5.8	5.8	6.6	6.6

Notes:
Transmission & Distribution Losses: ***0%***

Upgrade 1 — Upgrade 1 is a 150 W OSRAM/Sylvania Icetron induction luminaire producing 10,000 lumens for 100,000 hours, and at an incremental cost of $300 (BPA).

Upgrade 2 — Upgrade 2 is the installation of dimming controls to reduce or shut off lighting during silent periods. The savings is estimated at 30% and the cost is estimated to be $220 per luminaire. ($160 materials (pers. comm.)+ $60 installation (estimated). The measure is based on the STI Lumen IQ street light control system. www.streetlightiq.com

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APPENDIX C

Achievable Workshop Opportunity Profiles

Table of Contents

Opportunity Profile

C1 – T8 FLUORESCENT UPGRADES (T12 BASELINE)

Overview:

- General lighting in the commercial building stock is typically a mix of fluorescent T12 and T8 lighting systems.
- This Opportunity Profile covers the replacement of T12 lighting systems with advanced T8 technologies in commercial buildings.
- Our discussion will be based on office buildings and will focus on the three standard approaches to achieving lighting energy savings:
  - Redesign with advanced T8s (new layout, fewer fixtures, lower light levels)
  - Retrofit with advanced T8s (relamp/reballast)
  - Occupancy controls (occupancy sensors, time-of day scheduling, etc.)
- The target market is the remaining stock of T12 lighting

Target Technologies and Building Types:

- The target technologies include: redesign with advanced T8s, retrofit with advanced T8s and controls as outlined above.
- The target market includes all existing commercial buildings with T12 lighting; however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland.
- The penetration of T12 lighting is estimated to be 60%

Opportunity Costs and Savings Profile:

- Redesign with advanced T8s: full cost $1.7/$ft^2$; savings 62%; CCE $0.056/kWh; simple payback 6 years.
- Retrofit with advanced T8s: full cost $1.0/$ft^2$; savings 39%; CCE $0.049/kWh; simple payback 6 years.
- Occupancy controls: full cost $0.5/$ft^2$; savings 30%; CCE $0.066 cents/kWh; simple payback 5 years.

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Lighting manufacturers and suppliers
- Lighting designers, IESNA
- Electrical maintenance contractors
- NRCan and Ministry of Energy re: lighting standards and regulations
- Performance contractors
- Commercial renovation contractors

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, improved light quality, productivity, longer life
  - Split incentive, e.g., lease arrangements – commercial “triple net lease” discourages owner participation
  - High paybacks, particularly for the redesign upgrades
  - Financing, e.g., access to capital
  - Lack of standards to differentiate “advanced” T8, manufacturer sets own protocol

Opportunities & Synergies:

- Phasing out of T12s through regulations
- Trade ally alliances, tying trade “partners” to qualified leads
- Opportunities for work environment improvements, customized to work function needs
- Link to renovation upgrades, building sales

Opportunity Profile

C2 – T8 FLUORESCENT UPGRADES (T8 BASELINE)

Overview:

- Similar to C1, this Opportunity Profile covers the replacement of standard T8 lighting systems with advanced T8 technologies in commercial buildings
- Our discussion will be based on office buildings and will focus on the three standard approaches to achieving lighting energy savings:
  - Redesign with advanced T8s (new layout, fewer fixtures, lower light levels)
  - Retrofit with advanced T8s (relamp/reballast)
  - Occupancy controls (occupancy sensors, time-of day scheduling, etc.)
- The target market is the stock of standard T8 lighting.

Target Technologies and Building Types:

- The target technologies include: redesign with advanced T8s, retrofit with advanced T8s and controls as outlined above.
- The target market includes all existing commercial buildings with standard T8 lighting (end of lighting life cycle or renovation/fit-up); however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland.
- The penetration of T8 lighting is estimated to be 40%

Opportunity Costs and Savings Profile:

- Redesign with advanced T8s: incremental cost $0.00/$ft^2$; savings 48%; CCE $0.00/kWh; simple payback 0 years.
- Retrofit with advanced T8s: incremental cost $0.20/$ft^2$; savings 17%; CCE $0.021/kWh; simple payback 3 years.
- Occupancy controls: full cost $0.50/$ft^2$; savings 30%; CCE $0.066 cents/kWh; simple payback 5 years.

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Lighting manufacturers and suppliers
- Lighting designers, IESNA
- Lighting and electrical contractors
- NRCan and Ministry of Energy re: lighting standards and regulations

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, improved light quality, productivity, longer life
  - Split incentive, e.g., lease arrangements
  - High paybacks
  - Financing, e.g., access to capital
  - Lack of standards to differentiate “advanced” T8, manufacturer sets own protocol

Opportunities & Synergies:

- Phasing out of T12s through regulations (many buildings have a mix of T12 and T8)
- Trade ally alliances, tying trade “partners” to qualified leads
- Opportunities for work environment improvements, customized to work function needs
- Link to renovation upgrades, building sales

Opportunity Profile

C3 – INCANDESCENT UPGRADES

Overview:

- Secondary lighting in the commercial building stock is typically a mix of incandescent light sources
- This Opportunity Profile covers the replacement of incandescent lamps with incandescent upgrades in commercial buildings
- Our discussion will be based on office buildings and will focus on two standard incandescent upgrade technologies:
  - Incandescent to CFL
  - Incandescent to LED exit sign
- The target market is the remaining stock of incandescent lighting

Target Technologies and Building Types:

- The target technologies include: incandescent to CFL and incandescent to LED exit sign
- The target market is all existing commercial buildings with incandescent lighting; however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland
- The penetration of CFLs is estimated at 45% and the penetration of LED exit signs is estimated at 40%

Opportunity Costs and Savings Profile:

- CFLs: full cost $22; savings 69%; CCE $0.029/kWh; simple payback 1.5 years.
- LED exit sign: full cost $70; savings 93%; CCE $0.02/kWh; simple payback 3 years

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Lighting manufacturers and suppliers
- Lighting designers, IESNA
- Lighting and electrical contractors
- NRCan and Ministry of Energy re: lighting standards and regulations

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, maintenance savings, longer life
  - Split incentive, e.g., lease arrangements
  - Financing, e.g., access to capital

Opportunities & Synergies:

- Heightened public awareness and visibility of CFL
- Possible federal incandescent phase-out

Opportunity Profile

C4 – BUILDING ENVELOPE MEASURES

Overview:

- This Opportunity Profile covers building envelope upgrades in commercial buildings
- Our discussion will be based on office buildings and will focus on the three building envelope measures profiled in this study:
  - High-performance glazing systems
  - Upgrade wall insulation
  - Upgrade roof insulation
- The target market is all commercial buildings

Target Measures and Building Types:

- The target measures include: high-performance glazing systems, upgrade wall insulation, upgrade roof insulation
- The target market is all existing commercial buildings (end of envelope life cycle); however, the focus of our discussion is existing office buildings (> 40,000 ft^2) in Newfoundland

Opportunity Costs and Savings Profile:

- High-performance glazing systems: incremental cost $2.00/$ft^2$; savings 28% of heating and cooling energy; CCE $0.065/kWh; simple payback 8 years
- Upgrade wall insulation: incremental cost $1.4/$ft^2$; savings 18% of heating energy; CCE 7.4 cents/kWh; simple payback 10 years
- Upgrade roof insulation: incremental cost $1.00/$ft^2$; savings 13% of heating energy; CCE $0.065/kWh; simple payback 8 years

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Roofing and general contractors
- Maintenance contractors

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, comfort improvements
  - Split incentive, e.g., lease arrangements

Opportunities & Synergies:

- Potential synergies with a similar residential program

Opportunity Profile

C5 – BUILDING RECOMMISSIONING & ADVANCED BAS

Overview:

- This Opportunity Profile covers HVAC recommissioning and the application of advanced building automation systems (BAS) in commercial buildings
- Our discussion will be based on office buildings and will focus on the two main components of this opportunity:
  - Building recommissioning involves monitoring, diagnostics, simulation, rebalancing and control optimization
  - Advanced BAS involves expanded control to the zone level, integrated control strategies, diagnostics and self-tuning algorithms

Target Technologies and Building Types:

- The target technologies include building recommissioning and advanced BAS
- The target market is all existing commercial buildings; however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland

Opportunity Costs and Savings Profile:

- Building recommissioning: full cost \$0.60/ft^2; savings 13% of total, 20% of HVAC energy use; CCE \$0.043/kWh; simple payback 2 years
- Advanced BAS: full cost \$0.90/ft^2; savings 10% of total; CCE \$0.047/kWh; simple payback 4 years

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Controls suppliers and contractors, commissioning contractors
- Engineering practitioners, designers, building technicians
- ASHRAE

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, improved comfort and productivity, longer equipment life
  - Inadequate maintenance and operation of facilities
  - Split incentive, e.g., lease arrangements
  - High costs
  - Financing, e.g., access to capital

Opportunities & Synergies:

- Computerized direct digital control (DDC) systems costs have been dropping resulting in the use of more control points per building and the application of BAS in smaller buildings
- High operating and maintenance costs stimulate uptake of recommissioning and BAS
- Expansion and maturation of data communication protocols (BACnet, LON) and Web-based communications

Opportunity Profile

C6 – GROUND SOURCE HEAT PUMPS

Overview:

- Standard HVAC systems typically consist of electric resistance heating and the vapour compression cycle for cooling
- This Opportunity Profile covers upgrading standard HVAC systems with ground source heat pumps (GSHP) in commercial buildings
- A GSHP is a heat pump that uses the Earth as either a heat source, when operating in heating mode, or a heat sink, when operating in cooling mode
- Our discussion will be based on office buildings and will focus on the GSHP measure profiled in this study
- The target market is all commercial buildings

Target Measures and Building Types:

- The target measure is: ground source heat pumps
- The target market is all existing commercial buildings (end of the HVAC life cycle or major renovation); however, the focus of our discussion is existing office buildings (> 40,000 ft^2) in Newfoundland

Opportunity Costs and Savings Profile:

- GSHP: incremental cost $4.90/$ft^2$; savings 60% of heating and cooling energy; CCE $0.073/kWh; simple payback 9 years

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- HVAC manufacturers and suppliers
- HVAC engineers, ASHRAE
- HVAC contractors
- Performance contractors/ESCOs

Constraints & Challenges:

- The most significant barriers are:
  - Lack of customer awareness, e.g., energy savings, environmental benefits
  - Long-term investment.
  - Split incentive, e.g., lease arrangements

Opportunities & Synergies:

- “Corporate greening” initiatives
- Current high profile of renewable resources

Opportunity Profile

C7 – ADVANCED NEW COMMERCIAL BUILDING CONSTRUCTION

Overview:

- This Opportunity Profile covers advanced new commercial buildings that are designed using the integrated design process and energy-efficient technologies to achieve substantial improvements over conventional new buildings
- Our discussion will be based on office buildings and will focus on the two new construction measures profiled in this study:
  - New commercial building 25% more efficient than current standards – involves the integrated design approach to identify and apply energy-efficiency measures to the building envelope, lighting and HVAC systems (similar to LEED Certified buildings)
  - New commercial building 40% more efficient than current standards is similar to the above but requires a very high-performance design that results in significant equipment downsizing (similar to LEED Gold buildings)
- The target market is new commercial buildings

Target Technologies and Building Types:

- The target technologies include: new commercial building (40%) and new commercial building (25%)
- The target market is all new commercial buildings; however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland

Opportunity Costs and Savings Profile:

- New commercial building 40%: incremental costs $4.50/$ft^2$; savings 40%; CCE $0.031/kWh; simple payback 5 years
- New commercial building 25%: incremental costs $1.00/$ft^2$; savings 25%; CCE $0.011 cents/kWh; simple payback 2 years

Target Audience(s) & Potential Delivery Allies:

- Owners, developers, facility managers, BOMA members
- Architects, engineers, design consultants (LEED, Green Building)
- General, mechanical contractors
- NRCan, municipal planning and development

Constraints & Challenges:

- The most significant barriers to the design of high performance commercial buildings:
  - Lack of customer awareness, e.g., energy savings, improved comfort and productivity, longer equipment life
  - Inadequate maintenance and operation of facilities
  - Split incentive, e.g., lease arrangements
  - High costs
  - Financing, e.g., access to capital
  - Lack of qualified infrastructure to complete modelling and analysis
  - Development constraints on decision makers in complex development/design/construction process

Opportunities & Synergies:

- LEED practice and protocols better established, opportunity to leverage case study examples, cost analyses

Opportunity Profile

C8 – ENERGY STAR COMPUTER EQUIPMENT

Overview:

- Most computers are left on and operate under default power management settings
- This Opportunity Profile covers the replacement of standard computers and monitors with equivalent ENERGY STAR rated units in commercial buildings
- Our discussion will be based on office buildings and will focus on ENERGY STAR computers and monitors profiled in this study
- The target market is the existing stock of non-ENERGY STAR computer equipment

Target Technologies and Building Types:

- The target technologies include ENERGY STAR rated computers and monitors. The target market is all existing commercial buildings with non-Energy Star rated computer equipment; however, the focus of our discussion is office buildings (> 40,000 ft^2) in Newfoundland
- The penetration of ENERGY STAR rated computers and monitors is estimated to be 25%

Opportunity Costs and Savings Profile:

- ENERGY STAR computers & monitors: incremental cost $0; savings 75%; CCE $0.00/kWh; simple payback 0 years

Target Audience(s) & Potential Delivery Allies:

- IT managers, corporate managers
- Procurement personnel
- Suppliers and retailers
- Manufacturers
- NRCan – ENERGY STAR promotion and incentives

Constraints & Challenges:

- The most significant barriers are:
  - Lack of user awareness, e.g., energy savings
  - Lack of corporate energy-efficiency purchasing guidelines.
  - IT managers do not routinely consider energy efficiency when procuring computer equipment

Opportunities & Synergies:

- A residential ENERGY STAR program would generate interest and participation in a similar commercial program.

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APPENDIX D

Achievable Workshop Opportunity Worksheets

Table of Contents

Commercial Sector -- Opportunity C1 -- T8 Fluorescent Upgrade (T12 Baseline)

Sub Sector		Office - Existing				
Total Economic Savings Potential (GWh/yr) in 2026	General and Secondary Lighting	23				
Market Size	# of sites (approx.)	381				
	ft2 (approx.)	15,250,000				
	% eligible	60%				
	# eligible sites	229				
Major Technologies & Approx. Contribution to Economic Potential Savings	Redesign	39%				
	Advanced T8	57%				
	Occupancy Sensors	3%				
	Sub total:	100%				
Approx CCE (c/kWh)	Redesign + AT8	5.6	Full Cost			
	Retrofit with AT8	4.9	Full Cost			
	Occupancy Sensors	6.6	Full Cost			
Approx payback (years)	Redesign + AT8	6				
	Retrofit with AT8	6				
	Occupancy Sensors	5				
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***	
Lighting Redesign + AT8	*Lower*					
	Upper					
Lighting Retrofit with AT8	*Lower*					
	Upper					
Occupancy Sensors	*Lower*					
	Upper					
Savings, by Year (GWh/yr)		***F2011***	***F2016***	***F2021***	***F2026***	
Lighting Redesign + AT8	*Lower*					
	Upper					
Lighting Retrofit with AT8	*Lower*					
	Upper					
Occupancy Sensors	*Lower*					
	Upper					
Total	*Lower*					
	Upper					

Commercial Sector -- Opportunity C2 -- T8 Fluorescent Upgrade (T8 baseline)

Sub Sector		Office - Existing			
Total Economic Savings Potential (GWh/yr) in 2026	General and Secondary Lighting.	13			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	40%			
	# eligible sites	152			
Major Technologies & Approx. Contribution to Economic Potential Savings	Redesign	63%			
	Advanced T8	34%			
	Occupancy Sensors	2%			
	Sub total:	100%			
Approx CCE (c/kWh)	Redesign + AT8	0.0	Incremental		
	Retrofit with AT8	2.1	Incremental		
	Occupancy Sensors	6.6	Full Cost		
Approx payback (years)	Redesign + AT8	0			
	Retrofit with AT8	3			
	Occupancy Sensors	5			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
Lighting Redesign + AT8	*Lower*				
	Upper				
Lighting Retrofit with AT8	*Lower*				
	Upper				
Occupancy Sensors	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***F2011***	***F2016***	***F2021***	***F2026***
Lighting Redesign + AT8	*Lower*				
	Upper				
Lighting Retrofit with AT8	*Lower*				
	Upper				
Occupancy Sensors	*Lower*				
	Upper				
Total	*Lower*				
	Upper				

Commercial Sector -- Opportunity C3 -- Incandescent Upgrades

Sub Sector		**Office - Existing**			
Total Economic Savings Potential (GWh/yr) in 2026	General and Secondary Lighting	10			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	50%	Approx. 60% for LED exit sign		
	# eligible sites	191			
Major Technologies & Approx. Contribution to Economic Potential Savings	CFL	100%			
	LED Exit Sign	0%			
	Other Technologies	0%			
	Sub total:	100%			
Approx CCE (c/kWh)	CFL	2.9	Full Cost		
	LED Exit Sign	2.0	Full Cost		
	Other Technologies	0.5 - 5.0	Full Cost		
Approx payback (years)	CFL	1.4			
	LED Exit Sign	3			
	Other Technologies	1 - 3			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
Relamp Incandescent with CFL	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
Relamp Incandescent with CFL	*Lower*				
	Upper				
Total	*Lower*				
	Upper				

Commercial Sector -- Opportunity C4 -- Building Envelope Measures

Sub Sector		Office - Existing			
Total Economic Savings Potential (GWh/yr) in F2026	Space Heating	49			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	79%			
	# eligible sites	301			
Major Technologies & Approx. Contribution to Economic Potential Savings	High Performance Glazing	75%			
	Wall Insulation	13%			
	Roof Insulation	11%			
	Sub total:	100%			
Approx CCE (c/kWh)	High Performance Glazing	6.5	Incremental		
	Wall Insulation	7.4	Incremental		
	Roof Insulation	8.5	Incremental		
Approx payback (years)	High Performance Glazing	8			
	Wall Insulation	10			
	Roof Insulation	12			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
High Performance Glazing	*Lower*				
	Upper				
Wall Insulation	*Lower*				
	Upper				
Roof Insulation	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
High Performance Glazing	*Lower*				
	Upper				
Wall Insulation	*Lower*				
	Upper				
Roof Insulation	*Lower*				
	Upper				
Total	*Lower*				
	Upper				

Commercial Sector -- Opportunity C5 -- HVAC Recommissioning and Advanced BAS

Sub Sector		Office - Existing			
Total Economic Savings Potential (GWh/yr) in 2026	HVAC	35			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	90%			
	# eligible sites	343			
Major Technologies & Approx. Contribution to Economic Potential Savings	HVAC Recommissioning	40%			
	Advanced BAS	60%			
	Sub total:	100%			
Approx CCE (c/kWh)	HVAC Recommissioning	4.3	Full Cost		
	Advanced BAS	4.7	Full Cost		
Approx payback (years)	HVAC Recommissioning	2			
	Advanced BAS	4			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
HVAC Recommissioning	*Lower*				
	Upper				
Advanced BAS	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
HVAC Recommissioning	*Lower*				
	Upper				
Advanced BAS	*Lower*				
	Upper				
Total	*Lower*				
	Upper				

Commercial Sector -- Opportunity C6 -- Ground Source Heat Pumps

Sub Sector		Office - Existing				
Total Economic Savings Potential (GWh/yr) in 2026	HVAC	14				
Market Size	# of sites (approx.)	381				
	ft2 (approx.)	15,250,000				
	% eligible	40%				
	# eligible sites	152				
Major Technologies & Approx. Contribution to Economic Potential Savings	GSHP	100%				
	Sub total:	100%				
Approx CCE (c/kWh)	GSHP	7.4	Incremental			
Approx payback (years)	GSHP	9				
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***	
GSHP	*Lower*					
	Upper					
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***	
GSHP	*Lower*					
	Upper					
Total	*Lower*					
	Upper					

Commercial Sector -- Opportunity C7 -- Advanced New Commercial Construction

Sub Sector		Office - New			
Total Economic Savings Potential (GWh/yr)	Approx. Savings in New Buildings to 2011	3.1			
	New Bldings Built 2012 to 2016	3.2			
	New Bldings Built 2017 to 2021	3.8			
	New Bldings Built 2022 to 2026	4.0			
Market - New Buildings	Approx. # New Buildings to 2011	17			
	New Buildings 2012 to 2016	17			
	New Buildings 2017 to 2021	21			
	New Buildings 2022 to 2026	22			
Major Technologies & Approx. Contribution to Economic Potential Savings	Current Practice - 40%	100%			
	Current Practice - 25%	0%			
	Sub total:	100%			
Approx CCE (c/kWh)	Current Practice - 40%	3.1	Incremental		
	Current Practice - 25%	1.1	Incremental		
Approx payback (years)	Current Practice - 40%	5			
	Current Practice - 25%	2			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
Current Practice - 40%	*Lower*				
	Upper				
Remaining Eligible Buildings	*Lower*	17	17	21	22
	Upper	17	17	21	22
Current Practice -25%	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
Current Practice - 40%	*Lower*				
	Upper				
Current Practice -25%	*Lower*				
	Upper				
Total	*Lower*	0.0	0.0	0.0	0.0
	Upper	0.0	0.0	0.0	0.0

Commercial Sector -- Opportunity C8 -- Energy Star Computer Equipment

Sub Sector		Office - Existing			
Total Economic Savings Potential (GWh/yr) in F2026	Energy Star Computer and Plug Loads	23			
Market Size	# of sites (approx.)	381			
	ft2 (approx.)	15,250,000			
	% eligible	75%			
	# eligible sites	286			
	# computers (approx.)	38,000			
Major Technologies & Approx. Contribution to Economic Potential Savings	Energy Star Computer	75%			
	Energy Star Office equip.	15%			
	Efficient Server Technology	10%			
	Sub total:	100%			
Approx CCE (c/kWh)	Energy Star Computer	0.0	Incremental		
Approx payback (years)	Energy Star Computer	0			
Participation Rates, by Year (% of Eligible Sites)		***2011***	***2016***	***2021***	***2026***
Energy Star Computer	*Lower*				
	Upper				
Energy Star Office equip.	*Lower*				
	Upper				
Efficient Server Technology	*Lower*				
	Upper				
Savings, by Year (GWh/yr)		***2011***	***2016***	***2021***	***2026***
Energy Star Computer	*Lower*				
	Upper				
Energy Star Office equip.	*Lower*				
	Upper				
Efficient Server Technology	*Lower*				
	Upper				
Total	*Lower*				
	Upper				

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APPENDIX E

LOADLIB Model Description

Electric Demand Modelling, AEG Model Description

The modeling of electric demand employs Applied Energy Group's (AEG) Cross-Sector Load Shape Library Model (LOADLIB). The load shape library, as implemented through the AEG LOADLIB Model, provides a means for organizing, documenting and reporting statistics on load shapes for use in various applications, including load research, load forecasting, load aggregation, and demand-side management impact analysis.

LOADLIB uses a per-unit structure data format that facilitates calibration of load data to take advantage of known statistics and best sources, and scaling of load data to match target consumption levels. The format was developed by AEG to provide a means of more easily describing load profiles in a way that is both flexible and detailed. This format has supported many projects for numerous AEG clients since its first use in 1982. The 36-day format developed and used for the LOADLIB System consists of three hourly load profiles per month -- peak day, average weekday and average weekend day, and one set of ratios for each of twelve months. The format consists of four profile parameters, as follows:

- ***Monthly Usage Allocation:*** This allocation factor represents the percent of annual usage allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, residence, end use or appliance, and is dictated by weather or other factors. An equal allocation (1/12 each month, or 8.33%) would indicate no seasonality. This parameter can be calibrated to actual values using statistics such as monthly kWh from utility bills and weather (degree days).

- ***Peak Day Adjustment Factor***: This ratio reflects the degree of daily weather-sensitivity associated with the load shape, particularly heating or cooling, comparing a peak (e.g. hottest or coldest day) day to a typical day in that month. For overall facilities, this is typically dependent on the amount of air-conditioned or electrically-heated space in the facility and the weather conditions of the area in which it is located. A highly air-conditioned office space in a warm climate may have a peak day adjustment factor of as much as 1.5 - 1.6, while an unconditioned space with no difference between peak days and typical days might have a factor of 1.0.

- ***Weekend to Weekday Ratio***: This ratio describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. For example, residential customers will have weekend to weekday ratios close to 1.0 or even slightly greater than 1.0, because residential consumption levels on weekend days and weekdays are generally about the same, although they may occur at different times of the day. For offices, weekend to weekday ratios will vary between 60-80% of weekdays, depending on the degree of weekend operations, i.e., whether it is a 5-day only operation, vs. six or seven days.

- ***Per-Unit Hourly Profiles***: The relationship of load among different hours of the day for each day type (weekday, weekend day, peak day) and for each month reflects the operating hours of the electric equipment, facility or residence. In the case of businesses, the hourly energy profile reflects when the business operates, as well as what equipment (such as lighting and air conditioning) operates during off-hours. For example, a large office building open from 9-5 on weekdays will have close to full energy consumption levels (80-100%) during the day, then drop to 50-60% of peak levels during the evening and 30-40% of peak levels overnight. The overnight consumption typically includes security lighting, 24-hour computer operations, and other 24-hour equipment (refrigerators, clocks).

The resulting complete load shape description can be easily calibrated to match known statistics such as monthly billing or weather, and produce any relevant statistic that may be required to convert annual energy to monthly energy, daily energy, and peak demands for any hour and for any month. An offshoot of the LOADLIB analysis is a set of standard statistics that can be used as inputs to many other energy models, including load factors, coincidence factors, average and peak demands, hours-use, and calculation of bills for various rate structures.

CONSERVATION AND DEMAND MANAGEMENT (CDM) POTENTIAL

NEWFOUNDLAND and LABRADOR

Industrial Sector

–Final Report–

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EXECUTIVE SUMMARY

❑ Background and Objectives

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province's future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report meets, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five-year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

❑ Scope and Organization

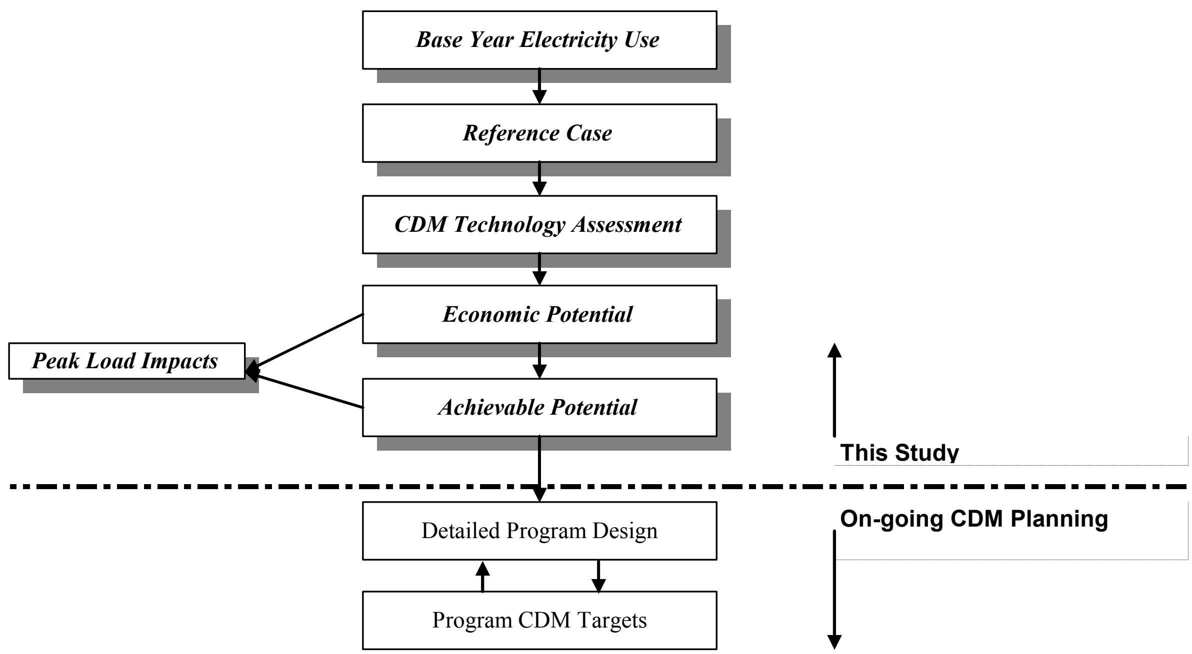
This study covers a 20-year study period from 2006 to 2026 and addresses the Residential, Commercial and Industrial sectors as well as street lighting. The study addresses the customers from both utilities. Due to differences in cost and rate structures, the Utilities' customers are organized into two service regions, which in this report are referred to as the Island and Isolated, and the Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island service region due to their relatively small size and electricity usage. The study reviews all commercially viable electrical efficiency technologies or measures.

❑ Approach

It was agreed that the Industrial sector, including the large transmission level customers, would be treated at a much higher level than the Residential and Commercial sectors, The detailed end-use analysis of electrical efficiency opportunities in the Industrial sector employed Marbek's customized spreadsheet model. The model is organized by major industrial sub sector and major end use. The sub sectors and end uses are described in detail in Section 2.

The major steps involved in the analysis are shown in Exhibit ES1 and are discussed in greater detail in Section 1. As illustrated in Exhibit ES1, the results of this study, and in particular the estimation of Achievable Potential,[1] support the on-going work of the Utilities; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific targets or with program design.

Exhibit ES1: Study Approach - Major Analytical Steps



❑ Overall Study Findings

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies and the rate of future growth in the stock of industrial buildings are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgement of the consultant team, Utilities' personnel and local experts.

[1] The proportion of savings identified that could realistically be achieved within the study period without consideration of budgetary constraints.

The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

The study findings confirm the existence of significant potential cost-effective opportunities for CDM in Newfoundland and Labrador's Industrial sector. Electricity savings from efficiency improvements within the Island and Isolated service region would provide between 125 and 59 GWh/yr. of electricity savings by 2026 in, respectively, the Upper and Lower Achievable scenarios. The most significant Achievable Savings opportunities were in the actions that addressed motors and compressed air, and refrigeration/freezing and cooling for the Small and Medium Sector, and process specific equipment in the Large Industrial Sector.

- **Summary of Electricity Savings**

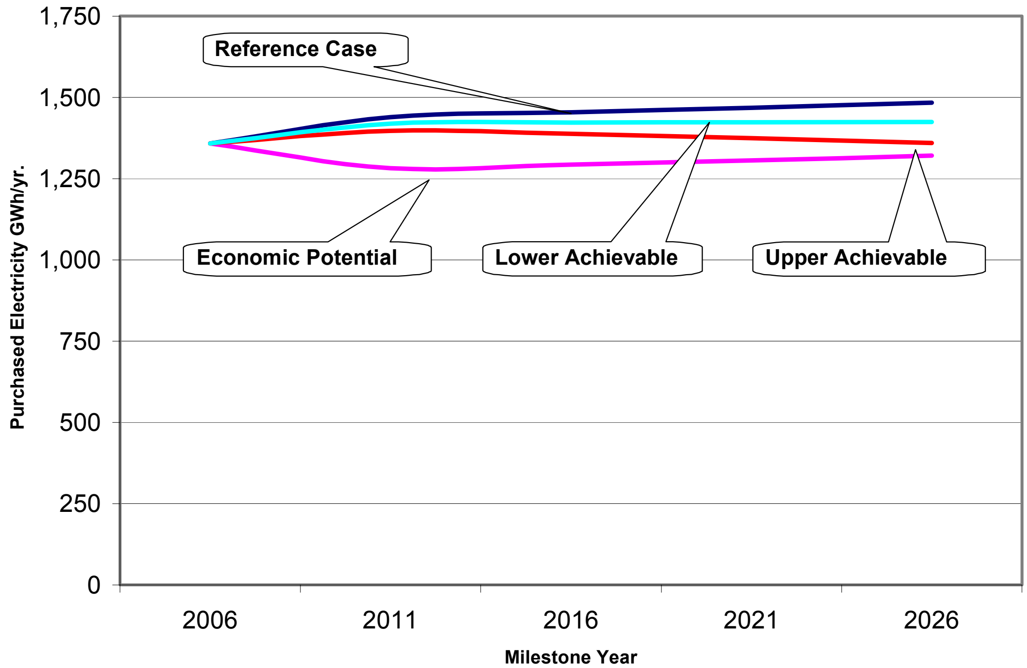
A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by the study is presented in Exhibits ES2 and ES3, by milestone year, and discussed briefly in the paragraphs below.

Exhibit ES2: Summary of Forecast Results for the Island and Isolated Service Region – Annual Purchased Electricity Consumption,* Industrial Sector (GWh/yr.)

Annual Consumption (GWh/yr.)						Potential Annual Savings		
Milestone Year	Base Year	Reference Case	Economic	Achievable		Economic	Achievable	
				Upper	Lower		Upper	Lower
2006	1,359	1,359						
2011		1,440	1,282	1,397	1,419	158	43	21
2016		1,454	1,293	1,388	1,422	161	66	32
2021		1,468	1,306	1,375	1,424	162	93	44
2026		1,484	1,321	1,360	1,425	164	125	59

**Results are measured at the customer's point-of-use and do not include line losses and exclude self-generation of about 3,200 GWh/yr.*

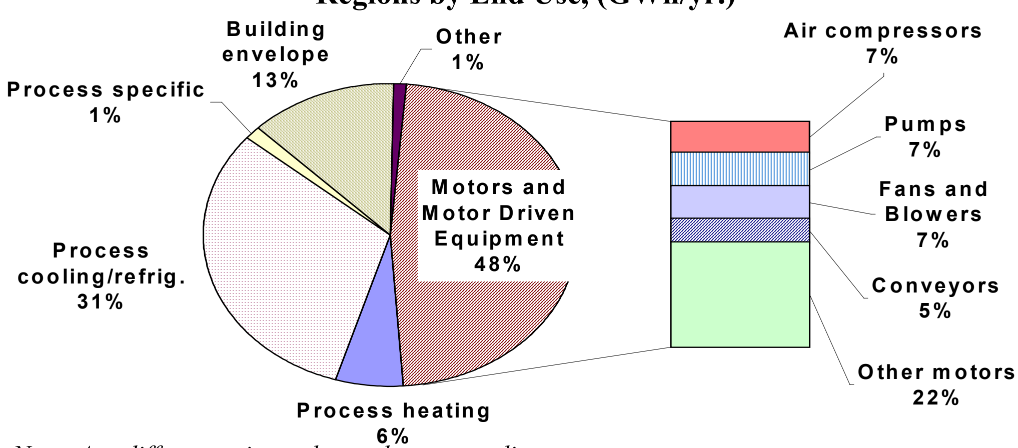
Exhibit ES3: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in the Industrial Sector (GWh/yr.)



Base Year Electricity Use

In the Base Year of 2006, the Island and Isolated and Labrador Interconnected service regions consumed about 4,558 GWh, of which 1,359 GWh was purchased electricity. The Large Industrial sub sector consumed 79% of the total purchased electricity. Exhibit ES4 shows the purchase electricity use by end use for the Small and Medium Industrial sector. Most of the electricity is used by motor and motor drive equipment (48%) and process cooling and refrigeration/freezing (31%).

Exhibit ES4: Small and Medium Industry Base Year Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by End Use, (GWh/yr.)



Note: Any differences in totals are due to rounding.

Reference Case

In the absence of new Utilities CDM initiatives, the study estimates that purchased electricity consumption in the Industrial sector will grow from 1,359 GWh/yr. in 2006 to about 1,484 GWh/yr. by 2026 in the Island and Isolated and Labrador Interconnected service regions. This represents an overall growth of about 9% in the period and compares very closely with NLH's load forecast, which also included consideration of the impacts of "natural conservation" for the Small and Medium Industrial sectors.

Economic Potential Forecast

Under the conditions of the Economic Potential Forecast,[2] the study estimated that electricity consumption in the Industrial sector would decline to about 1,321 GWh/yr. by 2026 in the Island and Isolated and Labrador Interconnected service regions. Annual savings relative to the Reference Case are 164 GWh/yr. or about 11%.

Achievable Potential

The Achievable Potential is the proportion of the economic electricity savings (as noted above) that could realistically be achieved within the study period. In the Industrial sector within the Island and Isolated and Labrador Interconnected service regions, the Achievable Potential for electricity savings was estimated to be 125 GWh/yr. and 59 GWh/yr. by 2026 in, respectively, the Upper and Lower scenarios.

The most significant Achievable savings opportunities were in the actions that addressed motors and compressed air, refrigeration/freezing and cooling for the Small and Medium Industrial Sectors, and process specific equipment in the Large Industrial sector.

[2] The level of electricity consumption that would occur if all equipment were upgraded to the level that is cost effective against future avoided electricity costs.

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APPENDICES

List of Exhibits

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province's s future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report is prepared to meet, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

1.2 STUDY SCOPE

The scope of this study is summarized below.

- **Sector Coverage:** This study addresses the Residential, Commercial and Industrial sectors as well as street lighting. It was agreed that the Industrial sector, including the large transmission level customers, would be treated at a much higher level than the Residential and Commercial sectors.

- **Geographical Coverage**: The study addresses the customers from both utilities. Due to differences in cost and rate structures, the Utilities' customers are organized into two service regions, which in this report are referred to as the Island and Isolated and the Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island service region due to their relatively small size and electricity usage..

- **Study Period**: This study covers a 20-year period. The Base Year is the calendar year 2006, with milestone periods at five-year increments: 2011, 2016, 2021 and 2026. The Base Year of 2006 was selected as this was the most recent calendar year for which complete customer data were available.

- **Technologies:** The study addresses conservation and demand management (CDM) measures. CDM refers to a broad range of potential measures (see Section 1.3, Definitions); however, for the purposes of this study, it was agreed that the primary focus is on energy-efficiency measures. This includes measures that reduce electricity use, and for the Residential and Commercial sectors the associated capacity impact on a winter peak period was included.

1.2.1 Data Caveat

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the province's industrial electricity load and customer willingness to implement new CDM measures are particularly influential.

Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgement of the consultant team, client personnel and/or local experts. The reader should use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.3 DEFINITIONS

This study uses numerous terms that are unique to analyses and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study. A brief description of some of the most important terms and their application within this study is included below.

Base Year Electricity Use The Base Year is the starting point for the analysis. It provides a description of "where" and "how" electrical energy is currently used in the existing Industrial sector facilities. The results are calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2006.

Reference Case Electricity Use

The Reference Case Electricity Use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2006) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of "economic" and "achievable" electricity savings potentials. The Reference Case aligns well with the NLH Long Term Planning (PLF) Review Forecast, Summer/Fall 2006.

Conservation and Demand Management (CDM) Measures

CDM refers to a broad range of potential measures that can include: energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and self-generation/co-generation (displace load off of grid).

As noted in Section 1.2, it was agreed that the primary focus is on energy-efficiency measures and this includes measures that reduce electricity use.

The Cost of Conserved Energy (CCE)

The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Economic Potential Electricity Forecast

The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and facilities were upgraded to the level that is cost effective against the future avoided cost of electricity in the Newfoundland and Labrador Hydro service area (for this study, the value was set at $0.0980/kWh for the Island and Isolated service area and $0.0432/kWh for the Labrador Interconnected service area).[3]). All the energy-efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the preceding avoided cost of new electricity supply were incorporated into the Economic Potential Forecast.

Achievable Potential

The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. Achievable Potential recognizes that it is difficult to induce customers to

[3] Sensitivity analysis was also conducted using avoided cost values expected to prevail if the Lower Churchill/DC Link project is completed.

purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as "upper" and "lower."

1.4 APPROACH

To meet the objectives outlined above, the study was conducted within an iterative process that involved a number of well-defined steps. At the completion of each step, the client reviewed the results and, as applicable, revisions were identified and incorporated into the interim results. The study then progressed to the next step. A summary of the steps is presented below.

Step 1: **Develop Base Year Electricity Use Profile**

- Compile available data on the Utilities' industrial customers.
- Conduct "high-level" facility energy use survey of transmission level customers.
- Develop "high-level" technical profile of electricity use within the major industrial facilities, based on survey results, existing facility data, experience in other jurisdictions and study team experience.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.

Step 2: **Develop Reference Case Electricity Use Profile**

- Develop computer spreadsheet simulations of electricity use in each industrial sub sector and electricity end use.
- Compile data on forecast levels of growth in Industrial sub sectors, "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.

Step 3: **Identify and Assess Energy-efficiency Measures**

- Develop list of energy-efficiency measures.
- Compile cost and performance data for each measure.
- Identify the baseline technologies employed in the Reference Case, develop energy-efficiency upgrade options and associated electricity savings for each option and determine the CCE for each upgrade option.

Step 4: **Estimate Economic Electricity Savings Potential**

- Compile utility economic data on the forecast cost of new electricity generation; costs of $0.0980/kWh and $0.0432/kWh were selected as the economic screens for, respectively, the Island and Isolated and Labrador Interconnected service regions.
- Screen the identified energy-efficiency upgrade options from Step 3 against the utility economic data.
- Identify the energy-efficiency upgrade measures and industry sub sectors where the cost of saving one kilowatt of electricity is equal to, or less than, the cost of new electricity generation.

- Apply the economically attractive electrical efficiency measures from Step 3 within the energy use simulation model developed previously for the Reference Case.
- Determine annual electricity consumption in each industrial sub sector and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: **Estimate Achievable Potential Electricity Savings**

- "Bundle" the electricity reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a "high-level" implementation framework, including measure description, cost and savings profile, target sub sectors, potential delivery allies, barriers and possible synergies.
- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct workshop with industry, suppliers and engineering consulting representatives to define achievable potential.
- Determine achievable potential for each end use and sub sector.

1.5 ANALYTICAL MODEL

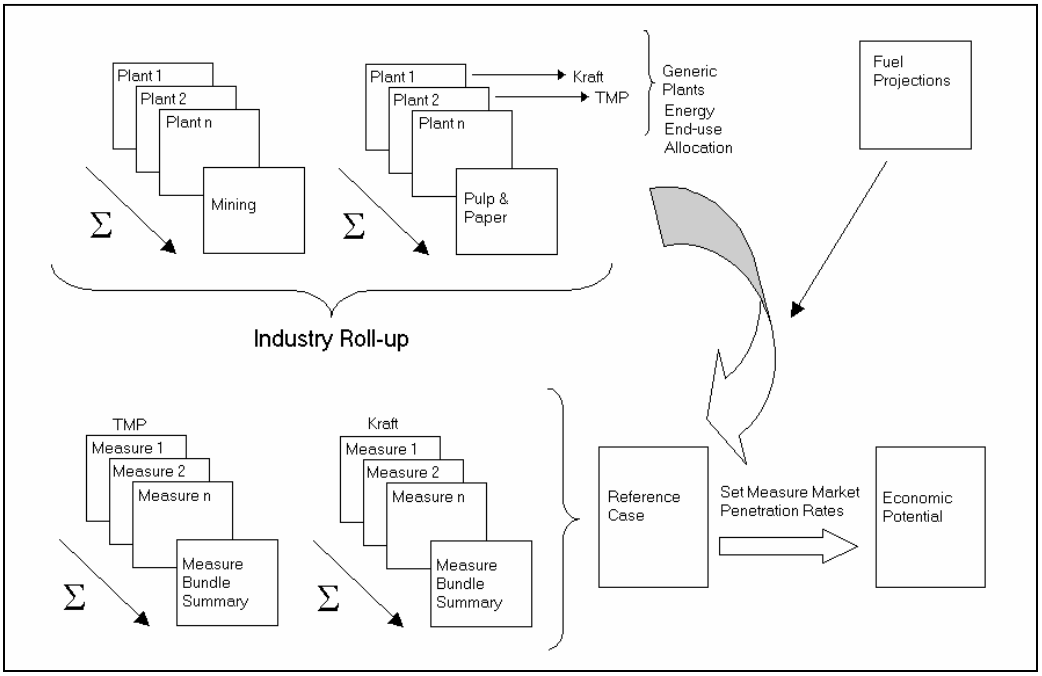
The analysis of the Industrial sector employed Marbek's customized spreadsheet model. The model is organized by major industrial sub sector and major end use. The sub sectors and end uses are described in detail in Section 2.

The model addresses each sub sector by defining a "generic" plant for the sub sector as a whole. Exhibit 1.1 illustrates how the model combines sub sector, end use, efficiency measures and fuel share data to generate the energy use forecasts used in the study.

The generic plant construct within the model is used to define an energy consumption profile representative of a "typical" or archetype plant within a given industry sub sector (or a specific type of plant within a given sub sector if there are substantial process differences). In Exhibit 1.1, the Pulp and Paper sub sector is used as an example with two archetype plants: TMP (thermomechanical pulping mill) and Kraft (kraft pulping mill). The generic plant is a composite of energy use patterns, energy intensities and consumption levels within the particular target sub sector. The candidate energy management measures are applied to the generic plant to model energy savings potential.

Marbek's existing stock of generic industrial plants was used as a starting point for the analysis. The model was customized to the specific Newfoundland and Labrador facilities based on a survey of Large industry and input from Newfoundland and Labrador study team experts familiar with the provincial industrial facilities.

Exhibit 1.1: Industry Model Diagram



Note:

- TMP :Thermomechanical pulping mill (Archetype plant in pulp and paper sector)
- Kraft: Kraft pulping mill (Archetype plant in pulp and paper sector)

1.6 STUDY ORGANIZATION AND REPORTS

The study was organized and conducted by sector using a common methodology, as outlined above. The results for each sector are presented in individual reports as well as in a summary report. They are entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential Sector*
- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Commercial Sector*
- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Industrial Sector*
- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential, Commercial and Industrial Sectors, Summary Report*

The study also prepared a brief CDM program evaluation report, which is entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Program Evaluation Guidelines.*

This report presents the Industrial sector results; it is organized as follows:

- Section 2 presents a profile of Industrial sector Base Year electricity use in Newfoundland and Labrador, including a discussion of the major steps involved and the data sources employed.

- Section 3 presents a profile of Industrial sector Reference Case electricity use in Newfoundland and Labrador for the study period 2006 to 2026, including a discussion of the major steps involved.

- Section 4 identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Industrial sector.

- Section 5 presents the Industrial sector Economic Potential Electricity Forecast for the study period 2006 to 2026.

- Section 6 presents the estimated Upper and Lower Achievable Potential for electricity savings for the study period 2006 to 2026.

- Section 7 presents conclusions and next steps.

- Section 8 presents a listing of major references.

2. BASE YEAR (F2006) ELECTRICITY USE

2.1 INTRODUCTION

This section provides a profile of Base Year (2006) electricity use in Newfoundland and Labrador's Industrial sector. The discussion is organized into the following subsections:

- Segmentation of Industrial Sector
- Definition of End Uses
- Development of Electricity Use Profiles
- Summary of Results.

2.2 SEGMENTATION OF INDUSTRIAL SECTOR

The first major task in developing the Base Year calibration involved the segmentation of the industrial customers into specific sub sectors. The choice of sub sectors was determined by the combination of four factors:

- Data availability
- The need to maintain customer confidentiality
- The need to facilitate subsequent analysis of potential electrical efficiency improvements, which means that there must be similarity in terms of major design and operating considerations, such as manufacturing process, hours of operation and product type
- The resources required to assess industrial facilities, especially with large industrial facilities being significantly different from each other. As noted in Section 1, it was agreed that the Industrial sector would be treated at a "high level."

A summary of the Industrial sub sectors that are used in this study is provided in Exhibit 2.1

Exhibit 2.1: Industrial Sub Sectors

- **Large Industrial** (includes: Pulp and Paper, Large Mining and Oil Refining)
- **Small and Medium Industrial**:
  - Fishing and Fish Processing
  - Manufacturing
  - Other

A brief description of the industrial customers included in each of the sub sectors shown in Exhibit 2.1 is provided below.

- **Large Industrial**. This classification is based on the amount of electricity used and not on production volumes or number of employees. Facilities included in this category use more than 50 GWh electricity annually. This sub sector consists of six transmission level customers from the following sub sectors: Mining, Pulp and Paper and Oil Refining.

- **Small and Medium Industrial.** Similar to the Large Industrial category, this category is based on the amount of electricity and includes facilities that use less than 50 GWh/yr. The following sub sectors are included:

  - **Fishing and Fish Processing**. This sub sector consists of approximately 175 facilities. This sub sector's monthly electricity consumption is seasonal (monthly consumption peaking in July and August; minimum usage from January to March). The monthly peak consumption is almost 3.5 times more than the minimum monthly consumption.

  - **Manufacturing.** This sub sector consists of approximately 135 facilities; monthly electricity consumption is relatively stable throughout the year.

  - **Other.** This sub sector includes all the industrial facilities using less than 50 GWh/yr. and which are not included under the Fishing or Manufacturing sub sectors. The sub sectors included are: Small and Medium Mining, Municipal Water and Sewer Facilities and Commercial and Utility Water Systems. Approximately 95 facilities are included in this sub sector and the monthly electricity consumption is relatively consistent throughout the year.

The modeling of energy use was executed at the sub sector level, with archetypes for each of the three Large, and Small and Medium Industrial sub sectors. For the Large Industrial sector, the data and results are presented at the aggregated Large Industrial sub sector level to ensure that confidentiality of facility information is maintained.

2.3 DEFINITION OF END USES

Electricity use within each of the sub sectors noted above is further defined on the basis of specific end uses. In this study, an end use is defined as, "the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy."

A summary of the major Industrial sector end uses used in this study is provided in Exhibit 2.2 together with a brief description of each.

Exhibit 2.2: Industrial Sector End Uses

Electricity End Use		Description
Process heating		Process heating, including hot water and steam production and distribution
Process cooling / refrigeration / freezing		Process related cooling, refrigeration and freezing
Motors and motor driven equipment	Compressed air	Compressed air utilities, including compressors and compressed air distribution system
	Pumps	Process pumps
	Fans and blowers	Fans and blowers
	Conveyors	Conveyors and material handling
	Other motors	Motors not included in other categories, for example, motors in grinding, stamping, pressing equipment
Process specific		Processes and equipment not included in the other process categories and are specific to a sub sector
Building envelope and comfort	Lighting	Lighting systems
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	HVAC for comfort and work space climate control
Other		End uses not included in the other categories. These end-uses include system-wide end uses, such as plant-wide control systems and other supporting end uses, such as electric doors, electric charging for electric forklifts.

2.4 DEVELOPMENT OF INDUSTRIAL ELECTRICITY USE PROFILES

Electricity end-use profiles were developed for the six sub sectors described above. The profiles map proportionally how much electricity is used by each of the end uses for each sub sector. These profiles represent the sub sector archetypes and are used in the model to calculate the electricity used by each end use for each sub sector.

Three archetype profiles were developed for Large industry based on the results of a survey of the facilities included in these sub sectors.[4] In each case, site personnel provided data, which addressed both the allocation of electricity use by end use and general best practices implemented at the sites. A copy of the survey instrument is contained in Appendix A.

Experience from previous industry studies in other Canadian jurisdictions provided the necessary archetype end-use profiles for the three Small and Medium Industrial sub sectors. These profiles were reviewed by industry experts familiar with industry in Newfoundland and Labrador (NL) and were revised to be representative of the NL industrial sub sectors.

[4] The results were also compared with those from detailed studies of similar industries undertaken by Marbek and were found to compare well.

2.5 SUMMARY OF MODEL RESULTS

The summary of Base Year model results are measured at the customer's point-of-use.[5]

Exhibit 2.3 presents the model results for the Island and Isolated and Labrador Interconnected service regions with the results broken out by Industrial sub sector and end use. It is assumed that self-generated electricity is mixed with purchased electricity and does not apply selectively to end uses. Purchased electricity is the main focus to determine savings potential and self-generated electricity is presented separately.[6]

Highlights of the results are as follows:

2.5.1 Base Year Electricity Use by Sub Sector

Exhibits 2.3 and 2.4 indicate that:

- Almost 70% of all electricity use by industry is self-generated, while the remaining 30% (1,359 GWh/yr.) is supplied by NLH and NP. All the self-generated electricity is produced by the Large Industrial sub sector.
- Large industrial facilities use approximately 94% of all the electricity used by industry in Newfoundland and Labrador but consume about 1,067 GWh/yr. (79%) if only purchased electricity is considered.
- Of the Small and Medium Industrial sub sector, the Fishing and Fish Processing sub sector accounts for about 53% of electricity use.

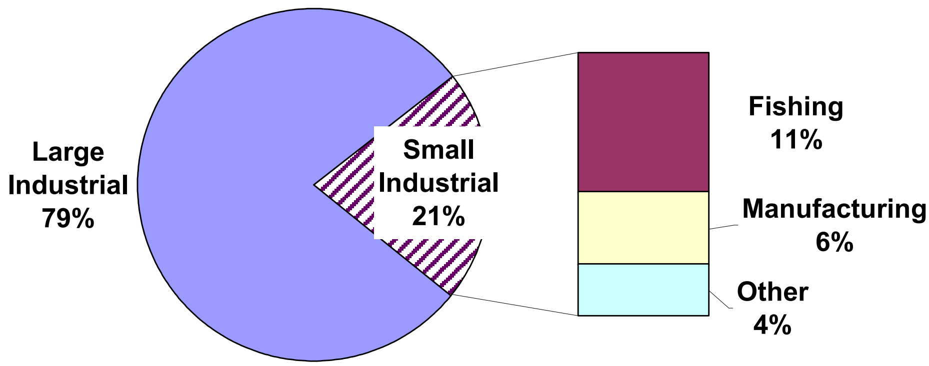
Exhibit 2.3: Base Year Modelled Annual Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector, (GWh/yr.)

Sectors		Purchased Electricity (GWh/yr.)	Self-generated Electricity (GWh/ yr.)	Total Electricity Use (GWh/yr.)	Percentage of Total (%)
Large Industrial		1,067	3,229	4,296	94%
Small and Medium Industrial	*Fishing*	*156*		*156*	*3%*
	Manufacturing	*81*		*81*	*2%*
	Other	*56*		*56*	*1%*
	Sub-total	292	0	292	6%
Total		***1,359***	***3,229***	***4,588***	***100%***
Percentage of Total		***29.6%***	***70.4%***	***100.0%***	

Note: Any differences in totals are due to rounding.

[5] Self-generated electricity includes line losses of transmission facilities not owned by NLH.
[6] Self-generation sites are owned and operated by individual customers, not the Utilities. As detailed, site-specific analysis of individual industrial facilities was outside the scope of this study, these facilities and related CDM opportunities were not included in the results presented.

Exhibit 2.4: Base Year Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Region by Sub Sector, (GWh/yr.)



Note: Any differences in totals are due to rounding.

2.5.2 Base Year Electricity Use by End Use

The electricity use by industrial end uses is summarized and illustrated in Exhibits 2.5 to 2.7. The results indicate that:

- Motors and motor driven equipment, including compressed air systems, use close to 63% of all the electricity in industry. Within this end use "other motors" account for almost 55% of end-use electricity; pumps account for 17%.

- The second largest electricity end-use consumption is associated with the process-specific end use, namely 18% of total industrial electricity use.

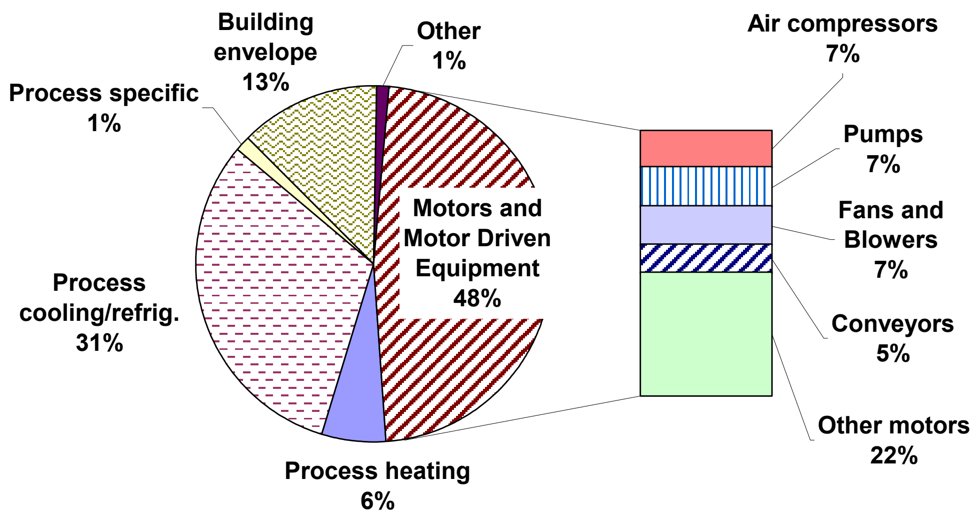
- When only purchased electricity is assessed and self-generation is excluded, the motor and motor driven equipment portion of electricity use decreases slightly to 60% (as illustrated in Exhibit 2.6). Within this end use, the portion of electricity used by "other motors" decreases to 45%, while the portion allocated to pumps increases to 22% and compressed air increases from 10% to 16%. This change is mainly due to the difference in end-use profiles of Large industry, which is responsible for all self-generated electricity.

Exhibit 2.5: Base Year Modelled Annual Total Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Region by Sub Sector and End Use, (GWh/yr.)

Electricity End Use		Large Industry – Electricity Use		Small and Medium Industry – Electricity Use					Total	Percentage of Total (%)
		Sub Total (GWH/yr.)	Percentage of Total (%)	Fishing (GWH/yr.)	Manufact. (GWH/yr.)	Other (GWH/yr.)	Sub Total (GWH/yr.)	Percentage of Total (%)		
Process heating (incl. water heaters, steam production)		260	6%	*12*	*2*	*2*	17	5.7%	**277**	6.0%
Process cooling / refrigeration / freezing		26	< 1%	*90*	*< 1*	*1*	92	31.4%	**118**	2.6%
Motors and motor driven equipment	Air compressors	189	4%	*5*	*14*	*1*	20	6.7%	**209**	4.5%
	Pumps	474	11%	*9*	*4*	*7*	20	7.0%	**494**	10.8%
	Fans and blowers	273	6%	*2*	*11*	*8*	20	6.9%	**293**	6.4%
	Conveyors	292	7%	*6*	*3*	*5*	12	4.0%	**304**	6.6%
	Other motors	1,542	36%	*6*	*33*	*25*	64	22.1%	**1,606**	35.0%
Process specific		817	19%	*3*	*< 1*	*1*	4	1.5%	**822**	17.9%
Building envelope and comfort	Lighting	220	5%	*12*	*11*	*3*	29	10.1%	**250**	5.5%
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	140	3%	*8*	*2*	*2*	11	3.8%	**151**	3.3%
Other		62	2%	*2*	*< 1*	*1*	2	0.8%	**65**	1.4%
TOTAL		***4,296***	100%	*156*	*81*	*56*	***292***	100.0%	***4,588***	***100.0%***
Percentage of Total		94%		*3.4%*	*1.8%*	*1.2%*	6.4%		100.0%	

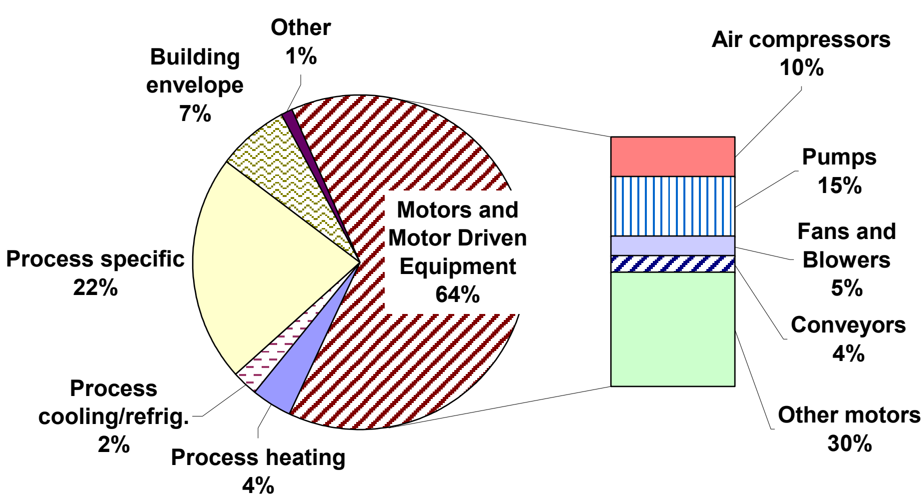
Note: Any differences in totals are due to rounding.

Exhibit 2.6: Small and Medium Industry Base Year Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by End Use, (GWh/yr.)



Note: Any differences in totals are due to rounding.

Exhibit 2.7: Large Industry Base Year Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by End Use, (GWh/yr.)



Note: Any differences in totals are due to rounding.

3. REFERENCE CASE ELECTRICITY USE

3.1 INTRODUCTION

This section presents the Industrial sector Reference Case for the study period (2006 to 2026). The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new Utilities-based CDM initiatives.

The Reference Case, therefore, provides the point of comparison for the calculation of electricity savings opportunities associated with each of the subsequent scenarios that are assessed within this study.

The discussion is presented within the following subsections:

- Forecast Electricity Consumption
- "Natural" Changes Affecting Electricity Use
- Summary of Model Results.

3.2 FORECAST ELECTRICITY CONSUMPTION

Exhibit 3.1 provides the electricity consumption forecast for the milestone years 2011, 2016, 2021 and 2026. The forecast is based on projected growth forecasts for Small and Medium industry provided by NLH, which includes anticipated closing of existing facilities and opening of new facilities. Potential new large industrial loads on the system are not included due to the uncertain and unknown make-up of process end use energy requirements. The self-generated electricity consumption is frozen for the 20-year forecast.

Exhibit 3.1: Forecast Annual Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector and Milestone Year, (GWh/yr.)

Sub Sector		Electricity Use by Milestone Year (GWH/y)				
		2006	**2011**	**2016**	**2021**	**2026**
Large Industrial	Purchased electricity	1,067	1,132	1,132	1,132	1,132
	Self-generation	3,229	3,229	3,229	3,229	3,229
	Sub-total	*4,296*	*4,361*	*4,361*	*4,361*	*4,361*
Small and Medium Industrial (Purchased)	Fishing	156	161	168	174	181
	Manufacturing	81	85	89	94	99
	Other	56	62	65	68	71
	Sub-total	*292*	*308*	*322*	*336*	*352*
Total purchased electricity		1,359	1,440	1,454	1,468	1,484
Total self-generated electricity		3,229	3,229	3,229	3,229	3,229
TOTAL		***4,588***	***4,669***	***4,683***	***4,697***	***4,713***

3.3 "NATURAL" CHANGES AFFECTING ELECTRICITY USE

The Reference Case is calibrated to the Utilities' forecasts, which assumes "natural" conservation through efficiency improvements in Small and Medium industry over the 20-year forecast period.

3.4 SUMMARY OF MODEL RESULTS

Exhibits 3.2 to 3.5 summarize the model results for each of the milestone years in the study period. Consistent with the scope of analysis for this sector, the results shown assume that the generic plant end-use profiles are frozen for the study period. As a result, the distribution of electricity use in each of the forecast milestone years is very similar to the Base Year results. For example:

- The Large Industrial sub sector continues to dominate electricity use, accounting for approximately 76% of total purchased industrial electricity use in 2026.
- Motors and motor driven equipment (61%) continue to account for the largest share of total (large, and Small and Medium combined) industrial electricity use in 2026.
- In the Small and Medium Industrial sub sector, process refrigeration accounts for about 30% of the electricity use.
- The building envelope and comfort end use continues to account for less than 5% of total electricity use in both the Large, and Small and Medium Industrial sub sectors over the study period.

Exhibit 3.2: Forecast Year 2011 Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector and End Use, (GWh/yr.)

Electricity End Use		Large Industry - Electricity Use: Sub-Total (GWH/y)	Large Industry - Electricity Use: Percentage of Total (%)	Small Industry - Electricity Use: Fishing (GWH/y)	Small Industry - Electricity Use: Manufact. (GWH/y)	Small Industry - Electricity Use: Other (GWH/y)	Small Industry - Electricity Use: Sub-Total (GWH/y)	Small Industry - Electricity Use: Percentage of Total (%)	Total	Percentage of Total (%)
Process heating (incl. water heaters, steam production)		48	4%	*13*	*2*	*3*	18	6%	66	5%
Process cooling / refrigeration / freezing		26	2%	*94*	*0.1*	*2*	95	31%	122	8%
Motors and motor driven equipment	Air compressors	111	10%	*5*	*14*	*1*	21	7%	132	9%
	Pumps	169	15%	*10*	*4*	*7*	22	7%	191	13%
	Fans and Blowers	59	5%	*2*	*12*	*8*	21	7%	80	6%
	Conveyors	54	5%	*6*	*3*	*6*	16	5%	70	5%
	Other motors	335	30%	*6*	*35*	*27*	69	22%	404	28%
Process specific		238	21%	*3*	*0.3*	*1*	4	1%	242	17%
Building envelope and comfort	Lighting	52	5%	*13*	*12*	*3*	28	9%	79	5%
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	28	2%	*8*	*2*	*2*	12	4%	40	3%
Other		12	1%	*2*	*0.4*	*1*	3	1%	15	1%
TOTAL		***1,132***	100%	*161*	*85*	*62*	***308***	100%	***1,440***	***100%***
Percentage of Total		79%		*11%*	*6%*	*4%*	21%		100%	

Note: Any differences in totals are due to rounding.

Exhibit 3.3: Forecast Year 2016 Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector and End Use, (GWh/yr.)

Electricity End Use		Large Industry - Electricity Use		Small Industry - Electricity Use					Total	Percentage of Total (%)
		Sub-Total (GWH/y)	Percentage of Total (%)	Fishing (GWH/y)	Manufact. (GWH/y)	Other (GWH/y)	Sub-Total (GWH/y)	Percentage of Total (%)		
Process heating (incl. water heaters, steam production)		48	4%	*13*	*2*	*3*	19	6%	67	5%
Process cooling / refrigeration / freezing		26	2%	*97*	*0.1*	*2*	99	31%	125	9%
Motors and motor driven equipment	Air compressors	111	10%	*5*	*15*	*1*	22	7%	133	9%
	Pumps	169	15%	*10*	*5*	*8*	23	7%	192	13%
	Fans and Blowers	59	5%	*2*	*12*	*9*	23	7%	82	6%
	Conveyors	54	5%	*7*	*4*	*6*	17	5%	70	5%
	Other motors	335	30%	*7*	*36*	*29*	72	22%	407	28%
Process specific		238	21%	*3*	*0.3*	*1*	5	1%	243	17%
Building envelope and comfort	Lighting	52	5%	*13*	*12*	*3*	29	9%	80	6%
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	28	2%	*8*	*2*	*2*	12	4%	40	3%
Other		12	1%	*2*	*0.4*	*1*	3	1%	15	1%
TOTAL		***1,132***	100%	*168*	*89*	*65*	***322***	100%	***1,454***	***100%***
Percentage of Total		78%		*12%*	*6%*	*4%*	22%		100%	

Note: Any differences in totals are due to rounding.

Exhibit 3.4: Forecast Year 2021 Modelled Annual Purchased Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector and End Use, (GWh/yr.)

Electricity End Use		Large Industry - Electricity Use		Small Industry - Electricity Use					Total	Percentage of Total (%)
		Sub-Total (GWH/y)	Percentage of Total (%)	Fishing (GWH/y)	Manufact. (GWH/y)	Other (GWH/y)	Sub-Total (GWH/y)	Percentage of Total (%)		
Process heating (incl. water heaters, steam		48	4%	*14*	*2*	*3*	19	6%	67	5%
Process cooling / refrigeration / freezing		26	2%	*101*	*0.1*	*2*	103	31%	129	9%
Motors and motor driven equipment	Air compressors	111	10%	*5*	*16*	*2*	23	7%	134	9%
	Pumps	169	15%	*10*	*5*	*8*	24	7%	193	13%
	Fans and Blowers	59	5%	*2*	*13*	*9*	24	7%	83	6%
	Conveyors	54	5%	*7*	*4*	*7*	17	5%	71	5%
	Other motors	335	30%	*7*	*38*	*30*	76	22%	411	28%
Process specific		238	21%	*3*	*0.3*	*1*	5	1%	243	17%
Building envelope and comfort	Lighting	52	5%	*14*	*13*	*3*	30	9%	82	6%
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	28	2%	*9*	*2*	*2*	13	4%	41	3%
Other		12	1%	*2*	*0.5*	*1*	3	1%	15	1%
TOTAL		***1,132***	100%	*174*	*94*	*68*	***336***	100%	***1,468***	***100%***
Percentage of Total		*77%*		*12%*	*6%*	*5%*	*23%*		100%	

Note: Any differences in totals are due to rounding.

Exhibit 3.5: Forecast Year 2026 Modelled Annual Total Electricity Consumption for the Island and Isolated and Labrador Interconnected Service Regions by Sub Sector and End Use, (GWh/yr.)

Electricity End Use		Large Industry - Electricity Use		Small Industry - Electricity Use					Total	Percentage of Total (%)
		Sub-Total (GWH/y)	Percentage of Total (%)	Fishing (GWH/y)	Manufact. (GWH/y)	Other (GWH/y)	Sub-Total (GWH/y)	Percentage of Total (%)		
Process heating (incl. water heaters, steam production)		48	4%	*15*	*2*	*3*	20	6%	68	5%
Process cooling / refrigeration / freezing		26	2%	*105*	*0.1*	*2*	107	30%	133	9%
Motors and motor driven equipment	Air compressors	111	10%	*5*	*17*	*2*	24	7%	135	9%
	Pumps	169	15%	*11*	*5*	*9*	25	7%	194	13%
	Fans and Blowers	59	5%	*2*	*14*	*10*	25	7%	84	6%
	Conveyors	54	5%	*7*	*4*	*7*	18	5%	72	5%
	Other motors	335	30%	*7*	*41*	*32*	80	23%	415	28%
Process specific		238	21%	*4*	*0.3*	*1*	5	1%	243	16%
Building envelope and comfort	Lighting	52	5%	*15*	*14*	*4*	32	9%	83	6%
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	28	2%	*9*	*2*	*2*	13	4%	42	3%
Other		12	1%	*2*	*0.5*	*1*	3	1%	15	1%
TOTAL		***1,132***	100%	*181*	*99*	*71*	***352***	100%	***1,484***	***100%***
Percentage of Total		*76%*		*12%*	*7%*	*5%*	*24%*		100%	

Note: Any differences in totals are due to rounding.

4. CONSERVATION & DEMAND MANAGEMENT (CDM) MEASURES

4.1 INTRODUCTION

This section identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Industrial sector and is presented as follows:

- Methodology
- Description of Energy-efficiency Technologies
- CCE Summary.

4.2 METHODOLOGY FOR ASSESSMENT OF ENERGY-EFFICIENCY MEASURES

The following steps were employed:

- Select candidate energy-efficiency measures
- Establish technical performance for each option within a range of applications
- Establish the capital and installation costs for each option
- Calculate the CCE for each conservation measure.

Consistent with the agreed study scope, the analysis of energy-efficiency measures presented in this section is limited to "generic" opportunities that are broadly applicable across North American industrial facilities. As outlined below, the technology descriptions and typical technology cost data draw heavily from the study team's previous and current work in other Canadian jurisdictions.[7] Energy savings estimates are based on the best available data for Newfoundland and Labrador.

A brief discussion of each step is outlined below.

Step 1 Select Candidate Measures

The candidate measures were selected in collaboration with the Utilities and from a literature review and previous study team experience. The selected measures are considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources including the experience and on-going research work of study team members.

[7] Marbek Resource Consultants and Willis Energy. *BC Hydro Conservation Potential Review- 2007, Industrial Sector*. Prepared for BC Hydro, 2007.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources including the experience and on-going research work of study team members.

The incremental cost is applicable when a measure is installed in a new facility or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy-efficiency measure relative to the "baseline" technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.

In both cases, the costs and savings are annualized, based on the number of years of equipment life and the discount rate, which in this study has been set at 6%. All costs are expressed in constant (2007) dollars.

Step 4 Calculate CCE for Each Measure

One of the important sets of information provided in this section is the CCE associated with each energy-efficiency measure. The CCE for an energy-efficient measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section is expressed in constant (2007) dollars.

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast. The CCE is calculated according to the following formula:

$$\frac{C_A + M}{S}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of O&M
S is the annual kWh energy savings.

And A is the annualization factor.

Where: $$A = \frac{i(1+i)^n}{(1+i)^n - 1}$$

i is the discount rate
n is the life of the measure.

The detailed results (see Exhibit 4.2) show both "incremental" and "full" installed costs for the energy-efficiency measures, as applicable. If the measure or technology is installed in a new facility, or at the point of natural replacement in an existing facility, then the "incremental" cost of the efficient measure versus the cost of the baseline technology is used.

If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the "full" cost of the efficient measure is used. In both cases, the costs of the measures are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations that accompany this document, three discount rates are shown: 4%, 6% and 8%. The 6% real discount rate was used for the primary CCE calculation. The CCE was also calculated using the 4% and 8% real discount rates to provide sensitivity analysis.

Selection of the appropriate discount rate to be used in this analysis was guided by the intended use of the study results. This study seeks to identify the economic potential for CDM in Newfoundland and Labrador from a provincial perspective. Therefore, the appropriate discount rate is the social opportunity cost of capital, which is the estimated average pre-tax rate of return on public and private investments in the provincial economy.[8]

4.3 DESCRIPTION OF ENERGY-EFFICIENCY TECHNOLOGIES

Exhibit 4.1 shows a summary of the energy-efficient measures included in this study.

Exhibit 4.1: Energy-efficiency Technologies and Measures – Industrial Sector

• Cooling, refrigeration/freezing measures	• Conveyors or material handling measures
• Compressed air measures	• Motors measures
• Pump measures	• Lighting measures
• Fan/blower measures	• Process specific measures

Energy-efficiency improvement opportunities are presented along with a brief description of the technology, savings relative to the baseline, typical installed costs, applicability and co-benefits. A detailed list of the results of the economic assessment of all measures is provided in Exhibit 4.2. The discussion of measures is organized by end use and sub sector.[9]

The following sources were relied upon for technology descriptions, installed cost data, electricity savings data and useful life data.

[8] This discount rate allows for analytic consistency with the earlier NERA Marginal Cost Study, which used a nominal discount rate of 8.4% (approximately 6% real, i.e. net of inflation). NLH lowered its nominal discount rate in the summer of 2007 to 7.75%; however, this change has no material impact on the results of this study.
[9] Measure inputs not otherwise sourced are based on the consultants' recent work with BC Hydro and other utility clients.

- Marbek Resource Consultants and Willis Energy. *BC Hydro Conservation Potential Review- 2007, Industrial Sector*. Prepared for BC Hydro, 2007.

- Electricity savings potential studies for Nova Scotia (in progress) and New Brunswick. Both studies were commissioned by the Canadian Manufacturers and Exporters with member of the electric utilities present on the steering committees.

- Electricity savings potential studies for Ontario commissioned by the Ontario Power Authority. The studies addressed Small and Medium industrial facilities and fuel substitution.

- Natural Resources Canada, Office of Energy Efficiency research publications.

4.3.1 Cooling and Refrigeration/Freezing

The following efficiency measures for cooling and refrigeration (or freezing) were considered:

- Premium efficiency refrigeration equipment including efficient compressors, optimized floating head pressure and equipment size optimization
- Improved control including adjustable speed drives (ASD)
- Premium efficiency control including computer control and floating head pressure control
- Improved distribution system including increased insulation and piping network optimization.

❑ **Premium Efficiency Refrigeration Equipment**

Improving the efficiency of refrigeration equipment is accomplished through system reconfiguration, such as optimizing the condenser size, and through technology applications such as efficient compressors and condenser fans. Additional energy savings opportunities include high-efficiency refrigeration compressors, which use more efficient electric motors and have lower compressor losses, additional insulation for the refrigeration units and thermo siphon oil coolers for screw compressors.

This measure has attractive energy savings but increased equipment costs. To capitalize on all potential benefits, the feasibility of efficient refrigeration system opportunities are best evaluated during system expansion or as part of a system reliability and safety review.

Measure Profile	
Sub Sectors	Small and Medium Industry
Typical Measure Size/Specification	50-HP
Typical Measure Costs	$41,000 (full cost) $ 2,000 (incremental cost)
Typical Measure Savings	11 MWh/yr.
Useful Measure Life	25 years

- **Improved Control**

Improved control is accomplished through the use of ASD on the evaporator fan and condenser fan, compressor speed control and improved defrost control. Currently, most refrigeration systems employ constant speed fan motors on the evaporator and condenser fans. ASD control reduces fan horsepower at part load and reduces the refrigeration load associated with waste heat generated by the fan motors. Improved defrost controls reduce the compressor load by activating the defrost cycle only when excessive ice has accumulated or the temperature has dropped below a preset point.

Measure Profile	
Sub Sectors	Small and Medium Industry
Typical Measure Size/Specification	50-HP
Typical Measure Costs	$60,000 (full cost) $30,000 (incremental cost)
Typical Measure Savings	13 MWh/yr.
Useful Measure Life	15 years

- **Premium Efficiency Control**

Premium efficiency refrigeration control is accomplished by using computer controls for the refrigeration equipment, floating head pressure controls to take advantage of low outdoor air temperatures and computerized defrost controls.

Currently, most refrigeration equipment is not designed with computer controls, efficient defrost cycles or floating head pressure controls. Premium refrigeration controls result in improved compressor, evaporator and condenser controls. With floating head pressure controls the system is also able to take advantage of lower outdoor air temperatures. Modern refrigeration controls also include improved defrost cycle algorithms that will reduce the defrost time by as much as 60% compared to conventional defrost controls. Barriers to the implementation of this measure include the high equipment costs and the capacity of the refrigeration plant to incorporate improved refrigeration controls.

Measure Profile	
Sub Sectors	Small and Medium Industry
Typical Measure Size/Specification	50-HP
Typical Measure Costs	$78,000 (full cost) $48,000 (incremental cost)
Typical Measure Savings	20 MWh/yr.
Useful Measure Life	15 years

- **Improved Distribution System**

Improving distribution piping requires a thorough analysis of the complex relationship between the flow of refrigerant, oil and pipe insulation. Improved distribution must compromise between maximum capacity at minimum cost and proper oil return to the compressor, while using well-insulated piping.

In industrial screw compressors, oil lubricates the system. Small amounts of oils are always present in the refrigerant. Oil is properly circulated only when the mass velocity of the refrigerant vapour is great enough. Currently, the refrigeration industry uses oil purgers and refrigerant decontamination systems to ensure that the oil does not create problems in the refrigerant system.

Insulation on the refrigerant piping and other parts of the system reduces the absorption of heat by the refrigerant from any environment other than the refrigerated area. An improved distribution system ensures proper refrigerant feed to evaporators without excessive pressure drop, prevents excessive lubricating oil in any part of the system, ensures the compressor is adequately lubricated and optimizes refrigerant distribution.

Measure Profile	
Sub Sectors	Small and Medium Industry
Typical Measure Size/Specification	50-HP
Typical Measure Costs	$10,000 (full cost) $3,000 (incremental cost)
Typical Measure Savings	7 MWh/yr.
Useful Measure Life	25 years

4.3.2 Compressed Air

Measures that were considered for the compressed air end use include:

- Efficient equipment including efficient compressors, air dryers and equipment size optimization
- Efficient control including ASD, sequencing and dryer dewpoint control
- Efficient distribution system including increased air storage and reduced piping friction losses.

Below is a brief description of the most promising measures as well as summaries of the results of their economic assessment.

- **Premium Efficiency Compressed Air Equipment**

Premium efficiency compressed air equipment includes both the compressor and the air dryer. Each is described briefly below.

Premium efficiency air compressors come with built-in ASD control that allows the compressor output to match the plant air demand. These compressors may save as much as 40% over standard compressors which typically use modulated control.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	200-HP compressor
Typical Measure Cost	$62,000 (full cost) $25,000 (incremental cost)
Typical Measure Savings	89 MWh/yr.
Useful Measure Life	25 years

Premium efficiency air dryers are of the refrigerated type with dewpoint control. These dryers are typically at least 15% more efficient than regenerative desiccant dryers, which are still commonly used in industry.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	2,000 CFM refrigerated air dryer
Typical Measure Cost	$37,000 (full cost) $12,000 (incremental cost)
Typical Measure Savings	60 MWh/yr.
Useful Measure Life	20 years

- **Premium Efficiency Sequencing Control**

As mentioned above, premium efficiency air compressors come with built-in ASD control. The additional measure considered here is sequencing control.

Industrial facilities typically have several air compressors. Sequencing control systems can operate the compressors so that the larger compressor is base loaded (always on), the mid-sized compressors are used as needed to increase supply and an ASD compressor acts as the trim compressor (provides for the variable component of the process air demand). This setup is intended to closely match the demand for compressed air, to maintain consistent pressure and flow and to reduce O&M costs.

This measure applies to a retrofit or to a new facility. In each case, the alternative is to do nothing, i.e., use the factory installed control system. Therefore, the full and the incremental costs are equivalent.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	800-HP compressed air system
Typical Measure Cost	$41,000 (full cost)
Typical Measure Savings	119 MWh/yr.
Useful Measure Life	15 years

- **Improved Distribution System**

This measure involves the addition of air storage to reduce pressure fluctuations, and air piping redesign to reduce friction losses. Not included in this measure are leak fixing and nozzle improvement, which are considered separate O&M measures.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	800-HP compressed air system
Typical Measure Cost	$10,000 (full cost) $7,000 (incremental cost
Typical Measure Savings	167 MWh/yr.
Useful Measure Life	25 years

4.3.3 Pumps

Measures that were considered for this end use include:

- Efficient and premium efficiency equipment including equipment size optimization
- Efficient control including ASD.

Below is a brief description of these measures as well as summaries of the results of their economic assessment.

- **Premium Efficiency Pump**

In industrial applications pumps are often used for cooling tower sprays, spray cooler, water boosters, liquid transport, liquid recovery and liquid mixing. Energy savings can be gained by replacing older stock pumps with premium efficiency models that are application specific or with premium efficiency impellers and motors. Pumps should be sized and selected based on their performance curve for the required flow. Impeller sizing is also an important consideration; impellers should be sized for a specific application.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	50-HP pump
Typical Measure Costs	$2,000 (full cost) $600 (incremental cost)
Typical Measure Savings	10 MWh/yr.
Useful Measure Life	20 years

- **Premium Efficiency Control, Including Adjustable Speed Drives**

Pumps used for variable flow in industrial applications may be candidates for ASD. Currently, most pump installations are single speed and operate continuously independent of the actual load. Installing ASD on smaller pumps will result in significant energy savings in variable load applications where full operation may be required for less than 30% of the operating time. In these applications, 40% energy savings can be achieved. Modulating valves installed on by pass lines will provide sufficient flow at all times, allowing the pump to perform at maximum efficiency on the pump curve. Barriers to implementation include large capital investment equipment; however, energy savings and production improvements will make this an attractive investment.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	50-HP pump
Typical Measure Costs	$8,100 (full cost) $4,300 (incremental cost)
Typical Measure Savings	15 MWh/yr.
Useful Measure Life	15 years

4.3.4 Fans and Blowers

Measures that were considered for the fans and blowers end use include:

- Efficient and premium efficiency equipment, including equipment size optimization
- Efficient control, including timers and ASD.

❑ **Premium Efficiency Fans and Blowers**

Fans and blowers are often used for ventilation, exhaust, cooling, dust collection and aeration. Energy savings can be gained by replacing older stock fans and blowers with premium efficiency models that are application specific. Fans should be sized and selected for an application based on the performance curve of the fan at the required airflow.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	50-HP
Typical Measure Cost	$2,000 (full cost) $600 (incremental cost)
Typical Measure Savings	7 MWh/yr.
Useful Measure Life	20 years

❑ **Premium Efficiency Control, Including Adjustable Speed Drives**

Fans are widely used in industry for conveyance, drying and ventilation purposes. Operations requiring variable air delivery, such as drying, can benefit from premium control with ASD allowing air delivery to match process requirements. ASD save electricity and improve product quality by providing plant operators greater and finer control.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	220-HP fan
Typical Measure Cost	$51,500 (full cost) $26,500 (incremental cost)
Typical Measure Savings	66 MWh/yr.
Useful Measure Life	15 years

4.3.5 Conveyors and Material Handling

Measures that were considered for the conveyor (or material handling) end use include:

- Efficient and premium efficiency equipment, including equipment size optimization, low friction systems and drive optimization
- Efficient control, including ASD.

Where variation exists between the economic assessment results for large versus small systems, the measures are grouped by size.

- **Premium Efficiency Conveyors**

Conveyors often use gear boxes to isolate the motor and to provide better torque control. Currently, most gear boxes in most of the Large Industrial sub sectors consist of transmissions with 90%-92% efficiencies. Opportunities include using higher-efficiency drives, couplings and gear/speed reducer alternatives. In older conveyor systems, or where process requirements have changed, it may be possible to resize a conveyor, upgrade the controls or re-engineer the system to improve layout and configuration, all of which will result in energy savings.

Measure Profile	
Sub Sectors	Large Industry
Typical Measure Size/Specification	100-HP system
Typical Measure Costs	$40,000 (full cost) $17,5000 (incremental cost)
Typical Measure Savings	12 MWh/yr.
Useful Measure Life	20 years

- **Premium Efficiency Control for Conveyors**

Incorporating programmable logic controls (PLC) into the conveyor system will result in energy savings. PLC controls can shut down unloaded conveyors and control the conveyor based on load. Barriers to implementation include additional maintenance costs due to increased number of components in the system.

Measure Profile	
Sub Sectors	Small and Medium Industry
Typical Measure Size/Specification	50-HP system
Typical Measure Costs	$12,000 (full cost) $6,0000 (incremental cost)
Typical Measure Savings	9 MWh/yr.
Useful Measure Life	15 years

4.3.6. Premium Efficiency Motors

The three motor efficiency levels included in this study are standard (93.5% efficient), high efficiency (94.5% efficient) and premium efficiency (95.5% efficient). Premium efficiency motors apply to all sub sectors and end uses.

Electric motors convert approximately 85% of industrial plant electricity use to torque to drive industrial end uses such as fans, pumps, material handling and a large portion of process loads. These motors range in size from 75 Watts to more than 25,000 kW, with corresponding efficiencies of 40%-98%. While inherently efficient in converting electricity to shaft or motive power, on average 5%-8% of this power is lost in motor inefficiencies that occur before the driven equipment losses.

Both synchronous and induction motors are used in industrial facilities. It is estimated that induction motors in the 1-HP to 500-HP range use over 50% of the motor energy use, while induction motors in the 500-HP to 5,000-HP range account for 15% to 20% of the total plant load. Induction motor efficiency can be increased through adherence to proper specification or though the implementation of an efficient motor purchasing program. Synchronous motors are typical of refiner motors in the Pulp and Paper sub sector and of Large Mining grinding operations. These motors are often built up for efficiency in the design process.

Electric motor efficiency improvement has been a major thrust in the North American market for more than 25 years. Throughout the 1980s, standard efficiency induction motors dominated industrial plant installations. Prior to 1990, only 5% of new motor purchases were considered energy efficient. Since the late 1990s, energy-efficient motors comprised the majority of sales.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	150-HP motor
Typical Measure Costs	$13,000 (full cost) $700 (incremental cost)
Typical Measure Savings	9 MWh/yr.
Useful Measure Life	25 years

4.3.7 Synchronous Belts

Synchronous belts, also called timing, positive drive or high torque drive belts, apply to all sub sectors and end uses.

Often, industrial end uses are driven by pulleys that use V-Belts. By replacing the pulley sheaves with synchronous belt pulleys and installing synchronous belts onto the end use (e.g., fan) an efficiency gain of 3%-5% can be achieved because of reduced slippage and friction between the pulley and belt. Synchronous belts may require motor vibration sensors to prevent damage from continuous operation following a system failure.

Since the alternative to this measure is to do nothing, the full and incremental costs are the same.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	150-HP motor
Typical Measure Costs	$1,450 (full cost)
Typical Measure Savings	13 MWh/yr.
Useful Measure Life	10 years

4.3.8 Building Envelope and Comfort

This end use includes lighting, comfort heating and cooling, plug loads and elevators. This end use consumed about 8% of electricity in the Industrial sector in the Base Year. Lighting systems account for more than 60% of the electricity consumed by this end use and, therefore, are the focus for this end use.

- **Lighting**

Numerous lighting retrofit measures exist. Summarized here are two of the largest potential lighting measures for industrial facilities: 1) major lighting fixtures and controls retrofit, and 2) replacement of high-intensity discharge lighting with fluorescent high-bay T5 high-output lighting.

Opportunities exist for major lighting retrofits at older facilities, especially larger facilities. The lighting systems in these facilities are often several decades old. In some cases, low-efficiency mercury vapor lighting is still in use and no lighting control measures are in place. Potential electricity savings at such facilities are significant but retrofits are often complicated by a lack of dedicated circuits, and consistency across the facility.

In all cases, these projects are necessarily full cost measures because the retrofit is considered for an existing facility before the end of the useful life of the existing lighting system.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	Medium-sized facility
Typical Measure Costs	$38,000 (full cost)
Typical Measure Savings	45 MWh/yr.
Useful Measure Life	10 years

A medium-sized facility is defined as a facility with about 120 lamps, including fluorescent, high-pressure sodium and mercury vapor types. The upgrade measures include retrofitting the lighting fixtures to high-efficiency fixtures and lamps and installing lighting control.

High-intensity discharge (HID) lighting, such as the metal halide lamp, is the most widely used lighting type in industrial facilities. Recent advances in the development of high-bay T5 high-output fluorescent lighting indicate that replacing HID lighting with T5 high-output lighting may be a promising efficiency measure.

HID lighting is used for illuminating high bay areas such as production facilities. HID lighting includes mercury vapor, metal halide and high-pressure sodium lamps. The most widely used type of lamp in industrial facilities is the metal halide. Replacing them with T5 high-output lamps is estimated to reduce electricity use by 20%-40%. Other benefits of T5 high-output lighting over HID lighting are better colour rendering and longer lamp life. Although T5 high-output lighting is commercially available, advances in the technology are fairly recent. To date, the technology has had negligible impact and is not expected to gain market share in the absence of utility or other CDM programs.

Measure Profile	
Sub Sectors	All
Typical Measure Size/Specification	19x4 lamp T5 high-output luminaire plus 24x6 lamp T5 high-output luminaires
Typical Measure Costs	$13,000 (full cost) $3,000 (incremental cost)
Typical Measure Savings	4 MWh/yr.
Useful Measure Life	10 years

4.3.9 Process Specific

Electricity consumed in the process-specific end use is about 1% for Small and Medium industry in Newfoundland and Labrador, but is close to 22% of the total electricity use for industry. Large industry in Newfoundland and Labrador consists of six large facilities. Process-specific energy-efficiency measures are very site specific and are best addressed through the use of on-site assessments, which are beyond the scope of this study.

Based on experience in other jurisdictions, potential electricity savings would be expected to be in the range of 10% to 15% for process-specific end uses such as those typically found in the Pulp and Paper, Mining and Oil Refining sub sectors.

4.3.10 Other

This end use includes non-specific miscellaneous loads and consumed only 1% of electricity in the Industrial sector in the Base Year; therefore, a detailed economic analysis was not considered.

4.4 CCE SUMMARY

Exhibit 4.2 shows the CCE for each measure.

Exhibit 4.2: CCE Summary Table – Savings and Costs per Measure

End Use	Sub Sector	Measure Description	Annual Savings (kWh/year)	Total Cost ($)	Basis: Full or Incremental	Useful Measure Life (y)	4% Discount Rate: CCE (c/kWh)	6% Discount Rate: CCE (c/kWh)	8% Discount Rate: CCE (c/kWh)
Refrigeration / Freezing	Small / Medium	Premium efficiency refrigeration equipment	11,186	41,000	Full	25	23.5	28.7	34.3
		Premium efficiency refrigeration equipment	11,186	2,000	Incremental	25	1.1	1.4	1.7
		Improved control	13,423	60,000	Full	15	47.7	53.5	59.7
		Improved control	13,423	30,000	Incremental	15	27.6	30.5	33.6
		Premium efficiency control	20,134	78,000	Full	15	40.8	45.8	51.2
		Premium efficiency control	20,134	48,000	Incremental	15	27.4	30.5	33.8
		Improved distribution system	6,711	10,000	Full	25	9.5	11.7	14.0
		Improved distribution system	6,711	3,000	Incremental	25	2.9	3.5	4.2
Compressed air	All	Premium efficiency ASD compressor	89,484	62,000	Full	25	6.7	7.7	8.7
		Premium efficiency ASD compressor	89,484	25,000	Incremental	25	4.0	4.4	4.9
		Premium efficiency refrigerated air dryer	59,656	37,000	Full	20	5.4	6.2	7.2
		Premium efficiency refrigerated air dryer	59,656	12,000	Incremental	20	2.3	2.6	2.9
		Premium efficiency sequencing control	119,312	41,000	Full	15	3.8	4.2	4.7
		Improved distribution system	167,037	10,000	Full	25	0.4	0.5	0.6
		Improved distribution system	167,037	7,000	Incremental	25	0.3	0.3	0.4
Pump	All	Premium efficiency pump	10,440	1,900	Full	20	3.7	4.0	4.2
		Premium efficiency pump	10,440	600	Incremental	20	2.8	2.9	3.0
		Premium efficiency control, incl ASD	14,914	8,100	Full	15	6.2	6.9	7.7
		Premium efficiency control, incl ASD	14,914	4,300	Incremental	15	3.9	4.3	4.7
Fans/Blowers	All	Premium efficiency fan / blower	7,457	2,000	Full	20	5.3	5.7	6.1
		Premium efficiency fan / blower	7,457	600	Incremental	20	3.9	4.1	4.2
		Premium efficiency control, including ASD	65,622	51,500	Full	15	7.7	8.8	9.9
		Premium efficiency control, including ASD	65,622	26,500	Incremental	15	4.3	4.8	5.4
Conveyors	All	Premium efficiency small conveyors	5,966	4,000	Full	20	9.1	10.0	11.0
		Premium efficiency small conveyors	5,966	2,000	Incremental	20	6.7	7.1	7.6
		Premium efficiency control for small conveyors	8,948	12,000	Full	15	14.9	16.6	18.5
		Premium efficiency control for small conveyors	8,948	6,000	Incremental	15	8.8	9.7	10.6
		Premium efficiency large conveyors	11,931	40,000	Full	20	27.6	32.2	37.1
		Premium efficiency large conveyors	11,931	17,500	Incremental	20	13.7	15.7	17.9
		Premium efficiency control for large conveyors	17,897	43,000	Full	15	24.4	27.5	30.9
		Premium efficiency cotnrol for large conveyors	17,897	20,500	Incremental	15	13.1	14.6	16.2

Exhibit 4.2 (Continued)

End Use	Sub Sector	Measure Description	Annual Savings (kWh/year)	Total Cost ($)	Basis: Full or Incremental	Useful Measure Life (y)	4% Discount Rate: CCE (c/kWh)	6% Discount Rate: CCE (c/kWh)	8% Discount Rate: CCE (c/kWh)
Motors	All	Synchronous belts	13,423	1,450	Full	10	2.2	2.4	2.5
		30 HP Standard to premium efficiency motor	1,790	6,000	Full	25	32.6	37.4	42.6
		30 HP High to premium efficiency motor	1,790	1,100	Incremental	25	12.3	13.2	14.1
		150 HP Standard to premium efficiency motor	8,948	13,000	Full	25	9.3	11.4	13.6
		150 HP High to premium efficiency motor	8,948	700	Incremental	25	0.5	0.6	0.7
		1000 HP Standard to premium efficiency motor	74,570	72,000	Full	25	6.9	8.2	9.7
		1000 HP High to premium efficiency motor	74,570	6,000	Incremental	25	0.9	1.0	1.2
Lighting	All	Metal halide to high bay T5 HO	4,474	13,000	Full	10	47.0	50.7	54.5
		Metal halide to high bay T5 HO	4,474	3,000	Incremental	10	19.4	20.3	21.2
		Efficient lighting system, incl design, fixtures, control	44,742	38,000	Full	10	12.7	13.8	14.9

5. ECONOMIC POTENTIAL ELECTRICITY FORECAST

5.1 INTRODUCTION

This section presents the Industrial sector Economic Potential Forecast for the study period 2006 to 2026. The Economic Potential Forecast estimates the level of electricity consumption that would occur if all equipment were upgraded to the level that is cost effective against the long-run avoided cost of electricity in the Newfoundland Labrador service area. In this study, "cost effective" means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) in the preceding section, is equal to, or less than, the economic screen.[10]

The discussion in this section is organized and presented in the following subsections:

- Avoided Cost Used for Screening
- Major Modelling Tasks
- Technologies Included in Economic Potential Forecast
- Summary of Results.

5.2 AVOIDED COST USED FOR SCREENING

NLH has determined that the primary avoided costs of new electricity supply to be used for this analysis are $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region. These avoided costs represent a future in which the Lower Churchill project is not built and there is no DC link from Labrador to the Island.[11]

Therefore, the Economic Potential Forecast incorporates all the CDM measures reviewed in Section 4 that have a CCE equal to or less than the avoided costs.

NLH is currently studying the Lower Churchill/DC Link project. However, a decision on whether to proceed is not expected until 2009 and, even if the project proceeds, the earliest completion date would be in late 2014. This means that regardless of the decision, the avoided cost values shown above will be in effect until the approximate mid point of the study period. If the project does proceed, the avoided costs presented above are expected to change. To provide insight into the potential impacts of the Lower Churchill/DC Link project on this study, it was agreed that the consultants would provide a high-level sensitivity analysis.

[10] Costs related to program design and implementation are not yet included.
[11] The avoided costs draw on the results of the earlier study conducted by NERA Economic Consulting, which is entitled: Newfoundland and Labrador Hydro. *Marginal Costs of Generation and Transmission*. May 2006. The avoided costs used in this study include generation, transmission and distribution.

5.3 MAJOR MODELLING TASKS

By comparing the results of the Industrial sector Economic Potential Electricity Forecast with the Reference Case, it is possible to determine the aggregate level of potential electricity savings within the Industrial sector, as well as identify which specific end uses provide the most significant opportunities for savings.

To develop the Industrial sector Economic Potential Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibit 4.2 were reviewed, using the 6% (real) discount rate. Due to the limited interactive effects between measures in industry, an analysis of interactive effects was excluded from the study.
- Technology upgrades that had a CCE equal to, or less than, the avoided cost threshold were selected for inclusion in the economic potential scenario, either on a "full cost" or "incremental" basis. It is assumed that technical upgrades having a "full cost" CCE that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an "incremental" basis are being introduced more slowly as the existing stock reaches the end of its useful life.
- Electricity use within the Large, and Small and Medium Industrial sectors was modelled with the same energy models used to generate the Reference Case. However, for this forecast, the remaining "baseline" technologies included in the Reference Case forecast were replaced with the most efficient "technology upgrade option" and associated performance efficiency that met the cost threshold of $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region.
- When more than one upgrade option was applied, the measures were bundled and overall efficiency and market penetration rates were determined.
- A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC Link.

5.4 TECHNOLOGIES INCLUDED IN ECONOMIC POTENTIAL FORECAST

Exhibits 5.1 and 5.2 provide a listing of the technologies selected for inclusion in this forecast for, respectively, the Small and Medium, and Large Industrial sectors. In each case, the exhibits show the following:

- End use affected
- Upgrade measures selected
- Rate at which the upgrade measures were introduced into the stock.

Exhibit 5.1: Technologies Included in Economic Potential Forecast for Small and Medium Industry and Total Economic Potential Market Penetration Rates

End Use	Measures	2006	2011	2016	2021	2026
Refrigeration / Freezing	Premium efficiency refrigeration equipment	10%	36%	62%	88%	100%
	Improved distribution system					
Compressed air	Premium efficiency ASD compressor	15%	100%	100%	100%	100%
	Premium efficiency refrigerated air dryer					
	Premium efficiency sequencing control					
	Improved distribution system					
Pump	Premium efficiency pump	18%	100%	100%	100%	100%
	Premium efficiency control, incl ASD					
Fans/Blowers	Premium efficiency fan / blower	18%	100%	100%	100%	100%
	Premium efficiency control, including ASD					
Motors	Synchronous belts	18%	100%	100%	100%	100%
	150 HP High to premium efficiency motor					
	1000 HP High to premium efficiency motor					

Exhibit 5.2: Technologies Included in Economic Potential Forecast for Large Industry and Total Economic Potential Market Penetration Rates

End Use	Measures	2006	2011	2016	2021	2026
Compressed air	Premium efficiency refrigerated air dryer	18%	100%	100%	100%	100%
	Premium efficiency ASD compressor					
	Premium efficiency sequencing control					
	Improved distribution system					
Pump	Premium efficiency pump	25%	100%	100%	100%	100%
	Premium efficiency control, incl ASD					
Fans/Blowers	Premium efficiency fan / blower	25%	100%	100%	100%	100%
	Premium efficiency control, including ASD					
Motors	Synchronous belts	25%	100%	100%	100%	100%
	150 HP High to premium efficiency motor					
	1000 HP High to premium efficiency motor					

5.5 SUMMARY OF RESULTS

This section compares the Reference Case and Economic Potential Electricity Forecast levels of industry electricity consumption. The results are presented as electricity savings that would occur at the customer's point-of-use. Due to the small sample size of industry in the Labrador Interconnected service region, the results are presented at an aggregated industry level for both Labrador Interconnected and the Island and Isolated service regions. The results are presented in the following exhibits:

- Exhibit 5.3 shows the electricity savings for the Industrial sector over the study period. As illustrated, under the Reference Case industrial electricity use would grow from the Base Year level of 1,359 GWh/yr. to approximately 1,484 GWh/yr. by 2026. This contrasts with the Economic Potential Forecast in which electricity use would decrease to approximately 1,321 GWh/yr. for the same period, a difference of approximately 164 GWh/yr.

- Exhibit 5.4 presents the results by end use, Industrial sector and milestone year.

- Exhibit 5.5 illustrates the 2026 savings by major end use and industrial sector.

Exhibit 5.3: Reference Case versus Economic Potential Electricity Consumption in Industrial Sector (GWh/yr.)

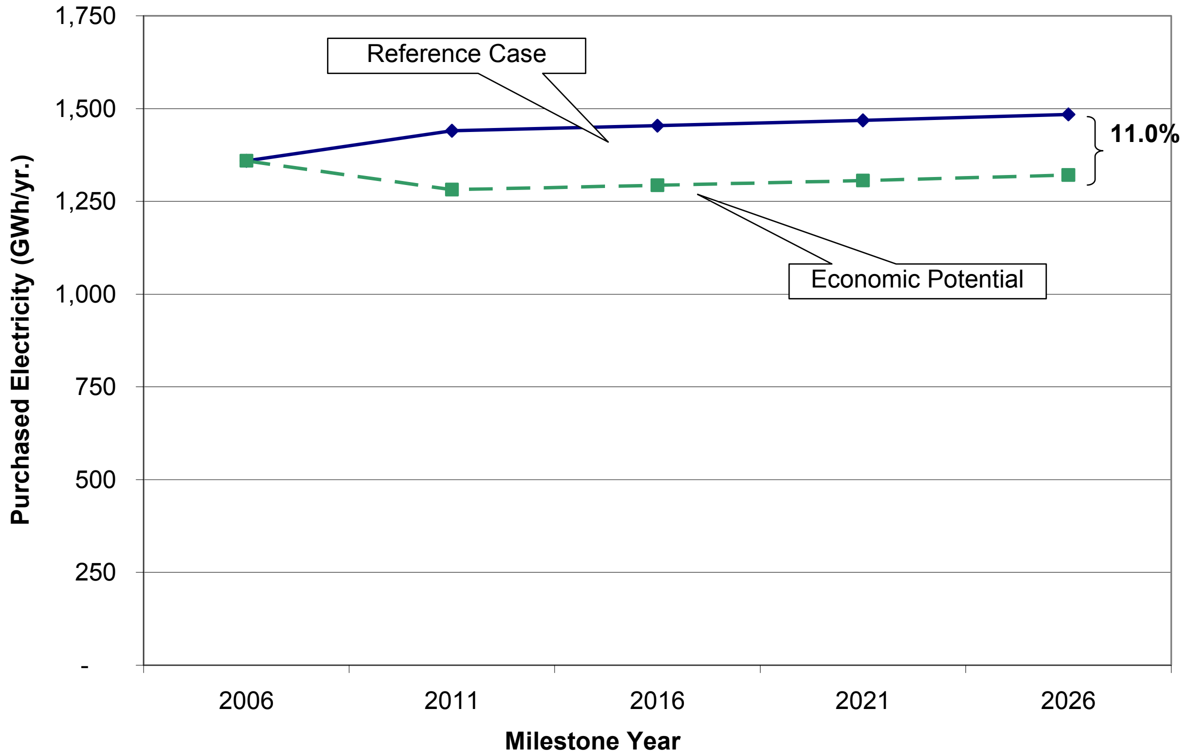
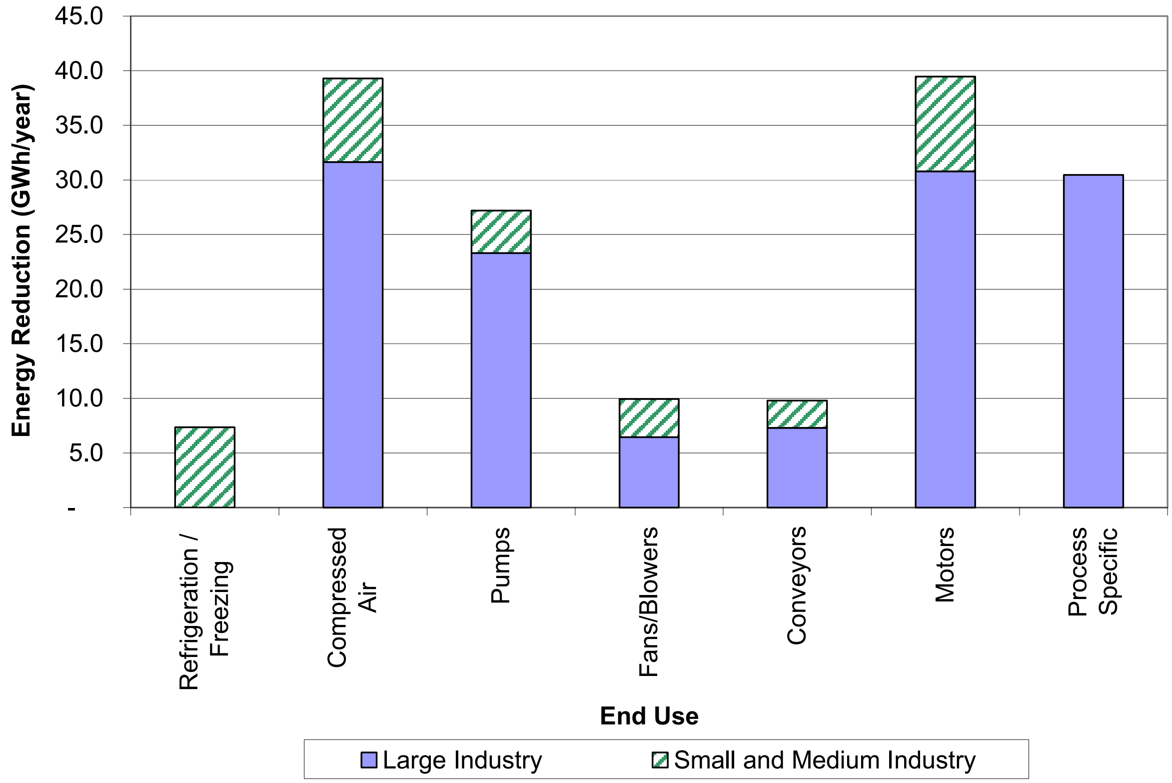


Exhibit 5.4: Total Potential Electricity Savings by End Use, Industry Sector and Milestone Year (GWh/yr.)

End Use	2006	2011	2016	2021	2026	2026 Percentage of Total (%)
Small and Medium Industry						
Refrigeration / Freezing	0.0	1.9	4.0	6.2	7.4	22%
Compressed air	0.0	6.9	7.1	7.4	7.7	23%
Pumps	0.0	3.5	3.6	3.7	3.9	12%
Fans/Blowers	0.0	3.1	3.2	3.3	3.5	10%
Conveyors	0.0	2.2	2.3	2.4	2.5	7%
Motors	0.0	7.7	7.9	8.2	8.7	26%
Sub-Total	***0.0***	***25.2***	***28.1***	***31.2***	***33.6***	***100%***
Large Industry						
Compressed air	0.0	32.9	32.4	32.0	31.6	24%
Pumps	0.0	24.3	24.0	23.6	23.3	18%
Fans/Blowers	0.0	6.4	6.5	6.5	6.5	5%
Conveyors	0.0	7.6	7.5	7.4	7.3	6%
Motors	0.0	32.1	31.6	31.2	30.8	24%
Process specific	0.0	30.2	30.5	30.5	30.5	23%
Sub-Total	***0.0***	***133.5***	***132.5***	***131.3***	***129.9***	***100%***
Total						
Refrigeration / Freezing	0.0	1.9	4.0	6.2	7.4	5%
Compressed air	0.0	39.7	39.6	39.4	39.3	24%
Pumps	0.0	27.8	27.6	27.4	27.2	17%
Fans/Blowers	0.0	9.5	9.7	9.9	9.9	6%
Conveyors	0.0	9.6	9.5	9.5	9.5	6%
Motors	0.0	40.0	39.9	39.7	39.8	24%
Process specific	0.0	30.2	30.5	30.5	30.5	19%
TOTAL	***0.0***	***158.7***	***160.6***	***162.5***	***163.5***	***100%***

Note: The potential electricity savings for the process-specific end use in the Large Industrial sector is based on an assumed savings of 13% (see Section 4.3.9). Any differences in totals are due to rounding.

Exhibit 5.5: Savings by Major End Use and Industrial Sector, 2026



5.5.1 Interpretation of Results – Primary Avoided Costs

A systems approach was used to model the energy impacts of the CDM measures presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible.

Highlights of the results presented in the preceding exhibits are summarized below:

- **Electricity Savings by Milestone Year**

The estimated annual economic potential electricity savings in 2011 is about 159 GWh/yr. (11%) compared to the Reference Case. As shown, the savings are relatively flat from 2011 to the end of the study period with estimated savings of about 164 GWh/yr. in 2026. This is because a significant portion of the energy-efficiency measures are applied at full cost and, consequently, were modelled to achieve full market penetration by 2011. The variability to the savings impact between 2011 and 2026 is due to the effect of the measures applied at stock turn-over rates.

- **Electricity Savings by Sector and End Use**

About 80% of the total economic potential savings of 164 GWh/yr. in 2026 is attributed to the Large Industrial sector. The largest potential savings in this sector are associated with motors (29% of total savings) and compressed air and process specific (each contributing between 23% and 24% of total savings).

The end uses with the largest potential savings in the Small and Medium Industrial sector are motors (33%), compressed air (23%) and refrigeration/freezing (22%). Considering small, medium and Large industry, the economic electricity savings potential is the largest for the motors end use (30%) followed by compressed air (24%).

5.5.3 Sensitivity Analysis – Alternative Avoided Costs

A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC Link. The sensitivity analysis reviewed the scope of measures that would pass or fail the economic screen under the changed avoided costs. Based on the preliminary avoided cost values assessed, the analysis concluded that any impacts would be modest.

6. ACHIEVABLE POTENTIAL

6.1 INTRODUCTION

This section presents the Industrial sector Achievable Potential electricity savings for the study period (2006 to 2026). The Achievable Potential is defined as the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period.

Consistent with the study's scope, the Industrial sector are presented at a less detailed level than for the Residential and Commercial sectors.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to Estimation of Achievable Potential
- Workshop Results
- Summary of Achievable Electricity Savings.

6.2 DESCRIPTION OF ACHIEVABLE POTENTIAL

Achievable Potential recognizes that it is difficult to induce all customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability
- Consumer awareness.

The rate at which customers accept and purchase energy-efficient products can be influenced by a variety of factors including, the level of financial incentives, information and other measures put in place by the Utilities, governments and the private sector to remove barriers such as those noted above.

Exhibit 6.1 presents the level of electricity consumption that is estimated in the Achievable Potential scenarios. As illustrated, the Achievable Potential scenarios are "banded" by the two forecasts presented in previous sections, namely, the Economic Potential Forecast and the Reference Case.

Electricity savings under Achievable Potential are typically less than in the Economic Potential Forecast. In the Economic Potential Forecast, efficient new technologies are assumed to fully penetrate the market as soon as it is financially attractive to do so. However, the Achievable Potential recognizes that under "real world" conditions, the rate at which customers are likely to implement new technologies will be influenced by additional practical considerations and will, therefore, occur more slowly than under the assumptions employed in the Economic Potential Forecast. Exhibit 6.1 also shows that future electricity consumption under the Reference Case is greater than in either of the two Achievable Potential forecasts. This is because the Reference Case represents a "worst case" situation in which there are no additional utility market interventions and hence no additional electricity savings beyond those that occur "naturally."

Exhibit 6.1 presents the achievable results as a band of possibilities, rather than a single line. This recognizes that any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty and that there are different levels of potential CDM program intervention.

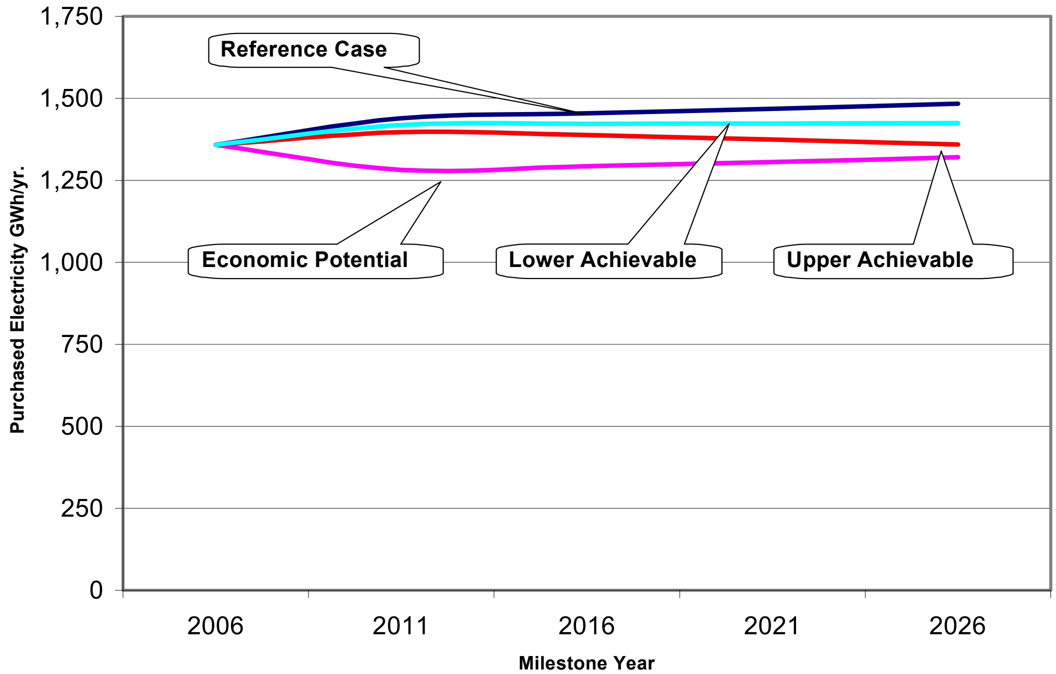
- **The Upper Achievable Potential** assumes both an aggressive program approach and a very supportive context, e.g., healthy economy, very strong public commitment to climate change mitigation, etc.

  However, the Upper Achievable Potential scenario also recognizes that there are limits to the scope of influence of any electric utility. It recognizes that some markets or submarkets may be so price sensitive or constrained by market barriers beyond the influence of CDM programs that they will only fully act if forced to by legal or other legislative means. It also recognizes that there are practical constraints related to the pace that existing inefficient equipment can be replaced by new, more efficient models or that existing building stock can be retrofitted to new energy performance levels

  For the purposes of this study, the Upper Achievable Potential can, informally, be described as: "*Economic Potential less those customers that "can't" or "won't" participate."*

- **The Lower Achievable Potential** assumes that existing CDM programs and the scope of technologies addressed are expanded, but at a more modest level than in the Upper Achievable Potential. Market interest and customer commitment to energy efficiency and sustainable environmental practices remain approximately as current. Similarly, federal, provincial and municipal government energy-efficiency and GHG mitigation efforts remain similar to the present.

Exhibit 6.1: Annual Electricity Consumption – Example of Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Industrial Sector



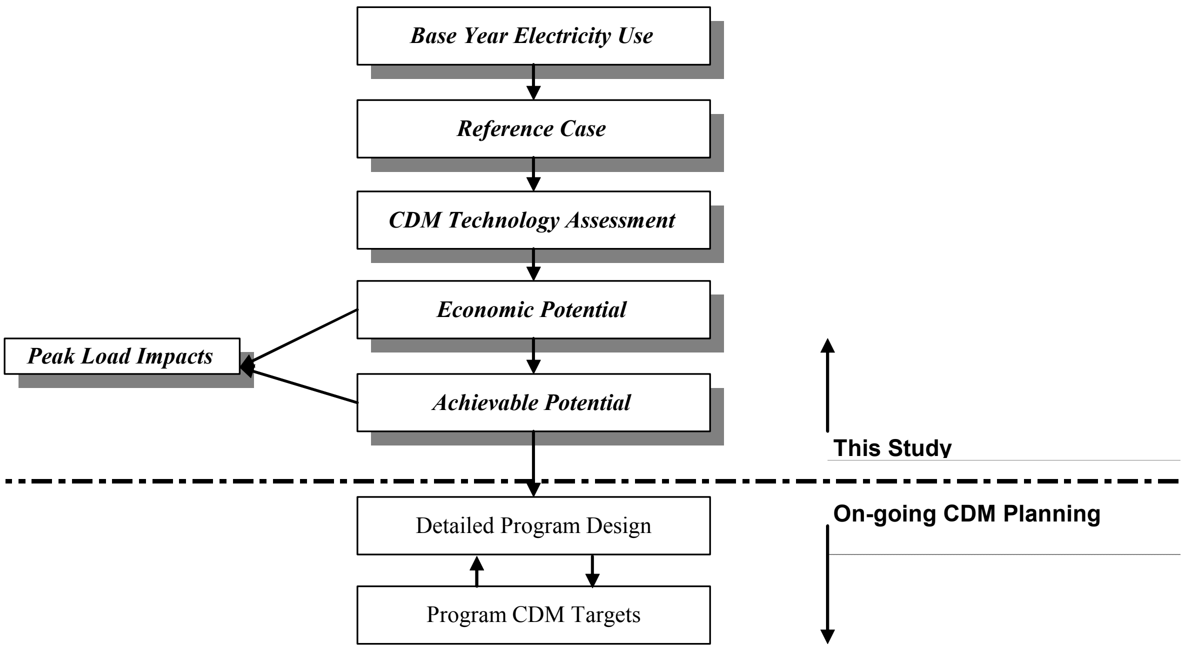
❑ Achievable Potential versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.[12]

Exhibit 6.2 illustrates the relationship between Achievable Potential and the more detailed program design.

[12] The Achievable Potential savings assume program start-up in 2007. Consequently, electricity savings in the first milestone year of 2011 will need to be adjusted to reflect actual program initiation dates. This step will occur during the detailed program design phase, which will follows this study.

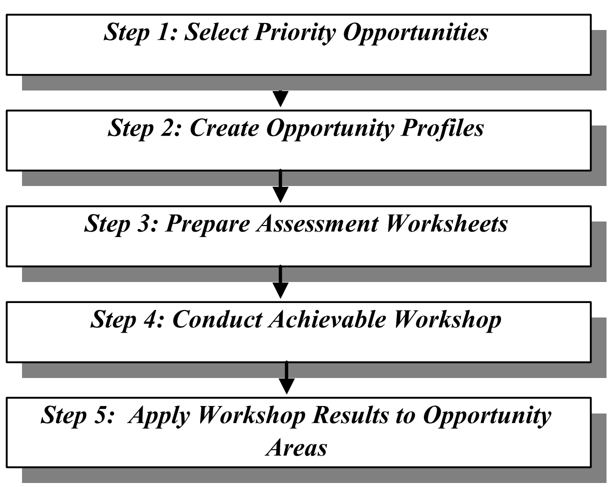
Exhibit 6.2: Achievable Potential versus Detailed Program Design



6.3 APPROACH TO THE ESTIMATION OF ACHIEVABLE POTENTIAL

Achievable Potential was estimated in a five-step approach. A schematic showing the major steps is shown in Exhibit 6.3 and each step is discussed below.

Exhibit 6.3: Approach to Estimating Achievable Potential



- **Step 1: Select Priority Opportunities**

The first step in developing the Achievable Potential estimates required that the energy saving opportunities identified in the Economic Potential Forecasts be "bundled" into a set of opportunity areas that would facilitate the subsequent assessment of their potential market penetration. The energy-efficiency opportunity areas were grouped by end use (Exhibit 6.4) for discussion in the Industrial sector workshop held November 1, 2007.

The workshop focused on the Small and Medium Industrial sectors. Exhibit 6.4 summarizes the opportunity areas and shows the approximate percentage that each represents of the total Small and Medium Industrial sectors potential contained in the Economic Potential Forecast. Large industry includes six facilities and the Achievable Potential is deemed to be very site specific. Within the scope of the high-level industry assessment, the Achievable Potential assessment focused on analyzing the Small and Medium Industrial sectors. The results from this assessment were extrapolated to Large industry and, as a "reality check," was compared to the project team's experience in other jurisdictions

Exhibit 6.4: Industrial Sector Opportunity Areas for Small and Medium Industry – Percentage of Economic Potential for Sector

End Use	2026 Percentage of Total (%)
Small and Medium Industry	
Refrigeration / Freezing	22%
Compressed air	23%
Pumps	12%
Fans/Blowers	10%
Conveyors	7%
Motors	26%
Sub-Total	***100%***

Note: Any differences in totals are due to rounding.

- **Step 2: Create Opportunity Profiles**

The next step involved the development of brief profiles for the priority opportunity areas noted above in Exhibit 6.4. A sample profile for Opportunity I1 (cooling and refrigeration/freezing) is presented in Exhibit 6.5; the remaining Opportunity Profiles are provided in Appendix B.

The purpose of the Opportunity Profiles was to provide a "high-level" logic framework that would serve as a guide for participant discussions in the workshop. The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project.

Exhibit 6.5: Sample Opportunity Profile

I1 – Cooling and Refrigeration/Freezing
Overview: Cooling and refrigeration/freezing apply mainly to the Fishing and Fish Processing sub sector. The opportunity includes improving the efficiency of refrigeration equipment through system reconfiguration, such as optimizing the condenser size, and through technology applications, such as efficient compressors and condenser fans. Improving distribution piping requires a thorough analysis of the complex relationship between the flow of refrigerant, oil and pipe insulation.
Target Technologies and Measures: • Premium efficiency refrigeration equipment including efficient compressors, optimized floating head pressure and equipment size optimization • Improved distribution system
***Opportunity Costs and Savings Profile*:** • A typical cooling/refrigeration/freezing project has an implementation cost of $2,000 to $50,000 • The total economic potential for these measures is estimated to be 7.4 GWh/yr. by 2026 • Customer payback is in the range of 12 years • The CCE for these opportunities is estimated to be $0.01 to $0.04/kWh
Target Audience(s)& Potential Delivery Allies: • Fishing and Fish Processing sub sector • Cooling and refrigeration/freezing equipment manufacturers and suppliers • Provincial and federal government
Constraints & Challenges: The most significant barriers are: • Premium efficiency equipment has attractive energy savings but increased equipment costs • Long payback periods • Retrofitting main equipment and distribution system require systems to be out of operation and may interfere with production schedules
Opportunities & Synergies: • To capitalize on all potential benefits, the feasibility of efficient refrigeration system opportunities are best evaluated during system expansion or as part of a system reliability and safety review. • Improved cooling and freezing may improve product quality and ensure compliance with food safety requirements.
Experience Related to Possible Participation Rates:

As illustrated in Exhibit 6.5, each Opportunity Profile addresses the following areas:

- ***Overview*** – provides a summary statement of the broad goal and rationale for the opportunity.
- ***Target Technologies and Measures –*** highlights the major technologies where the most significant Opportunities have been identified in the Economic Potential Forecast.
- ***Opportunity Costs and Savings Profile*** – provides information on the financial attractiveness of the opportunity from the perspective of both the customer and NLH or NP.

- ***Target Audiences and Potential Delivery Allies*** – identifies key market players that would be expected to be involved in the actual delivery of services. The list of stakeholders shown is intended to be "indicative" and is by no means comprehensive.

- ***Constraints and Challenges*** **–** identifies key market barriers that are currently constraining the increased penetration of energy-efficient technologies or measures. Interventions for addressing the identified barriers are noted. Again, it is recognized that the interventions are not necessarily comprehensive; rather, their primary purpose was to help guide the workshop discussions.

- ***Opportunities and Synergies*** **–** identifies information or possible synergies with other Opportunities that may affect workshop participant views on possible customer participation rates.

- ***Experience Related to Possible Participation Rates*** – provides benchmark data on the past performance of Utilities programs, where available.

- **Step 3: Prepare Draft Opportunity Assessment Worksheets**

A draft Assessment Worksheet was prepared for each Opportunity Profile in advance of the workshop. The Assessment Worksheets complemented the information contained in the Opportunity Profiles by providing quantitative data on the potential energy savings for each opportunity as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

A sample Assessment Worksheet for Opportunity I1 (cooling and refrigeration/freezing) is presented in Exhibit 6.6 (worksheets for the remaining opportunity areas are provided in Appendix C). As illustrated in Exhibit 6.6, each Assessment Worksheet addresses the following areas:

- ***Typical Project Costs*** – provides the typical project costs (includes capital and installation costs) for participants to implement the opportunities.

- ***Customer Payback*** **–** shows the simple payback from the customer's perspective for the package of energy-efficiency measures included in the opportunity area. This information provided an indication of the level of attractiveness that the opportunity measures would present to customers.

- ***Cost of Conserved Energy (CCE)*** – shows the approximate CCE for the measure(s) included within each opportunity area. Where multiple measures are included, a weighted average value is presented. The CCE provides an indication of the relative economic attractiveness of the energy-efficiency measures from the Utilities' perspective. For the purposes of the workshop, this information provided participants with an indication of the scope for using financial incentives to influence customer participation rates. The CCE value combined with the preceding customer payback information provided an important reference point for the workshop participants when considering potential participation rates. The combined information enabled participants to "roughly" estimate the level of financial incentives that could be employed to increase the opportunity's attractiveness to customers without making the measures economically unattractive to NLH or NP.

- ***Total Capacity and Estimated Number of Units*** – shows the total population of potential units that could, theoretically, be addressed in the opportunity area. Numbers shown are from the eligible populations used in the Economic Potential Forecasts. The definition of "unit" varies by opportunity area. In the example shown, a unit is defined as a refrigeration unit with a capacity of 50 HP.

- ***Market Penetration Rates*** **–** show the percentage market penetration rates for the Base Year and the economic potential at the milestone years. As noted in the introduction to this section, the approach to the Industrial sector was less detailed than for the Residential and Commercial sectors. In the Industrial sector, market penetration rates were determined by the consultant's interpretation of the workshop discussions. Two scenarios were determined: Lower and Upper.

Exhibit 6.6: Sample Industrial Sector Opportunity Assessment Worksheet

I1: Cooling / Refrigeration / Freezing

Opportunities
Premium efficiency equipment
Improved distribution system

Typical project cost	$ 2,000 - $ 50,000
Payback period	12 years
CCE	$ 0.01 - 0.04 / kWh
Typical capacity	50 HP
Estimated number of units	400 - 550

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	10	10	10	10
2016	12			60
2026	15			100

- **Step 4: Achievable Potential Workshop**

The most critical step in developing the estimates of Achievable Potential was the half-day workshop held November 1, 2007. Workshop participants consisted of core members of the consultant team, program personnel from the Utilities, industrial facility operators and local trade allies.

The purpose of the workshop was to promote discussion regarding the technical and market conditions confronting the identified energy-efficiency opportunities. Estimates of the Achievable Potential were then developed based on the results of the workshop discussions.

The discussion of each opportunity area was structured around the following questions:

- What is the current age and general condition of the existing stock of equipment? What level of energy-efficiency activity has taken place to date?
- What are the major challenges to implementing energy-efficiency projects involving this type of equipment within the applicable industrial sub sectors?
- What are the minimum conditions that would be required to increase energy-efficiency investments affecting this type of equipment within the applicable industrial sub sectors? How can the Utilities best support additional energy-efficiency investments?

- **Step 5: Apply Workshop Results to Opportunity Areas**

The workshop discussions provided a qualitative understanding of the current Achievable Potential in industry, specifically the Small and Medium Industrial sector. The qualitative potential was converted to quantitative values by considering the profile of the equipment, in terms of age and type of technology, challenges limiting implementation of energy-efficiency opportunities, and experience in other jurisdictions, specifically recent Achievable Potential studies completed by the project team in Nova Scotia, New Brunswick, Ontario and British Columbia. The results for the Small and Medium assessment were extrapolated to the Large Industrial sector and compared with the aforementioned studies. Exhibits 6.7 and 6.8 provide the market penetration rates for the bundled opportunities by end use and milestone year.

Exhibit 6.7: Market Penetration Rates of Energy-efficiency Opportunities by End Use and Milestone Year – Upper Achievable Potential

Small and Medium Industry					
End Use	**2006**	**2011**	**2016**	**2021**	**2026**
Refrigeration / Freezing	10%	41%	64%	78%	83%
Compressed air	15%	43%	63%	75%	80%
Pump	18%	23%	35%	54%	80%
Fans/Blowers	18%	23%	35%	54%	80%
Conveyors	18%	23%	35%	54%	80%
Motors	18%	23%	35%	54%	80%
Large industry					
End Use	**2006**	**2011**	**2016**	**2021**	**2026**
Compressed air	18%	45%	64%	76%	81%
Pump	25%	29%	40%	58%	82%
Fans/Blowers	25%	29%	40%	58%	82%
Conveyors	25%	29%	40%	58%	82%
Motors	25%	29%	40%	58%	82%

Exhibit 6.8: Market Penetration Rates of Energy-efficiency Opportunities by End Use and Milestone Year – Lower Achievable Potential

Small and Medium Industry					
End Use	**2006**	**2011**	**2016**	**2021**	**2026**
Refrigeration / Freezing	10%	26%	38%	45%	48%
Compressed air	15%	28%	38%	45%	47%
Pump	18%	21%	27%	37%	49%
Fans/Blowers	18%	21%	27%	37%	49%
Conveyors	18%	21%	27%	37%	49%
Motors	18%	21%	27%	37%	49%
Large industry					
End Use	**2006**	**2011**	**2016**	**2021**	**2026**
Compressed air	18%	31%	40%	47%	49%
Pump	25%	28%	33%	42%	54%
Fans/Blowers	25%	28%	33%	42%	54%
Conveyors	25%	28%	33%	42%	54%
Motors	25%	28%	33%	42%	54%

6.4 WORKSHOP RESULTS

The following subsection provides a summary of the key issues identified by participants during the workshop and identifies the major assumptions employed by the consultants for applying the workshop results to achievable estimates.

The results are presented for each of the opportunity areas that were discussed during the workshop, which were:

- Cooling and refrigeration/freezing
- Compressed air
- Motors and driven equipment.[13]

6.4.1 I1 – Cooling and Refrigeration/Freezing

Highlights:

- Estimated 95% of the equipment is older than 15 years
- Hurdle rate to implement projects usually less than three years simple payback period
- Awareness of energy efficiency has grown in the past few years
- Short power disruption can have significant negative impact on production, especially in the Fishing and Fish Processing and Manufacturing sub sectors
- Facilities generally do not have expertise in energy efficiency and have a need for engineering resources to assist in developing projects.

Based on the above discussion the market penetration rates were developed as presented in Exhibit 6.7.

6.4.2 I2 – Compressed Air

- Estimated 70% of the equipment is older than 10 years
- Hurdle rate to implement projects usually less than two to three years simple payback period
- Compressed air energy-efficiency awareness and knowledge are lacking in industry
- Some suppliers provide free service to detect air leaks in system and to identify energy-efficiency opportunities.

Market penetration rates are presented in Exhibits 6.7 and 6.8.

[13] The discussion of motors (Opportunity Profile I6) was combined with the discussion of driven equipment, such as pumps, fans and blowers, etc.

6.4.3 I3-I6 – Motors and Driven Equipment

- Estimated 60% - 70% of the equipment is older than 15 years
- No general standardized frames for existing motors, which limits the direct replacement of motors with new, more efficient motors. More common practice is to repair motors rather than replace them
- Motor driven equipment energy-efficiency awareness and knowledge are lacking in industry. This includes limited use and understanding of energy metering and use profiling
- Limited supply of stock locally available due to wide variety of motors
- Limited take up of variable frequency drives (VFD) due to non-standardized motors, pumps and fans.

Market penetration rates are presented in Exhibits 6.7 and 6.8.

6.5 SUMMARY OF ACHIEVABLE ELECTRICITY SAVINGS

Exhibit 6.9 provides an illustration of the achievable electricity savings under both the Lower and Upper scenarios for the combined Island and Isolated and Labrador Interconnected service regions.[14]

As discussed, under the Reference Case industrial purchased electricity use would grow from the Base Year level 1,359 GWh/yr. to approximately 1,484 GWh/yr. by 2026. This contrasts with the Upper Achievable scenario in which electricity use would increase to approximately 1,360 GWh/yr. for the same period, a difference of approximately 125 GWh/yr., or about 8 %. Under the Lower Achievable scenario, electricity use would increase to approximately 59 GWh/yr. for the same period, a difference of approximately 59 GWh/yr., or about 4 %.

Further detail on the total potential electricity savings provided by the Achievable Potential forecasts is provided in Exhibits 6.10 and 6.11. The Exhibits present, respectively, the Upper and Lower Achievable results by end use, sub sector type and milestone year.

[14] The CDM Potential reports for the Residential and Commercial sectors also include an assessment of the peak load reduction impacts associated with the achievable electricity savings. A similar assessment was not included in the Industrial sector study due to the more limited scope applied to this sector and the absence of the required data.

Exhibit 6.9: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in the Industrial Sector (GWh/yr.)

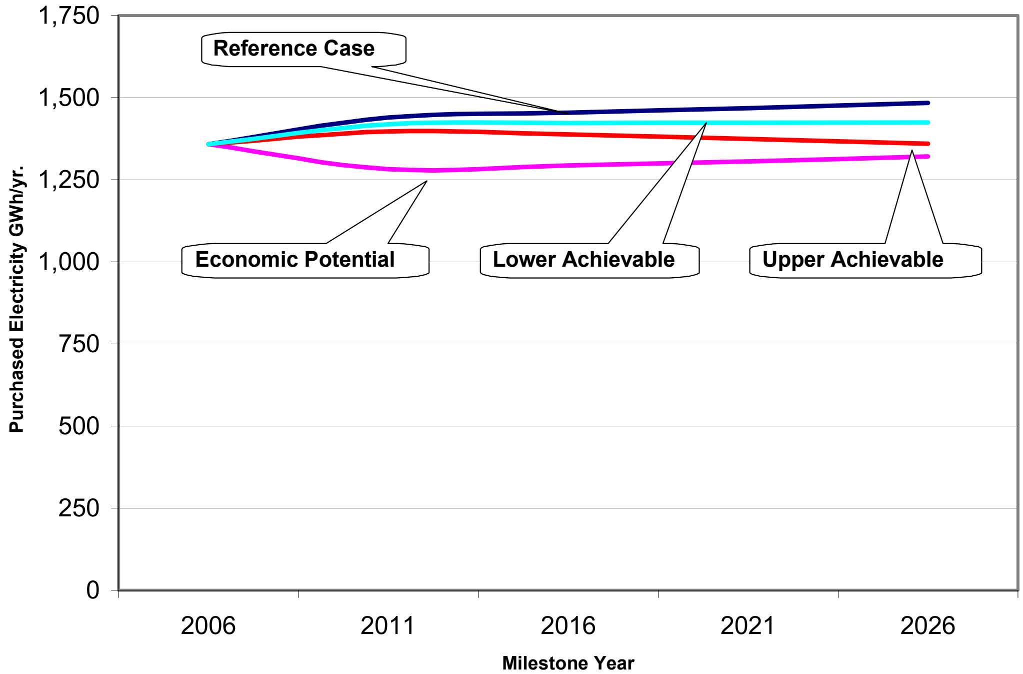


Exhibit 6.10: Summary of Annual Electricity Savings by End Use and Sub Sector, Upper Achievable Potential (GWh/yr.)

End Use	2006	2011	2016	2021	2026	2026 Percentage of Total (%)
Small and Mediun Industry						
Refrigeration / Freezing	0.0	2.3	4.1	5.3	5.9	23%
Compressed air	0.0	2.2	3.9	5.1	5.7	22%
Pumps	0.0	0.2	0.7	1.6	2.9	11%
Fans/Blowers	0.0	0.1	0.6	1.4	2.6	10%
Conveyors	0.0	0.1	0.4	1.0	1.9	7%
Motors	0.0	0.4	1.5	3.5	6.5	25%
Sub-Total	***0.0***	***5.2***	***11.1***	***17.9***	***25.6***	***100%***
Large Industry						
Compressed air	0.0	10.4	17.8	22.2	23.7	24%
Pumps	0.0	1.1	4.4	9.8	17.5	18%
Fans/Blowers	0.0	0.3	1.2	2.7	4.8	5%
Conveyors	0.0	0.3	1.4	3.1	5.5	6%
Motors	0.0	1.4	5.8	13.0	23.1	23%
Process specific	0.0	24.2	24.4	24.4	24.4	25%
Sub-Total	***0.0***	***37.8***	***54.9***	***75.2***	***99.0***	***100%***
Total						
Refrigeration / Freezing	0.0	2.3	4.1	5.3	5.9	5%
Compressed air	0.0	12.6	21.7	27.4	29.5	24%
Pumps	0.0	1.3	5.0	11.4	20.4	16%
Fans/Blowers	0.0	0.4	1.8	4.1	7.5	6%
Conveyors	0.0	0.4	1.7	4.0	7.1	6%
Motors	0.0	1.8	7.3	16.6	29.8	24%
Process specific	0.0	24.2	24.4	24.4	24.4	20%
TOTAL	***0.0***	***43.0***	***66.0***	***93.1***	***124.5***	***100%***

Note: Any differences in totals are due to rounding.

Exhibit 6.11: Summary of Annual Electricity Savings by End Use and Sub Sector, Lower Achievable Potential (GWh/yr.)

End Use	2006	2011	2016	2021	2026	2026 Percentage of Total (%)
Small and Medium Industry						
Refrigeration / Freezing	0.0	1.1	2.0	2.7	2.9	24%
Compressed air	0.0	1.0	1.8	2.4	2.7	22%
Pumps	0.0	0.1	0.3	0.7	1.4	11%
Fans/Blowers	0.0	0.1	0.3	0.7	1.2	10%
Conveyors	0.0	0.0	0.2	0.5	0.9	7%
Motors	0.0	0.2	0.7	1.6	3.0	25%
Sub-Total	***0.0***	***2.5***	***5.3***	***8.5***	***12.1***	***100%***
Large Industry						
Compressed air	0.0	4.8	8.3	10.4	11.1	24%
Pumps	0.0	0.5	2.0	4.6	8.2	17%
Fans/Blowers	0.0	0.1	0.6	1.3	2.3	5%
Conveyors	0.0	0.2	0.6	1.4	2.6	5%
Motors	0.0	0.7	2.7	6.1	10.8	23%
Process specific	0.0	12.1	12.2	12.2	12.2	26%
Sub-Total	***0.0***	***18.4***	***26.4***	***35.9***	***47.0***	***100%***
Total						
Refrigeration / Freezing	0.0	1.1	2.0	2.7	2.9	5%
Compressed air	0.0	5.9	10.1	12.8	13.8	23%
Pumps	0.0	0.6	2.4	5.3	9.5	16%
Fans/Blowers	0.0	0.2	0.8	1.9	3.5	6%
Conveyors	0.0	0.2	0.8	1.8	3.3	6%
Motors	0.0	0.8	3.4	7.7	13.9	24%
Process specific	0.0	12.1	12.2	12.2	12.2	21%
TOTAL	***0.0***	***20.9***	***31.8***	***44.4***	***59.1***	***100%***

Note: Any differences in totals are due to rounding.

7. CONCLUSIONS AND NEXT STEPS

This study has confirmed the existence of significant cost-effective CDM potential within Newfoundland and Labrador's Industrial sector. The study results provide:

- Specific estimates of the potential CDM savings opportunities, defined by sector, sub sector, end use and, in several cases, specific technology(s)
- A baseline set of energy technology penetrations and energy use practices that can assist in the design of specific programs.

The next step[15] in this process involves the selection of a cost-effective portfolio of CDM programs and the setting of specific CDM targets and spending levels. To provide a preliminary reference point for this next step in the program development process, the study team conducted a brief literature search in an attempt to identify typical CDM spending levels in other jurisdictions. The literature search identified two (relatively) recent studies that had addressed similar issues on behalf of other Canadian utilities. The two studies are:

- *Demand-Side Management: Determining Appropriate Spending Levels and Cost-Effectiveness Testing,* which was prepared by Summit Blue Consulting and the Regulatory Assistance Project for the Canadian Association of Members of Public Utility Tribunals (CAMPUT). The study was completed in January 2006.
- *Planning and Budgeting for Energy Efficiency/Demand-Side Management Programs,* which was prepared by Navigant Consulting for Union Gas (Ontario) Limited. The study was completed in July 2005.

The CAMPUT study, which included a review of U.S. and Canadian jurisdictions, concluded that an annual CDM expenditure equal to about 1.5% of annual electricity revenues might be appropriate for a utility (or jurisdiction) that is in the early stages of CDM[16] programming. This level of funding recognizes that it takes time to properly introduce programs into the market place.

The same study found that once program delivery experience is gained, a ramping up to a level of about 3% of annual electricity revenues is appropriate. The study also notes that higher percentages may be warranted if rapid growth in electricity demand is expected or if there is an increasing gap between demand and supply due to such things as plant retirements or siting limitations. The current emphasis on climate change mitigation measures would presumably also fall into a similar category of potential CDM drivers.

The CAMPUT study also notes that even those states with 3% of annual revenues as their CDM target have found that there are more cost-effective CDM opportunities than could be met by the 3% funding. The finding is consistent with the situation in British Columbia. In the case of BC Hydro, CDM expenditures over the past few years have been about 3.3% of electricity

[15] Full treatment of these next steps is beyond the scope of the current project.
[16] The CAMPUT study uses the term DSM (demand-side management); DSM is used interchangeably with CDM in this section.

revenues.[17] However, the results of BC Hydro's recently completed study (Conservation Potential Review (CPR) 2007) identified over 20,000 GWh of remaining cost-effective CDM opportunities by 2026. The magnitude of remaining cost-effective CDM opportunities combined with the aggressive targets set out in British Columbia's provincial Energy Plan suggest that BC Hydro's future CDM expenditures are likely to increase significantly if the new targets are to be met.

- **Additional notes:**

- Neither of the studies noted above found any one single, simple model for setting CDM spending levels and targets. Rather, the more general conclusion is that utilities use a number of different approaches that are reasonable for their context. In fact, the CAMPUT report identified seven approaches to setting CDM spending levels.

    - Based on cost-effective CDM potential estimates
    - Based on percentages of utility revenues
    - Based on Mills/kWh of utility electric sales
    - Levels set through resource planning process
    - Levels set through the restructuring process
    - Tied to projected load growth
    - Case-by-case approach.

- The CAMPUT study also notes that, although not always explicit, a key issue in most jurisdictions is resolving the trade off between wanting to procure all cost-effective energy-efficiency measures and concerns about the resulting short-term effect on rates. The study concludes that CDM budgets based on findings from an Integrated Resource Plan or a benefit-cost assessment tend to accept whatever rate effects are necessary to secure the overall resource plan, inclusive of the cost-effective energy-efficiency measures.

[17] CAMPUT, 2006. p. 14.

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APPENDIX A

Industry Electricity Survey

MARBEK
Resource Consultants Ltd.

Newfoundland CDM Potential

Industry Electricity Survey

INTRODUCTION

This electricity survey focuses on the electricity use and operating practices that will inform the assessment of electricity Conservation and Demand Management (CDM) potential in the province.

Please complete the following questionnaire, and return it within 2 weeks. Should you need immediate assistance call Henri van Rensburg at (416) 364-3772.

CLIENT INFORMATION

Facility Name: …………………………………………………………………………..

Facility Address: ………………………………………………………………………..

Your Name: ……………………………………………………………………...

Title: ………………………………………………………………………………………

Date: …………………………………………………………………………………….....

Telephone: ………………………………………………………………………………

Fax: ………………………………………………………………………………………..

Email Address: ………………………………………………………………………….

A ELECTRICITY USE

Please provide an estimate (in percentages) of how much of the total plant **electricity** is used by each of the end uses:

Electricity End Use		Percentage of Total Plant Electricity (%)
Process heating (incl. water heaters, steam production)		
Process cooling / refrigeration		
Motors and motor driven equipment	Air compressors	
	Pumps	
	Fans and Blowers	
	Conveyors	
	Other motors	
Process specific		
Building envelope and comfort	Lighting	
	Comfort heating, cooling, ventilation and air conditioning (HVAC)	
Other		
TOTAL		***100 %***

B GENERAL PRACTICES

Please answer the following questions:

B.1 Does your facility contain any of the following?

	Yes	No
Interval metering system	☐	☐
Sub-metering on various plant areas or processes	☐	☐
Electricity demand management control	☐	☐
Power Factor correction equipment	☐	☐
Overall plant control system	☐	☐
Program to replace old motors with high/premium efficiency motors	☐	☐
Program to ensure variable speed/frequency drives (VSD/VFD) are installed on motors/pumps/fans where possible	☐	☐

B.2 Does your cooling / refrigeration system contain any of the following systems?

	Yes	No
Standalone compressor control system	☐	☐
Integrated compressor control system	☐	☐
VFD controlled compressors	☐	☐

B.3 Does your compressed air system contain any of the following systems?

	Yes	No
Standalone compressor control system	☐	☐
Integrated compressor control system	☐	☐
VFD controlled compressors	☐	☐
Regular compressed air leak detection survey	☐	☐
Compressed air receiver tanks	☐	☐
Use outside air as make up air (answer only if compressor is air cooled)	☐	☐
Return exhaust air to heat building during winter (answer only if compressor is air cooled)	☐	☐

B.4 Does your lighting system contain any of the following systems?

	Yes	No
On/off timer settings	☐	☐
Occupancy sensors	☐	☐
Control of lighting system according to zones or separate production areas	☐	☐

B.5 Do you operate your HVAC system with the following?

	Yes	No
Different temperature setting for summer and winter	☐	☐
Different heating and cooling set points	☐	☐
Set back temperatures when facility is not occupied, for example during weekends	☐	☐
Recover heat from exhaust to heat make up air	☐	☐

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APPENDIX B

Opportunity Profiles

Opportunity Profile

I1 – Cooling and Refrigeration/Freezing

Overview:
Cooling and refrigeration/freezing apply mainly to the Fishing and Fish Processing sub sector. The opportunity includes improving the efficiency of refrigeration equipment through system reconfiguration, such as optimizing the condenser size, and through technology applications, such as efficient compressors and condenser fans. Improving distribution piping requires a thorough analysis of the complex relationship between the flow of refrigerant, oil and pipe insulation.

Target Technologies and Measures:
- Premium efficiency refrigeration equipment including efficient compressors, optimized floating head pressure and equipment size optimization
- Improved distribution system

Opportunity Costs and Savings Profile:
- A typical cooling/refrigeration/freezing project has an implementation cost of $2,000 to $50,000
- The total economic potential for these measures is estimated to be 7.4 GWh/yr. by 2026
- Customer payback is in the range of 12 years
- The CCE for these opportunities is estimated to be $0.01 to $0.04/kWh

Target Audience(s)& Potential Delivery Allies:
- Fishing and Fish Processing sub sector
- Cooling and refrigeration/freezing equipment manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:
The most significant barriers are:
- Premium efficiency equipment has attractive energy savings but increased equipment costs
- Long payback periods
- Retrofitting main equipment and distribution system require systems to be out of operation and may interfere with production schedules

Opportunities & Synergies:
- To capitalize on all potential benefits, the feasibility of efficient refrigeration system opportunities are best evaluated during system expansion or as part of a system reliability and safety review.
- Improved cooling and freezing may improve product quality and ensure compliance with food safety requirements.

Experience Related to Possible Participation Rates:

Opportunity Profile

I2 – Compressed Air

Overview:
Premium efficiency compressed air equipment includes both the compressor and the air dryer. Premium efficiency air compressors come with built-in ASD control that allows the compressor output to match the plant air demand. These compressors may save as much as 40% over standard compressors which typically use modulated control. Premium efficiency air dryers are of the refrigerated type with dewpoint control. These dryers are typically at least 15% more efficient than regenerative desiccant dryers, which are still commonly used in industry. Industrial facilities typically have several air compressors. Sequencing control systems can operate the compressors so that the larger compressor is base loaded (always on), the mid-sized compressors are used as needed to increase supply and an ASD compressor acts as the trim compressor (provides for the variable component of the process air demand). This setup is intended to closely match the demand for compressed air, to maintain consistent pressure and flow and to reduce O&M costs. Improving the compressed air distribution system involves the addition of air storage to reduce pressure fluctuations, and air piping redesign to reduce friction losses.

Target Technologies and Measures:
- Efficient equipment including efficient compressors, air dryers and equipment size optimization
- Efficient control including ASD, sequencing and dryer dewpoint control
- Efficient distribution system including increased air storage and reduced piping friction losses

Opportunity Costs and Savings Profile:
- A typical compressed air project has an implementation cost of $5,000 to $65,000
- The total economic potential for these measures is estimated to be 7.7 GWh/yr. by 2026
- Customer payback is in the range of 6-13 years
- The CCE for these opportunities is estimated to be $0.01 to $0.08/kWh

Target Audience(s)& Potential Delivery Allies:
- All Industrial sub sectors
- Compressed air equipment manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:
The most significant barriers are:
- Perception by production personnel that existing system should not be changed
- Relatively long payback periods
- Retrofitting main equipment and distribution system require systems to be out of operation and may interfere with production schedules

Opportunities & Synergies:
- Heat recovery from air compressors can be used for space heating
- Replacing water cooled air compressors with air cooled compressors eliminates water usage

Experience Related to Possible Participation Rates:

Opportunity Profile

I3 – Pumps

Overview:

Pumps in industrial applications are often used for cooling tower sprays, spray cooler, water boosters, liquid transport, liquid recovery and liquid mixing. Energy savings can be gained by replacing older stock pumps with premium efficiency models that are application specific with premium efficiency impellers and motors. Pumps should be sized and selected based on their performance curve for the required flow. Impeller sizing is also an important consideration. Impellers should be sized specific for an application.

Pumps used for variable flow in industrial applications may be candidates for ASD. Currently, most pump installations are single speed and operate continuously independent of the actual load. Installing ASD on smaller pumps will result in significant energy savings in variable load applications where full operation may be required for less than 30% of the operating time. In these applications, 40% energy savings can be achieved. Modulating valves installed on by-pass lines will provide sufficient flow at all times allowing the pump to perform at maximum efficiency on the pump curve.

Target Technologies and Measures:

- Efficient and premium efficiency equipment including equipment size optimization
- Efficient control including ASD

Opportunity Costs and Savings Profile:

- A typical pump project has an implementation cost of $500 to $50,000
- The total economic potential for these measures is estimated to be 3.9 GWh/yr. by 2026
- Customer payback is in the range of 2-8 years
- The CCE for these opportunities is estimated to be $0.03 to $0.07/kWh

Target Audience(s)& Potential Delivery Allies:

- All Industrial sub sectors
- Pump manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:

The most significant barriers are:

- Relatively large capital investment in equipment for some projects; however, energy savings and production improvements will make this an attractive investment
- Retrofitting main processing pumps will require pumps to be out of operation and may interfere with production schedules

Opportunities & Synergies:

- Well accepted and proven technology.
- Improved pumping may result in improved product quality

Experience Related to Possible Participation Rates:

Opportunity Profile

I4 – Fans and Blowers

Overview:
Fans and blowers are often used for ventilation, exhaust, cooling, dust collection and aeration. Energy savings can be gained by replacing older stock fans and blowers with premium efficiency models that are application specific. Fans should be sized and selected for an application based on the performance curve of the fan at the required airflow.

Fans are widely used in industry for conveyance, drying and ventilation purposes. Operations requiring variable air delivery, such as drying, can benefit from premium control with ASD allowing air delivery to match process requirements. ASD save electricity and improve product quality by providing plant operators greater and finer control.

Target Technologies and Measures:
- Efficient and premium efficiency equipment, including equipment size optimization
- Efficient control, including timers and ASD

Opportunity Costs and Savings Profile:
- A typical fan/blower project has an implementation cost of $500 to $50,000
- The total economic potential for these measures is estimated to be 3.5 GWh/yr. by 2026
- Customer payback is in the range of 2-9 years
- The CCE for these opportunities is estimated to be $0.04 to $0.09/kWh

Target Audience(s)& Potential Delivery Allies:
- All Industrial sub sectors
- Fan/blower manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:
The most significant barriers are:
- Lack of understanding by production personnel of energy savings potential

Opportunities & Synergies:
- Well accepted and proven technology.
- Improved air quality and indoor climate control

Experience Related to Possible Participation Rates:

Opportunity Profile

I5 – Conveyors

Overview:
Conveyors often use gear boxes to isolate the motor and to provide better torque control. Opportunities include using higher-efficiency drives, couplings and gear/speed reducer alternatives. In older conveyor systems, or where process requirements have changed, it may be possible to resize a conveyor, upgrade the controls or re-engineer the system to improve layout and configuration, all of which will result in energy savings. Incorporating programmable logic controls (PLC) into the conveyor system will result in energy savings. PLC controls can shut down unloaded conveyors and control the conveyor based on load.

Target Technologies and Measures:
- Efficient and premium efficiency equipment, including equipment size optimization, low friction systems, and drive optimization
- Efficient control, including ASD

Opportunity Costs and Savings Profile:
- A typical conveyor project has an implementation cost of $4,000 to $20,000
- The total economic potential for these measures is estimated to be 2.5 GWh/yr. by 2026
- Customer payback is in the range of 4-7 years
- The CCE for these opportunities is estimated to be $0.07 to $0.10/kWh

Target Audience(s)& Potential Delivery Allies:
- Small conveyors in all Industrial sub sectors
- Conveyor manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:
The most significant barriers are:
- Perception by production personnel that existing system should not be changed
- Relatively long payback periods
- Retrofitting main equipment and distribution system require systems to be out of operation and may interfere with production schedules
- Barriers to implementing premium efficiency controls include additional maintenance costs due to increased number of components in the system

Opportunities & Synergies:
- Better controlled conveyance may result in improved product quality

Experience Related to Possible Participation Rates:

Opportunity Profile

I6 – Motors

Overview:
Electric motors convert approximately 85% of industrial plant electricity use to torque to drive industrial end uses such as fans, pumps, material handling and a large portion of process loads. These motors range in size from 75 Watts to more than 25,000 kW, with corresponding efficiencies of 40%-98%. While inherently efficient in converting electricity to shaft or motive power, on average 5%-8% of this power is lost in motor inefficiencies that occur before the driven equipment losses. The three motor efficiency levels included in this study are standard (93.5% efficient), high efficiency (94.5% efficient) and premium efficiency (95.5% efficient). Premium efficiency motors apply to all sub sectors and end uses.

Synchronous belts, also called timing, positive drive or high torque drive belts, apply to all sub sectors and end uses. Often, industrial end uses are driven by pulleys that use V-Belts. By replacing the pulley sheaves with synchronous belt pulleys and installing synchronous belts onto the end use (e.g., fan) an efficiency gain of 3%-5% can be achieved because of reduced slippage and friction between the pulley and belt. Synchronous belts may require motor vibration sensors to prevent damage from continuous operation following a system failure.

Target Technologies and Measures:
- Premium efficiency motors
- Synchronous belts

Opportunity Costs and Savings Profile:
- A typical motor project has an implementation cost of $500 to $75,000
- The total economic potential for these measures is estimated to be 8.7 GWh/yr. by 2026
- Customer payback is in the range of 5-13 years
- The CCE for these opportunities is estimated to be $0.01 to $0.08/kWh

Target Audience(s)& Potential Delivery Allies:
- All Industrial sub sectors
- Motor manufacturers and suppliers
- Provincial and federal government

Constraints & Challenges:
The most significant barriers are:
- Relatively long payback periods
- Retrofitting motors on main process equipment require systems to be out of operation and may interfere with production schedules

Opportunities & Synergies:
- Better operating motors require less maintenance

Experience Related to Possible Participation Rates:

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APPENDIX C

Opportunity Profile Worksheets

I1: Cooling / Refrigeration / Freezing

Opportunities
Premium efficiency equipment
Improved distribution system

Typical project cost	$ 2,000 - $ 50,000
Payback period	12 years
CCE	$ 0.01 - 0.04 / kWh
Typical capacity	50 HP
Estimated number of units	400 - 550

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	10	10	10	10
2016	12			60
2026	15			100

I2: Compressed Air

Opportunities
Premium efficiency equipment
Efficient control
Improved distribution system

Typical project cost	$ 5,000 - $ 65,000
Payback period	6 - 13 years
CCE	$ 0.01 - 0.08 / kWh
Typical capacity	200 HP
Estimated number of units	351 - 400

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	15	15	15	15
2016	17			100
2026	20			100

I3: Pumps

Opportunities
Premium efficiency equipment
Efficient control

Typical project cost	$ 500 - $ 50,000
Payback period	2 - 8 years
CCE	$ 0.03 - 0.07 / kWh
Typical capacity	50 - 200 HP
Estimated number of units	2,500 - 3,000

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	20	20	20	20
2016	22			100
2026	25			100

I4: Fans / Blowers

Opportunities
Premium efficiency equipment
Efficient control

Typical project cost	$ 500 - $ 50,000
Payback period	2 - 9 years
CCE	$ 0.04 - 0.09 / kWh
Typical capacity	50 - 200 HP
Estimated number of units	800 – 1,800

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	20	20	20	20
2016	22			100
2026	25			100

I5: Conveyors

Opportunities
Premium efficiency equipment
Efficient control

Typical project cost	$ 4,000 - $ 20,000
Payback period	4 - 7 years
CCE	$ 0.04 - 0.06 / kWh
Typical capacity	50 - 200 HP
Estimated number of units	1,000 – 1,800

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	20	20	20	20
2016	22			100
2026	25			100

I6: Motors

Opportunities
Premium efficiency equipment
Synchronous belts and VFDs

Typical project cost	$ 500 - $ 75,000
Payback period	5 - 13 years
CCE	$ 0.01 - 0.08 / kWh
Typical capacity	50 - 200 HP
Estimated number of units	5,000 – 6,500

Retrofit

Milestone Year	Market Penetration Rate (%)			
	Reference Case	Achievable Lower	Achievable Upper	Economic Potential
2006	20	20	20	20
2016	22			100
2026	25			100

CONSERVATION AND DEMAND MANAGEMENT (CDM) POTENTIAL

NEWFOUNDLAND and LABRADOR

Residential Sector

–Final Report–

Prepared for:

Newfoundland & Labrador Hydro and Newfoundland Power

Prepared by:

Marbek Resource Consultants Ltd.

In association with:

Sustainable Housing and Education Consultants and Applied Energy Group

January 18, 2008

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EXECUTIVE SUMMARY

❑ Background and Objectives

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province's future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report meets, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five-year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

❑ Scope and Organization

This study covers a 20-year study period from 2006 to 2026 and addresses the Residential, Commercial and Industrial sectors as well as street lighting. The study addresses the customers from both utilities. Due to differences in cost and rate structures, the Utilities' customers are organized into two service regions, which in this report are referred to as the Island and Isolated, and the Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island service region due to their relatively small size and electricity usage.

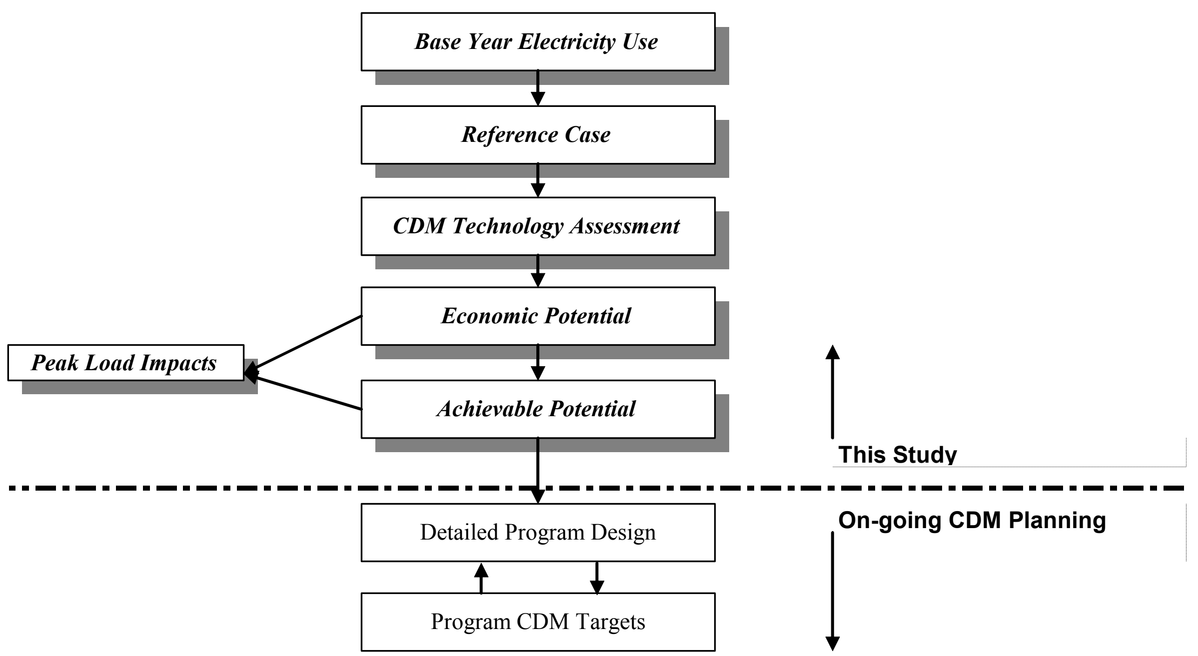
The study reviews all commercially viable electrical efficiency technologies or measures. In addition, the study also reviews selected peak load reduction and fuel switching measures.

❑ Approach

The detailed end-use analysis of electrical efficiency opportunities in the Residential sector employed two linked modelling platforms: **HOT2000,** a commercially supported residential building energy-use simulation software, and **RSEEM** (Residential Sector Energy End-use Model), a Marbek in-house spreadsheet-based macro model. Peak load savings were modelled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

The major steps involved in the analysis are shown in Exhibit ES1 and are discussed in greater detail in Chapter 1. As illustrated in Exhibit ES1, the results of this study, and in particular the estimation of Achievable Potential,[1] support the on-going work of the Utilities; however, it should be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific targets or with program design.

Exhibit ES1: Study Approach - Major Analytical Steps



❑ Overall Study Findings[2]

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the province's building stock and customer willingness to implement new CDM measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on

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[1] The proportion of savings identified that could realistically be achieved within the study period without consideration for budgetary constraints.

[2] Consistent with the study scope, the results presented in this Executive Summary address the Island and Isolated service region. The main report provides a similar breakdown for the Labrador Interconnected service region.

best available information, which in many cases includes the professional judgement of the consultant team, Utilities' personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

The study findings confirm the existence of significant potential cost-effective opportunities for CDM in Newfoundland and Labrador's Residential sector. Electricity savings from efficiency improvements within the Island and Isolated service region would provide between 439 and 236 GWh/yr. of electricity savings by 2026 in, respectively, the Upper and Lower Achievable scenarios. The most significant Achievable Savings opportunities were in the actions that addressed lighting, space heating and household electronics (e.g., computers and peripherals, televisions and television peripherals).

The study also assessed the peak load reductions that would result from the electricity savings (noted above). Electricity savings would provide peak load reductions of approximately 103 to 55 MW during the Utilities' typical Winter Peak Day[3] by 2026 in, respectively, the Upper and Lower Achievable scenarios.

❑ Summary of Electricity Savings

A summary of the levels of annual electricity consumption contained in each of the forecasts addressed by the study is presented in Exhibits ES2 and ES3, by milestone year, and discussed briefly in the paragraphs below.

Exhibit ES2: Summary of Forecast Results for the Island and Isolated Service Region – Annual Electricity Consumption, Residential Sector (GWh/yr.)

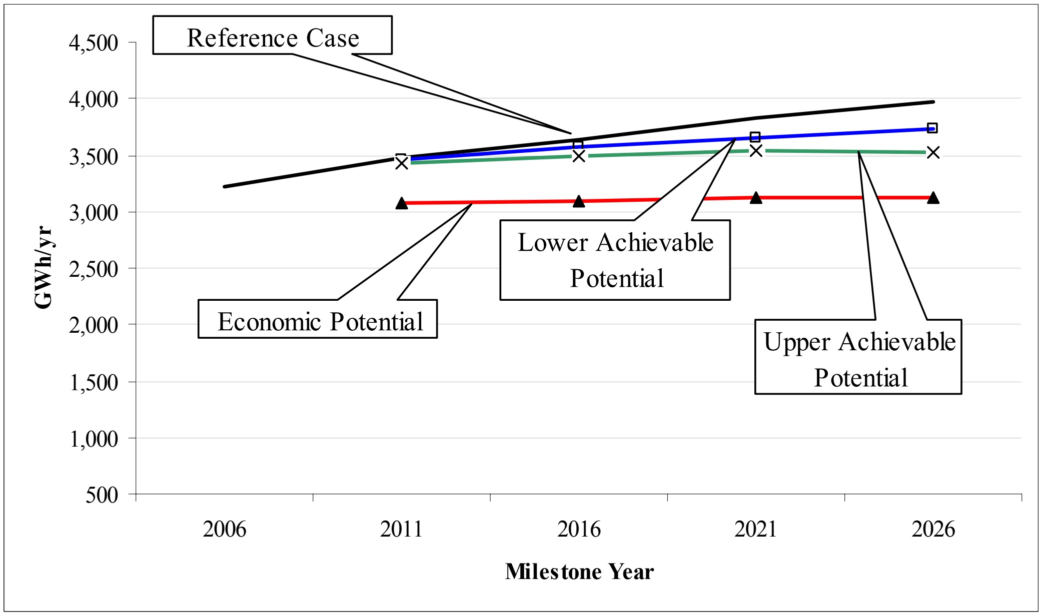
Annual Consumption (GWh/yr.) Residential Sector						Potential Annual Savings (GWh/yr.)		
Milestone Year	Base Year	Reference Case	Economic	Achievable Upper	Achievable Lower	Economic	Achievable Upper	Achievable Lower
2006	3,228	3,228						
2011		3,483	3,074	3,425	3,468	409	58	16
2016		3,637	3,092	3,486	3,568	545	151	69
2021		3,821	3,120	3,533	3,660	701	288	161
2026		3,968	3,122	3,529	3,732	846	439	236

*Results are measured at the customer's point-of-use and do not include line losses.

[3] Winter Peak Day is defined as the weekday hours from 7 am to noon and 4 pm to 8 pm on the four coldest days in the December to March period; totals 36 hours.

Exhibit ES3: Graphic of Forecast Results for the Island and Isolated Service Region – Annual Electricity Consumption, Residential Sector (GWh/yr.)

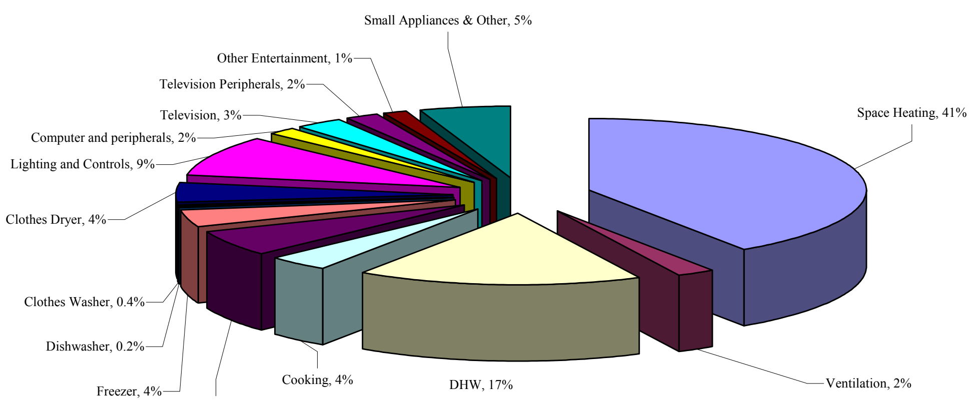
Base



Year Electricity Use

In the Base Year of 2006, the Residential sector in the Island and Isolated service region consumed about 3,228 GWh. Exhibit ES4 shows that space heating accounts for about 41% of total residential electricity use.[4] Domestic hot water (DHW) accounts for about 17% of the total electricity use, followed by kitchen appliances (14%) and lighting (9%). Household electronics (i.e., computers and peripherals, televisions and television peripherals) account for about 8% of electricity use.

Exhibit ES4: Base Year Electricity Use by End Use in the Island and Isolated Service Region, Residential Sector



Totals may not add to 100% due to rounding.

[4] Values are for all residential dwellings. Space heating share is much higher in electrically heated homes.

The overwhelming majority of residential electricity use in the Island and Isolated service region occurs in single detached dwellings (81%). The remaining electricity use is in attached dwellings (11%) followed by apartments (6%). Isolated and other residential buildings each account for about 1%.

Reference Case

In the absence of new utility CDM initiatives, the study estimates that electricity consumption in the Residential sector will grow from 3,228 GWh/yr. in 2006 to about 3,968 GWh/yr. by 2026 in the Island and Isolated service region. This represents an overall growth of about 23% in the period and compares very closely with NLH's load forecast, which also included consideration of the impacts of "natural conservation."

Economic Potential Forecast

Under the conditions of the Economic Potential Forecast,[5] the study estimated that electricity consumption in the Residential sector would decline to about 3,124 GWh/yr. by 2026 in the Island and Isolated service region. Annual savings relative to the Reference Case are 844 GWh/yr. or about 21%.

Achievable Potential

The Achievable Potential is the proportion of the economic electricity savings (as noted above) that could realistically be achieved within the study period. In the Residential sector within the Island and Isolated service region, the Achievable Potential for electricity savings was estimated to be 439 GWh/yr. and 236 GWh/yr. by 2026 in, respectively, the Upper and Lower scenarios.

Consistent with the results in the Economic Potential Forecast, the most significant Achievable savings opportunities were in the actions that addressed lighting and space heating, followed by water heating, household electronics (e.g., computers and peripherals, televisions and television peripherals) and large appliances.

- **Peak Load Savings**

The electricity savings noted above also result in a reduction in capacity requirements (MW), which can be of particular value to the Utilities during periods of high electricity demand. The study defined the Newfoundland Labrador system peak period as:

> *The morning period from 7 am to noon and the evening period from 4 to 8 pm on the four coldest days during the December to March period; this is a total of 36 hours per year.*

The resulting peak load reductions are presented in Exhibit ES5. As illustrated in Exhibit ES5, the Residential sector peak load savings was estimated to be 103 MW and 55 MW by 2026 in, respectively, the Upper and Lower scenarios. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case.

[5] The level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against future avoided electricity costs.

Exhibit ES5: Peak Load Savings from Electricity Savings in the Island and Isolated Service Region, Residential Sector

Milestone Year	Electricity Savings (GWh/yr.)		Peak Load Savings (MW)	
	Upper Achievable	Lower Achievable	Upper Achievable	Lower Achievable
2011	58	16	11	3
2016	151	69	29	13
2021	288	161	58	32
2026	439	236	91	49

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APPENDICES

List of Exhibits

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Newfoundland and Labrador Hydro and Newfoundland Power (collectively the Utilities) have partnered to produce this study, recognizing the role that each has in energy conservation and least cost electric utility planning within the province. Increasing electricity costs and the expectations of a growing number of their customers and stakeholders have contributed to the increased focus on conservation and demand management (CDM) and resulted in a number of recent initiatives and projects targeting energy savings in the province. This study is the next step in the Utilities efforts to develop a comprehensive plan for CDM in Newfoundland and Labrador. The Utilities envision electricity conservation and demand management (CDM) to be a valuable component in meeting the province’s future electricity requirements.

This study will also be a significant component in the further implementation of the Province's recently released Energy Plan. The Energy Plan establishes a long-term vision for how the province's energy resources will be developed and utilized to benefit the people of the province today as well as for future generations. Electricity conservation and demand management (CDM) are an important component of the provincial Energy Plan as are the conservation and demand management components for the other energy resources of the province.

This report meets, in part, the requirements of the Public Utilities Board Order PU 8 2007 requiring NLH to file this study and a five-year plan for implementation of CDM programs in 2008.

The objective of this study is to identify the potential contribution of specific CDM technologies and measures in the Residential, Commercial and Industrial sectors and to assess their economic costs and benefits. The Newfoundland and Labrador economy is expected to grow over the next 20 years, with an associated increase in energy consumption. The benefits of increased penetration of energy efficiency technologies include reduced energy costs for individuals and businesses, as well as environmental benefits through reduced pollution and greenhouse gas emissions.

The outputs from this study will assist the Utilities CDM planners and others to develop specific CDM programs for implementation and to optimize the contribution of CDM technologies and measures to the province's overall energy future.

1.2 STUDY SCOPE

The scope of this study is summarized below.

- **Sector Coverage:** This study addresses the Residential, Commercial and Industrial sectors as well as street lighting. It was agreed that the Industrial sector would be treated at a much higher level than the Residential and Commercial sectors.

- **Geographical Coverage**: The study addresses the customers from both utilities. Due to differences in cost and rate structures, the Utilities’ customers are organized into two service regions, which in this report are referred to a: the Island and Isolated, and the Labrador Interconnected. For the purposes of this study, the isolated diesel system customers have been combined with those in the Island service region due to their relatively small size and electricity usage.

- **Study Period**: This study covers a 20-year period. The Base Year is the calendar year 2006, with milestone periods at five-year increments: 2011, 2016, 2021 and 2026. The Base Year of 2006 was selected as it was the most recent calendar period for which complete customer data were available.

- **Technologies:** The study addresses conservation and demand management (CDM) measures. CDM refers to a broad range of potential measures (see Section 1.3, Definitions); however, for the purposes of this study, it was agreed that the primary focus is on energy-efficiency measures. This includes measures that reduce electricity use as well as the associated capacity impact on a winter peak period. The study also provides a high-level treatment of selected demand management measures, such as direct control of space heating loads, etc.[6]

1.2.1 Data Caveat

As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the province's building stock and customer willingness to implement new CDM measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Utilities and are based on best available information, which in many cases includes the professional judgement of the consultant team, Utilities' personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.3 DEFINITIONS

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

Base Year Electricity Use The Base Year is the starting point for the analysis. It provides a detailed description of "where" and "how" electrical energy is currently used in the existing Residential sector building stock. Building electricity use simulations were undertaken for the major dwelling types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2006.

[6] The information provided is based on the detailed analysis that Marbek is currently undertaking in other jurisdictions.

Reference Case Electricity Use (includes Natural Conservation)

The Reference Case Electricity Use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-F2006) utility-based CDM initiatives. It provides the point of comparison for the subsequent calculation of "economic" and "achievable" electrical energy potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the dwelling types, estimation of the expected growth in building stock and appliances and, finally, an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case aligns well with the NLH Long Term Planning (PLF) Review Forecast, Summer/Fall 2006.

Conservation and Demand Management (CDM) Measures

CDM refers to a broad range of potential measures that can include: energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and self-generation/co-generation (displace load off of grid).

As noted in Section 1.2, it was agreed that the primary focus is on energy-efficiency measures. This includes measures that reduce electricity use as well as the associated capacity impact on a winter peak period.

The Cost of Conserved Energy (CCE)

The CCE is calculated for each energy-efficiency measure and operating and maintenance (O&M) practice. The CCE is the annualized incremental capital and O&M cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Economic Potential Electricity Forecast

The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the future avoided cost of electricity in the Newfoundland and Labrador Hydro service area (for this study, the value was set at $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region).[7] All the energy-efficiency upgrades included in the technology assessment that had a CCE equal to, or less than, the preceding avoided costs of new electricity supply were incorporated into the Economic Potential Forecast.

[7] Sensitivity analysis was also conducted using avoided cost values expected to prevail if the Lower Churchill/DC Link project is completed.

Achievable Potential The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as "upper" and "lower."

1.4 APPROACH

To meet the objectives outlined above, the study was conducted within an iterative process that involved a number of well-defined steps. At the completion of each step, the client reviewed the results and, as applicable, revisions were identified and incorporated into the interim results. The study then progressed to the next step. A summary of the steps is presented below.

Step 1: **Develop Base Year Electricity Calibration Using Actual Utility Billing Data**

- Compile and analyze available data on Newfoundland and Labrador's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.

Step 2: **Develop Reference Case Electricity Use**

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with NLH load forecast for the study period.

Step 3: **Identify and Assess Energy-efficiency Measures**

- Develop list of energy-efficiency upgrade measures.
- Compile detailed cost and performance data for each measure.
- Identify the baseline technologies employed in the Reference Case, develop energy-efficiency upgrade options and associated electricity savings for each option and determine the CCE for each upgrade option.

Step 4: **Estimate Economic Electricity Savings Potential**

- Compile utility economic data on the forecast cost of new electricity generation; costs of $0.0980/kWh and $0.0432/kWh were selected as the

economic screens for, respectively, the Island and Isolated and Labrador Interconnected service regions.
- Screen the identified energy-efficiency upgrade options from Step 3 against the utility economic data.
- Identify the combinations of energy-efficiency upgrade options and building types where the cost of saving one kilowatt of electricity is equal to, or less than, the cost of new electricity generation.
- Apply the economically attractive electrical efficiency measures from Step 3 within the energy use simulation model developed previously for the Reference Case.
- Determine annual electricity consumption in each building type and end use when the economic efficiency measures are employed.
- Compare the electricity consumption levels when all economic efficiency measures are used with the Reference Case consumption levels and calculate the electricity savings.

Step 5: **Estimate Achievable Potential Electricity Savings**

- "Bundle" the electricity and peak load reduction opportunities identified in the Economic Potential Forecasts into a set of opportunities.
- For each of the identified opportunities, create an Opportunity Profile that provides a high-level implementation framework, including measure description, cost and savings profile, target sub sectors, potential delivery allies, barriers and possible synergies.
- Review historical achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a full day workshop involving the client, the consultant team and technical experts to reach general agreement on "upper" and "lower" range of achievable potential.

Step 6: **Estimate Peak Load Impacts of Electricity Savings**

- The electricity (electric energy) savings (GWh) calculated in the preceding steps were converted to peak load (electric demand) savings (MW).[8]
- The study defined the Newfoundland and Labrador system peak period as the morning period from 7 am to noon and the evening period from 4 to 8 pm on the four coldest days of the year during the December to March period; this is a total of 36 hours per year.
- The conversion of electricity savings to hourly demand drew on a library of specific sub sector and end use electricity load shapes. Using the load shape data, the following steps were applied:
  - Annual electricity savings for each combination of sub sector and end use were disaggregated *by month*
  - Monthly electricity savings were then further disaggregated *by day type* (weekday, weekend day and peak day)
  - Finally, each day type was disaggregated *by hour*.

[8] Peak load savings were modeled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

1.5 ANALYTICAL MODELS

The analysis of the Residential sector employed two linked modelling platforms:

- HOT2000, a commercially supported, residential building energy-use simulation software
- RSEEM (Residential Sector Energy End-use Model), a Marbek in-house spreadsheet-based macro model.

HOT2000 was used to define household heating, cooling and domestic hot water (DHW) electricity use for each of the residential building archetypes. HOT2000 uses state-of-the-art heat loss/gain and system modelling algorithms to calculate household electricity use. It addresses:

- Electric, natural gas, oil, propane and wood space heating systems
- DHW systems from conventional to high-efficiency condensing systems
- The interaction effect between space heating appliances and non-space heating appliances, such as lights and refrigerators.

The outputs from HOT2000 provide the space heating/cooling energy-use intensity (EUI) inputs for the Thermal Archetype module of RSEEM.

RSEEM consists of three modules:

- A General Parameters module that contains general sector data (e.g., number of dwellings, growth rates, etc.)
- A Thermal Archetype module, as noted above, which contains data on the heating and cooling loads in each archetype
- An Appliance Module that contains data on appliance saturation levels, fuel shares, unit electricity use, etc.

RSEEM combines the data from each of the modules and provides total use of electricity by service region, dwelling type and end use. RSEEM also enables the analyst to estimate the impacts of the electrical efficiency measures on the Utilities' on-peak system demand.

1.6 STUDY ORGANIZATION AND REPORTS

The study was organized and conducted by sector using a common methodology, as outlined above. The results for each sector are presented in individual reports as well as in a summary report. They are entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Commercial Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Industrial Sector*

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Residential, Commercial and Industrial Sectors, Summary Report*

The study also prepared a brief CDM program evaluation report, which is entitled:

- *Conservation and Demand Management Potential (2006 to 2026), Newfoundland and Labrador, Program Evaluation Guidelines*.

This report presents the Residential sector results; it is organized as follows:

- Section 2 presents a profile of Residential sector Base Year electricity use in Newfoundland and Labrador, including a discussion of the major steps involved and the data sources employed.

- Section 3 presents a profile of Residential sector Reference Case electricity use in Newfoundland and Labrador for the study period 2006 to 2026, including a discussion of the major steps involved.

- Section 4 identifies and assesses the economic attractiveness of the selected energy-efficiency technology measures for the Residential sector.

- Section 5 presents the Residential sector Economic Potential Electricity Forecast for the study period 2006 to 2026.

- Section 6 presents the estimated Upper and Lower Achievable Potential for electricity savings for the study period 2006 to 2026.

- Section 7 presents conclusions and next steps.

- Section 8 presents a listing of major references.

2. BASE YEAR (2006) ELECTRICITY USE

2.1 INTRODUCTION

This section provides a profile of Base Year (2006) electricity use in Newfoundland and Labrador's Residential sector. The discussion is organized into the following sub sections:

- Segmentation of Base Year Housing Stock
- Definition of End Uses
- Estimation of Net Space Heating Loads
- Development of Thermal Archetypes
- Annual Appliance Electricity Use
- Appliance Saturation
- Estimation of Fuel Share, by End Use
- Average Electricity Use Per Unit
- Summary of Model Results.

2.2 SEGMENTATION OF BASE YEAR HOUSING STOCK

The first major task in developing the Base Year electricity calibration involved the segmentation of the residential building stock on the basis of four factors:

- Dwelling type
- Service region
- Vintage
- Heating category (electrically heated versus non-electrically heated).

Based on discussions with the Utilities' personnel, it was agreed that Newfoundland and Labrador's existing residential stock would be segmented into the following dwelling types:

- Single-family detached, pre-2007 – electric space heat
- Single-family detached, pre-2007 – non-electric space heat
- Attached,[9] pre-2007 – electric space heat
- Attached, pre-2007 – non-electric space heat
- Apartment,[10] pre-2007 – electric space heat
- Apartment, pre-2007 – non-electric space heat
- Isolated (all residences in diesel communities)
- Other – includes very low use facilities and non-dwellings such as garages, sheds, wells, etc.
- Vacant and Partial – includes dwelling units that are either vacant all the time (such as homes owned by people who have moved away) or are used only seasonally (including cottages). The energy consumption of this residential stock is not reported in the remainder of this document.

[9] Includes the main dwellings above a basement apartment.
[10] Includes basement apartments, which make up about 50% of the units defined under this category.

Utility customer billing data was used to develop a breakdown of the Residential sector into the above dwelling types. The same customer data was also used to further divide the total population of each dwelling type by service region and primary heating type.

A summary is provided in Exhibit 2.1 and highlights are presented below:

- The Utilities currently service about 228,000 residential dwelling units between the two service regions; the Island and Isolated service region accounts for approximately 96.5% of the total residential customers served by the Utilities.

- 8% of residential dwellings are currently listed as vacant or partially occupied. This includes seasonal homes or cottages as well as vacant residences. These buildings have been separated out from the other dwelling types in the Base Year as their inclusion may result in an understating of the energy consumption.

- Of those residential units that are currently fully occupied, approximately 76% are single-family detached, followed by 11% attached units, 9% apartment units, and 2% other types of dwellings. The remaining 2% is made up of isolated dwellings.

- Electricity is the primary space heating fuel in approximately 55% of the provincial housing stock in the Island and Isolated service region and 92% of the provincial housing stock in the Labrador Interconnected service region.

- The inclusion of single-family dwellings with a basement apartment in the dwelling type "Attached," may result in energy consumption in this segment being slightly higher than is typical of other areas of Canada.

Exhibit 2.1: Existing Newfoundland and Labrador Residential Units by Dwelling Type, Service Region and Primary Heating Source

Dwelling Type	Units		
	Island and Isolated	**Labrador Interconnected**	**Total**
Single Family Detached, Electric Heat	80,300	5,031	**85,331**
Single Family Detached, Non-Electric Heat	74,231	103	**74,334**
Attached, Electric Heat	15,227	1,663	**16,890**
Attached, Non-Electric Heat	5,060	34	**5,094**
Apartment, Electric Heat	16,399	462	**16,861**
Apartment, Non-Electric Heat	2,728	9	**2,737**
Isolated	3,491	0	**3,491**
Other	3,512	606	**4,118**
Vacant and Partial	18,970	0	**18,970**
Subtotal	**219,918**	**7,908**	**227,826**

Source: NLH-NP customer billing data.

2.3 DEFINITION OF END USES

Electricity use within each of the dwelling types noted above is further defined on the basis of specific end uses. In this study, an end use is defined as, "the final application or final use to which energy is applied. End uses are the services of economic value to the users of energy."

A summary of the major Residential sector end uses used in this study is provided in Exhibit 2.2, together with a brief description of each.

Exhibit 2.2: Residential Electric End Uses

End Use	Description
Space heating	All space heating, including both central heating and supplementary heating
Space cooling	Saturation of space cooling is very low in Newfoundland and Labrador; the model includes any space cooling energy use under "Small Appliance & Other"
Ventilation	Primarily the furnace fan, but also includes the fan in heat recovery ventilators as well as kitchen and bathroom fans
Domestic Hot Water (DHW)	Heating of water for DHW use. Does not include hydronic space heating
Cooking	Includes ranges, separate ovens and cook tops and microwave ovens
Refrigerator	
Freezer	
Dishwasher	
Clothes washer	
Clothes dryer	
Lighting	Includes interior, exterior and holiday lighting
Computer and peripherals	Printers, scanners, modems, faxes, PDA and cell phone chargers
Television	
Television peripherals	Set top boxes, including digital cable converters and satellite converters
Other electronics	Stereos, DVD players, VCRs, boom boxes, radios, video gaming systems, security systems
Small Appliance & Other	There are hundreds of additional items within this category, each accounting for a fraction of a percent of household energy use, e.g., hair dryers, doorbells, garage door openers, block heaters, home medical equipment, electric lawnmowers

2.4 ESTIMATION OF NET SPACE HEATING LOADS

Net space heating load is the space heating load of a building that must be met by the space heating system. This is equal to the total heat loss through the building envelope minus solar and internal gains.

The net space heating loads for each combination of dwelling type and service region were developed based on the following combination of data sources:

- Marbek's database of residential energy consumption from other jurisdictions
- Current utility sales data combined with knowledge of the energy consumption and saturation of other end uses.

The net space heating load for each dwelling type is given by the following equation:

$$NetHL_1 = HL_1 + a_{i,1} * s_{i,1}$$

Where: $NetHL_1$ = Net heating load for dwelling type #1
HL_1 = Load on primary heating appliance for dwelling type #1
$a_{i,1}$ = Average consumption for supplementary heating in dwelling type #1
$s_{i,1}$ = Saturation of supplementary heating in dwelling type #1

HL_1 was estimated for each dwelling type and service region, based on the Utilities' customer sales data for electric and non-electrically heated dwellings combined with data on the electricity consumption of non-space heating end uses. The values for a_{i1} and s_{i1} were developed based on the estimated share of space heating that is provided by electricity (versus supplementary fuels), as taken from the Utilities' Residential End-use Surveys (REUS). The net space heating loads are presented in Exhibit 2.3 by dwelling type and service region.

It should be noted that the values shown in Exhibit 2.3 are not fuel specific; rather, they represent the total tertiary space heat load for each dwelling. The efficiency of the space heating appliances used to meet these loads are considered in subsequent stages of the analysis.

Exhibit 2.3: Existing Residential Units, 2006 (kWh/yr.) Net Space Heating Loads by Dwelling Type[11]

Dwelling Type	Island and Isolated	Labrador Interconnected
Single Family Detached, Electric Heat	12,554	29,379
Single Family Detached, Non-Electric Heat	16,700	39,081
Attached, Electric Heat	11,377	27,294
Attached, Non-Electric Heat	15,134	36,309
Apartment, Electric Heat	5,742	8,745
Apartment, Non-Electric Heat	5,742	8,745
Isolated	12,293	N/A
Other	10,036	5,411

[11] Net space heating load is the space heating load of a building that must be met by the space heating system over a full year. This is equal to the total heat loss through the building envelope minus solar and internal gains. Values shown for non-electrically heated dwellings are shown in kilowatt hours for format consistency. Work in other jurisdictions has shown significantly higher space heating energy consumption in homes with oil and gas furnaces than in homes with electric heat, even after accounting for furnace efficiency. The reasons for this require more research, but may include factors such as greater air leakage where air intake is required for combustion or homeowners turning down individual electric baseboards in unoccupied rooms.

2.4.1 Development of Thermal Archetypes – Existing Stock

The next major step involved the development of a thermal archetype for each of the major dwelling types noted in Exhibit 2.3 using HOT2000.

Each HOT2000 file contains a comprehensive physical description of the size, layout and thermal characteristics of each dwelling type. HOT2000 then uses these inputs to create a full computer model of the residence, calculating loads, interactive effects and energy consumption. In each case, the net heating and cooling loads simulated by HOT2000 were calibrated to the values shown in Exhibit 2.3, which had been established on the basis of the sources described above. The process of calibrating simulation models to the loads estimated from available data served to further confirm the estimated loads. Adjustments were made to the estimates as required.

The physical and operating characteristics of each residential thermal archetype were researched using a number of sources, including:

- Database of EnerGuide for Houses (EGH) evaluations in Newfoundland and Labrador
- Natural Resources Canada (NRCan) and Statistics Canada housing data
- Consultations with energy auditors and residential housing experts located in Newfoundland and Labrador.

For the existing housing stock, archetypes were created for the two primary dwelling types in each service region: single-family detached and attached. A brief description of each housing archetype is provided below.

❑ **Single-family Dwellings**

For the Island and Isolated service region, a "typical" existing, single-detached dwelling can be defined as a single-story bungalow of approximately 93.5m^2 (1000 ft^2), with a finished basement. This home has 7.7 m^2 (83 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.4 (R-13.5) insulation values, ceilings RSI-4.5 (R-25.5) and the basement is insulated to a value of RSI-0.6 (R-3.5). The houses are typically not very airtight with about five air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

For the Labrador Interconnected service region, a "typical" existing, single-detached dwelling can be defined as a single-story bungalow of approximately 85 m^2 (915 ft^2), with a heated basement. This home has 6.1 m^2 (66 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.1 (R-12) insulation values, ceilings RSI-4 (R-23) and there is no insulation in the basement. The houses are typically not very airtight with about seven air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

- **Attached Dwellings**

For the Island and Isolated service region, a "typical" existing, attached dwelling can be defined as a two-story middle-unit of approximately 104 m^2 (1120 ft^2), with a finished basement. This home has 7.2 m^2 (77 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.4 (R-13.5) insulation values, ceilings RSI-4.5 (R-25.5) and the basement is insulated to a value of RSI-0.6 (R-3.5). The houses are typically not very airtight with about five air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

For the Labrador Interconnected service region, a "typical" existing, attached dwelling can be defined as a two-story middle-unit of approximately 104 m^2 (1120 ft^2) with a heated basement. This home has 7.2 m^2 (77 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.1 (R-12) insulation values, ceilings RSI-4 (R-23) and there is no insulation in the basement. The houses are typically not very airtight with about seven air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

2.5 ANNUAL APPLIANCE ELECTRICITY USE

The next major task involved the development of estimated average annual unit electricity consumption (UEC) values for each of the major residential appliances.

While most appliances have increased in efficiency over time, there is no evident correlation or available data that links the age of the dwelling and the age of the appliances in it. Older homes likely have had major appliances replaced several times and newer homes can have old appliances transferred from previous residences. Lacking any definite relation between the age of the home and the age of an appliance, an average value for all in-place appliances was used for all existing vintages. This was based on an appliance stock model that takes into account the expected useful life of each type of appliance, the rate of purchase and retirement of appliances, the average annual consumption of newly purchased appliances in a given year and the average annual consumption of appliances being retired in a given year. The stock average consumption thus evolves with time. In any specific year, the average age of appliances in place is assumed to be half of the expected useful life of the appliance and the stock average is built up of all the appliances purchased and installed up to that point.

Exhibits 2.4 and 2.5 summarize the estimated average annual UEC for major end-use appliances in, respectively, the Island and Isolated and Labrador Interconnected service regions.

The values shown in Exhibits 2.4 and 2.5 apply to the current stock mix. Further discussion is provided below.

Exhibit 2.4: Annual Appliance Electricity Use (UEC) for the Island and Isolated Service Region, (kWh/yr.)

Dwelling Type	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	121	3,301	633	830	650	75	64	820	1,515	394	178	226	159	902
Single Family Detached, Non-Electric Heat	800	3,301	633	830	650	75	64	820	1,515	394	178	226	159	902
Attached, Electric Heat	110	2,991	488	830	650	58	48	615	1,373	394	178	226	159	428
Attached, Non-Electric Heat	725	2,991	488	830	650	58	48	615	1,373	394	178	226	159	428
Apartment, Electric Heat	55	2,239	378	560	370	49	41	490	693	394	178	226	159	135
Apartment, Non-Electric Heat	275	2,239	378	560	370	49	41	490	693	394	178	226	159	135
Isolated	118	3,301	806	813	827	73	63	803	1,483	385	174	221	156	883
Other	97	2,639	506	664	520	60	51	656	1,211	315	142	180	127	721

Exhibit 2.5: Annual Appliance Electricity Use (UEC) for the Labrador Interconnected Service Region, (kWh/yr.)

Dwelling Type	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	121	3,961	633	830	650	75	64	820	1,818	394	178	226	159	902
Single Family Detached, Non-Electric Heat	800	3,961	633	830	650	75	64	820	1,818	394	178	226	159	902
Attached, Electric Heat	112	3,680	488	830	650	58	48	615	1,689	394	178	226	159	428
Attached, Non-Electric Heat	743	3,680	488	830	650	58	48	615	1,689	394	178	226	159	428
Apartment, Electric Heat	36	2,687	378	560	370	49	41	490	832	394	178	226	159	135
Apartment, Non-Electric Heat	179	2,687	378	560	370	49	41	490	832	394	178	226	159	135
Other	22	730	117	153	120	14	12	151	335	72	33	42	29	166

❑ Occupancy

Occupancy rates[12] for each dwelling type were based on residential utility data from other jurisdictions. They are used, as applicable, to estimate electricity use for occupant-sensitive end uses, such as DHW, laundry and lighting. Exhibit 2.6 summarizes the occupancy rates, by dwelling type. The table indicates, for example, that 12% of single-family dwellings are occupied by only one person, 42% by two persons and 46% by three or more persons.

Exhibit 2.6: Occupancy Rates by Dwelling Type

Occupants	SFD	Attached	Apt
1	12%	27%	54%
2	42%	40%	35%
3+	46%	33%	12%

❑ Ventilation

Ventilation electricity is associated with fan/blower electricity in heating systems, kitchen fans, bathroom fans and heat recovery ventilators.

A furnace fan UEC of 700 kWh (heat mode only) is assumed for single-family dwellings having central forced air heating systems. This value is towards the upper range of Canadian end-use metered data, as reported in a study conducted for Natural Resources Canada, and is consistent with the relatively longer heating season experienced in Newfoundland and Labrador.[13]

For the purpose of estimating kitchen and bathroom fan electricity, it was assumed that a typical exhaust fan is rated at 75 Watts and operates, on average, for two hours per day. In homes with heat supplied by baseboard electric or by hydronic systems, these exhaust fans are the predominant ventilation load. With two such fans in a typical house, consumption would be approximately 100-110 kWh/yr.

The UEC for a forced air system includes the energy from both the furnace fan and the exhaust fans. The UEC for a baseboard electric system includes only the energy from the latter. The ventilation UEC values shown in Exhibits 2.4 and 2.5 for electrically heated dwellings in Newfoundland and Labrador reflect the mix between forced air systems (under 2% of electrically heated homes) and baseboard systems.

❑ Domestic Hot Water

UEC estimates for DHW assume a per capita hot water consumption of 45 litres per person per day and a temperature rise of 45^{o}C. Exhibit 2.7 shows the distribution of DHW load by major end use.

[12] Electricity use related to personal consumption increases with number of occupants in dwelling.
[13] This area is the focus of extensive research efforts. *See*: Gusdorf, John, *Final Report on the Project to Measure the Effects of ECM Furnace Motors on Gas Use at the CCHT Research Facility*, Natural Resources Canada, January 2003. Current estimates of fan energy use vary widely; upper range estimates (heat mode only) exceed 1,000 kWh/yr. Continuous ventilation or use with space cooling equipment would increase fan motor consumption.

Exhibit 2.7: Distribution of DHW Electricity Use by End Use in Existing Stock, (kWh/yr.)

End Use	Sample Electricity Use Single Family Detached (kWh/yr.)	%
Personal Use	1,155	35
Dishwashing	759	23
Clothes Washing	891	27
Standby Losses	495	15
Total	3,301	100

Note: Any differences in totals are due to rounding.

The DHW values shown in Exhibit 2.7 are based on a combination of sources including available data from other jurisdictions, NRCan studies (NRCan, 2005) and the results of conditional demand analysis and customer survey work done by both NP and NLH in the 1990s.[14]

❑ Cooking Appliances, Refrigerator, Freezer and Dishwasher

UEC estimates for the existing stock of this group of food preparation and storage appliances were obtained from *The End Use Energy Data Handbook* (NRCan, 2005). The values shown for dishwashers are for mechanical electricity only; hot water use is included with the DHW UEC.

❑ Clothes Washer and Dryer

Appliance UEC data was obtained from *The End Use Energy Data Handbook* (NRCan, 2005) and adjusted by region and dwelling type based on previous data. The values shown for clothes washers are for mechanical electricity only; hot water use is included with the DHW UEC.

❑ Computers

UEC data for computers is based on Marbek's current work for BC Hydro.[15] UEC varies with occupancy rate by region and dwelling type.

❑ Lighting

The lighting loads shown in Exhibits 2.4 and 2.5 were developed from the following sources:

- Residential utility data on lighting types and usage patterns from other jurisdictions
- *The End Use Energy Data Handbook* (NRCan, 2005).

Exhibit 2.8 shows the derivation of lighting UECs.

[14] The values shown in Exhibit 2.7 do not include combustion efficiency; therefore, if the water is heated using oil or propane, the on-site energy consumption would be higher than shown in Exhibit 2.7.
[15] Marbek Resource Consultants, *Conservation Potential Review – 2007*. Prepared for BC Hydro. 2007.

Exhibit 2.8: Derivation of Lighting UECs

Incandescent		
Number of regularly used bulbs		
SFD/Duplex	16	
Row	15	
Apt	8	
Mobile/Other	8	
Average wattage	60	
Average Hours/year	1,200	
Fluorescent		
(includes linear tubes and CFLs)		
Number of regularly used linear lamps/CFLs	*Linear*	*CFL*
SFD/Duplex	2	2
Row	2	3
Apt	1	3
Mobile/Other	1	2
Average wattage (including ballast)	48	15
Average Hours/year	1,200	1,200
Holiday/Other Lighting		
(includes garden and other outdoor lighting)		
Average wattage		
SFD/Duplex	350	
Row	250	
Apt	0	
Mobile/Other	225	
Average Hours/year	300	
Total Base Year Energy Use		
SFD/Duplex	1,388	
Row	1,373	
Apt	693	

❑ Television

UEC data for televisions was obtained from *Technology and Market Profile: Consumer Electronics* (Marbek, 2006). Saturation of televisions (number of sets per household) is adjusted by dwelling type based on data from the "Frequency Per Dwelling Type 2005" Survey (see Section 2.6) but consumption per television is not varied by dwelling type in this study.

❑ Television Peripherals

UECs, saturations and numbers per household for television peripherals were obtained from *Technology and Market Profile: Consumer Electronics* (Marbek, 2006) and other published data. A weighted UEC for the end use as a whole was generated from these numbers as shown in Exhibit 2.9. UEC varies with occupancy rate by dwelling type and region.

Exhibit 2.9: Derivation of UEC for Television Peripherals

	% of TV households	UEC kWh/yr
Digital Cable Service	17%	
Digital Adaptor	17%	82
Standard Digital STB	14%	194
Advanced Digital STB	3%	325
	Average UEC	299
Satellite Service	21%	
Standard Satellite STB	17%	141
Advanced Satellite STB	4%	273
	Average UEC	166
	Total Weighted UEC	**226**

❑ Other Electronics

Due to the large presence of electronic entertainment devices in many residential dwellings, this end use was separated from the general "Other" category. UECs were obtained from *Technology and Market Profile: Consumer Electronics* (Marbek, 2006), *Residential Miscellaneous Electricity Use* (LBL) and other published data. A weighted UEC for the end use as a whole was then generated from these numbers as shown in Exhibit 2.10.

Exhibit 2.10: Derivation of UECs for Other Electronics

	Penetration	Number Per Household	UEC (kWh/yr)	Weighted UEC (kWh/yr)
DVD	72%	1.2	35	30
VCR	69%	1.3	55	49
Audio System	29%	1.3	55	21
Surround Sound	25%	1	50	13
Compact Audio	79%	1.5	25	30
Game Console	25%	1.3	55	18
			Total Weighted UEC	**160**

❑ Small Appliances and Other

"Other" end uses include a wide range of appliances and equipment found in most homes. Reliable data on the actual annual electricity use of this collection of appliances and equipment within Newfoundland and Labrador is not available.

Exhibit 2.11 illustrates the major items included in this end use and presents sample UEC data estimated in earlier studies undertaken in other jurisdictions.[16] It should be noted that actual UECs for individual appliances will vary from those shown in Exhibit 2.11 and are affected by factors such as saturations by dwelling type, occupancy rates and service region. Saturation

[16] Lawrence Berkeley National Laboratory (LBL), *Residential Miscellaneous Electricity Use,* 1997.

information from LBL was not applied for this study because reliable information for Newfoundland and Labrador was not available. The "Other" category is not built up based on detailed analysis, but is an approximation only. The LBL data provided should be treated as being illustrative of the types of energy-using items in the category and how much electricity they typically use.

Exhibit 2.11: Typical UECs for Selected "Other" Appliances

Appliance	UEC (kWh/yr)	Appliance	UEC (kWh/yr)
Home radio, small/clock	18	Timer	18
Battery Charger	21	Hot Plate	30
Clock	18	Stand Mixers	1
Power Strip	3	Hand-Held Rechargeable	16
Vacuum	31	Hand-Held Electric Vacuum	4
Hand Mixers	2	Air Corn Popper	6
Iron	53	Security System	195
Hair Dryer	36	Perc Coffee	65
Toaster	39	Deep Fryer	20
Auto Coffee Maker	116	Waterbed Heaters	900
Blender	7	Humidifier	100
Heating Pads	3	Electric Toothbrush	20
Doorbell	18	Hot Oil Corn Popper	2
Answering Machine	29	Women's Shaver	12
Can Opener	3	Aquariums	548
Slow Cooker	16	Espresso Maker	19
Curling Iron	1	Electric Lawn Mower	100
Food Slicer	1	Mounted Air Cleaner	500
Garbage Disposer	10	Multi-fcn Device	41
Electric Knife	1	Heat Tape	100
Portable Fans	8	Auto Engine Heaters	250
Men's Shaver	13	Electric Kettle	75
Waffle Iron/Sandwich Grill	25	Bottled Water Dispenser	300
Electric Blankets	120	Central Vacuum	24
Garage Door Opener	30	Grow Lights	800
Hair Setter	10	Home Medical Equipment	400

2.6 APPLIANCE SATURATION

Exhibits 2.12 and 2.13 summarize the saturation levels that are used in the present analysis for, respectively, the Island and Isolated and Labrador Interconnected service regions. In each case, the assumed saturation levels are developed from the most recent utility REUS. Saturations were obtained through querying the database, by end use and dwelling type; minor refinements were made in selected cases to assist in calibration.

Exhibit 2.12: Appliance Saturation Levels for Island and Isolated in 2006, (%)

Dwelling Type	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	100%	100%	100%	119%	108%	48%	99%	96%	100%	77%	242%	158%	147%	100%
Single Family Detached, Non-Electric Heat	100%	100%	100%	119%	108%	48%	99%	96%	100%	77%	242%	158%	147%	100%
Attached, Electric Heat	100%	100%	110%	121%	74%	40%	96%	92%	100%	83%	234%	153%	143%	100%
Attached, Non-Electric Heat	100%	100%	110%	121%	74%	40%	96%	92%	100%	83%	234%	153%	143%	100%
Apartment, Electric Heat	100%	100%	100%	101%	50%	15%	55%	54%	100%	58%	166%	109%	101%	100%
Apartment, Non-Electric Heat	100%	100%	100%	101%	50%	15%	55%	54%	100%	58%	166%	109%	101%	100%
Isolated	100%	100%	99%	67%	116%	23%	86%	87%	100%	34%	157%	103%	96%	100%
Other	50%	20%	0%	5%	5%	0%	5%	5%	100%	0%	5%	3%	3%	100%

Exhibit 2.13: Appliance Saturation Levels for Labrador Interconnected in 2006, (%)

Dwelling Type	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	100%	100%	100%	99%	105%	62%	93%	94%	100%	60%	177%	116%	108%	100%
Single Family Detached, Non-Electric Heat	100%	100%	100%	99%	105%	62%	93%	94%	100%	60%	177%	116%	108%	100%
Attached, Electric Heat	100%	100%	100%	89%	98%	66%	98%	98%	100%	64%	170%	112%	104%	100%
Attached, Non-Electric Heat	100%	100%	100%	89%	98%	66%	98%	98%	100%	64%	170%	112%	104%	100%
Apartment, Electric Heat	100%	100%	100%	75%	58%	17%	58%	58%	100%	17%	142%	93%	86%	100%
Apartment, Non-Electric Heat	100%	100%	100%	75%	58%	17%	58%	58%	100%	17%	142%	93%	86%	100%
Other	50%	20%	0%	5%	5%	0%	5%	5%	100%	0%	5%	3%	3%	100%

2.7 ESTIMATION OF FUEL SHARE, BY END USE

Data on fuel shares, for all end uses except space heating, is taken from the most recent utility REUS. In the case of space heating, the starting point was the distribution of space heating appliances, by fuel type, as reported in the REUS and in the EnerGuide for Houses database:

- Electricity in non-electrically heated dwellings, and
- Non-electric sources in electrically heated dwellings.

Exhibits 2.14 and 2.15 summarize the electricity fuel shares assumed for each of the end uses included in the present analysis for, respectively, the Island and Isolated and Labrador Interconnected service regions. The space heating fuel shares presented in these exhibits[17] have been selected on the basis that they provide a reasonable fit with:

- General market description (i.e., known distribution of heating appliances by fuel)
- Electricity sales to different categories of homes.

The market share of electricity for space heating is a combination of the fuel shares shown in the exhibits below and the relative numbers of dwellings in the electric category and the non-electric category. For example, Exhibit 2.15 shows 94% of the space heating energy in electrically-heated homes is supplied by electricity (the rest is assumed to be provided by auxiliary heating sources such as wood stoves. As shown earlier in Exhibit 2.1, 98% of single-family dwellings in the Labrador Interconnected service region are in the electrically heated category. Therefore, the assumption used for market share of electric heat in single-family dwellings in the Labrador Interconnected service region is 98% x 94% = 92%. The market share of electricity for both space heating and water heating is very high in the Labrador Interconnected service region, largely due to the very low retail price of electricity.

[17] Adjustment of fuel shares for space heating was done in tandem with the adjustment of space heating loads described in Section 2.4 above.

Exhibit 2.14: Electricity Fuel Shares for the Island and Isolated in 2006, (%)

Dwelling Type	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Single Family Detached, Non-Electric Heat	4%	100%	63%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Attached, Electric Heat	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Attached, Non-Electric Heat	4%	100%	25%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Apartment, Electric Heat	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Apartment, Non-Electric Heat	4%	100%	56%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Isolated	5%	100%	83%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Other	52%	100%	50%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Exhibit 2.15: Electricity Fuel Shares for Labrador Interconnected in 2006, (%)

Dwelling Type	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other
Single Family Detached, Electric Heat	94%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Single Family Detached, Non-Electric Heat	0%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Attached, Electric Heat	94%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Attached, Non-Electric Heat	0%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Apartment, Electric Heat	94%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Apartment, Non-Electric Heat	0%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Other	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

2.8 AVERAGE ELECTRICITY USE PER UNIT

Exhibits 2.16 and 2.17 combine the building stock, efficiency, saturation and fuel share data presented in the preceding exhibits and show the resulting electricity use, by end use, for each dwelling type in, respectively, the Island and Isolated and Labrador Interconnected service regions.

Exhibit 2.16: Average Electricity Use per Dwelling Unit for the Island and Isolated Service Region in 2006, (kWh/yr.)

Dwelling Type	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other	Total
Single Family Detached, Electric Heat	11,956	121	3,301	634	985	703	36	64	787	1,515	305	430	358	235	902	**22,330**
Single Family Detached, Non-Electric Heat	621	800	2,085	622	985	703	36	64	787	1,515	305	430	358	235	902	**10,446**
Attached, Electric Heat	10,835	110	2,991	539	1,006	482	23	46	564	1,373	328	417	346	227	428	**19,716**
Attached, Non-Electric Heat	563	725	743	529	1,006	482	23	46	564	1,373	328	417	346	227	428	**7,800**
Apartment, Electric Heat	5,469	55	2,239	378	567	185	7	23	263	693	226	296	246	161	135	**10,944**
Apartment, Non-Electric Heat	214	275	1,258	370	567	185	7	23	263	693	226	296	246	161	135	**4,920**
Isolated	615	118	2,740	778	541	958	17	54	697	1,483	132	274	227	149	883	**9,666**
Other	4,215	48	264	0	33	26	0	3	33	1,211	0	7	6	4	2,884	**8,734**

Exhibit 2.17: Average Electricity Use per Dwelling Unit for Labrador Interconnected Service Region in 2006, (kWh/yr.)

Dwelling Type	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes washer	Clothes dryer	Lighting	Computer etc.	Television	TV peripherals	Other electronics	Small apps & Other	Total
Single Family Detached, Electric Heat	27,616	121	3,961	633	824	680	46	60	770	1,818	236	314	261	171	902	**38,412**
Single Family Detached, Non-Electric Heat	1,954	800	3,921	633	824	680	46	60	770	1,818	236	314	261	171	902	**13,389**
Attached, Electric Heat	25,656	112	3,680	488	736	635	38	47	601	1,689	250	303	252	165	428	**35,082**
Attached, Non-Electric Heat	1,815	743	3,643	488	736	635	38	47	601	1,689	250	303	252	165	428	**11,835**
Apartment, Electric Heat	8,220	36	2,687	378	420	216	8	24	286	832	66	252	209	137	135	**13,907**
Apartment, Non-Electric Heat	437	179	2,660	378	420	216	8	24	286	832	66	252	209	137	135	**6,240**
Other	5,411	11	144	0	8	6	0	1	8	335	0	2	1	1	747	**6,675**

2.9 SUMMARY OF MODEL RESULTS

This section presents the results of the model runs for the Base Year 2006. The results are measured at the customer's point-of-use and do not include line losses; they are presented in four separate exhibits:

- Exhibits 2.18 and 2.19 present the model results for the Island and Isolated service region. The results are broken out by dwelling type and end use.
- Exhibits 2.20 and 2.21 present the model results for the Labrador Interconnected service region. The results are broken out by dwelling type and end use.

❑ **By Dwelling Type**

Single detached dwellings account for the overwhelming majority of residential electricity use in both service regions: approximately 81% of residential electricity consumed in the Island and Isolated service region and 73% in the Labrador Interconnected service region.

In the Island and Isolated service region, the remaining electricity use is in attached dwellings (11%) followed by apartments (6%). Isolated and other residential buildings each account for about 1%.

In the Labrador Interconnected service region, the remaining electricity use is in attached dwellings (22%) followed by apartments (2%). Other residential buildings account for the remaining electricity use (2%).

❑ **By End Use**

Space heating accounts for the largest share of residential electricity use in both service regions: approximately 41% of residential electricity consumed in the Island and Isolated service region and 71% in the Labrador Interconnected service region. The larger space heating share in the Labrador Interconnected service region is due to the colder climate and the very high share of heating load met by electricity. The large electric space heating share reflects the low electricity prices in that region.

DHW is the second largest electricity end use in both service regions: approximately 17% of residential electricity consumed in the Island and Isolated service region and 11% in the Labrador Interconnected service region.

In the Island and Isolated service region, other significant end uses include lighting (9%) and refrigerators (6%). The electronic end uses (computers, televisions and peripherals, other electronics) combined account for approximately 8% of residential electricity use.

In the Labrador Interconnected service region, other significant end uses include lighting (5%), refrigerators (2%), freezers (2%) and cooking (2%). The electronic end uses (computers, televisions and peripherals, other electronics) combined account for approximately 3% of residential electricity use.

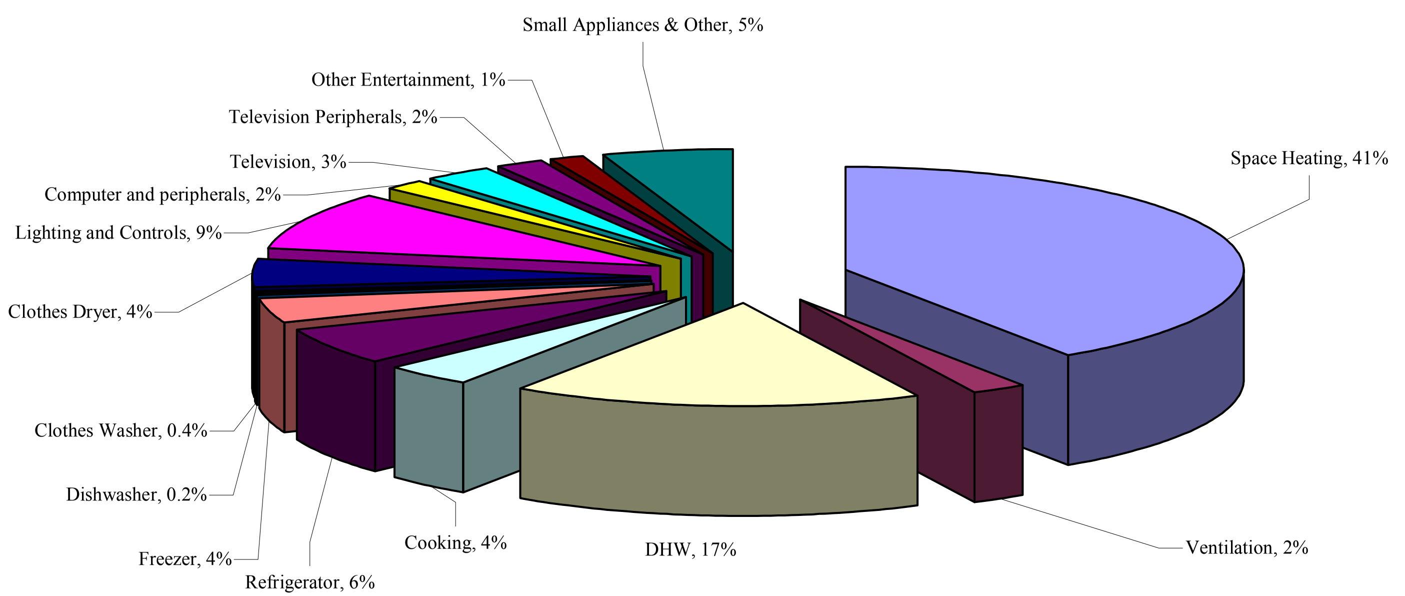
Exhibit 2.18: Electricity Consumption for the Island and Isolated Service Region, Modelled by End Use and Segment in the Base Year (2006), (GWh/yr.)[18]

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting and Controls	Computer and peripherals	Television	Television Peripherals	Other Entertainment	Small Appliances & Other
Single-Family	2006	2,569	1,006	69	420	97	152	109	6	10	122	234	47	67	55	36	139
Attached	2006	340	168	5	49	11	20	10	0.5	1	11	28	7	8	7	5	9
Apartment	2006	193	90	2	40	7	11	4	0.1	0	5	13	4	6	5	3	3
Isolated	2006	34	2	0.4	10	3	2	3	0.1	0	2	5	0.5	1	1	1	3
Other	2006	31	15	0.2	1	0.0	0.1	0.1	0.00	0.01	0.1	4	0	0.02	0.02	0.01	10
TOTAL	2006	3,166	1,281	77	520	118	186	125	6	11	141	285	59	82	68	44	164

Note: Any differences in totals are due to rounding.

[18] Electricity consumption in this exhibit does not include the "vacant and partially occupied" category of dwellings. Consumption data for the vacant and partial group must be added to these figures to obtain a total that matches the Utilities' forecast data.

Exhibit 2.19: Distribution of Electricity Consumption, by End Use in the Base Year (2006) for the Island and Isolated Service Region



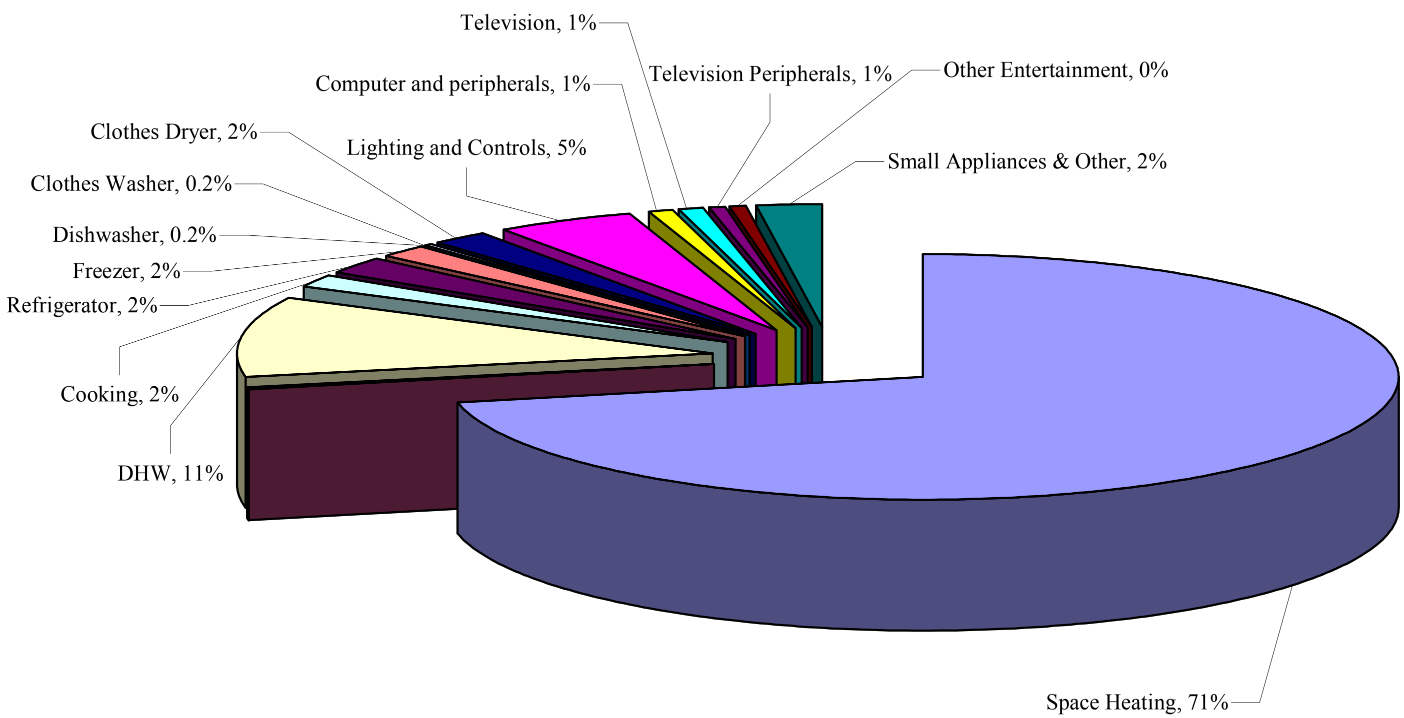
Totals may not add to 100% due to rounding.

Exhibit 2.20: Electricity Consumption for the Labrador Interconnected Service Region, Modelled by End Use and Segment in the Base Year (2006), (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting and Controls	Computer and peripherals	Television	Television Peripherals	Other Entertainment	Small Appliances & Other
Single-Family	2006	195	139	1	20	3	4	3	0.2	0.3	4	9	1	2	1	1	5
Attached	2006	59	43	0.2	6	1	1	1	0.1	0.1	1	3	0.4	1	0.4	0.3	1
Apartment	2006	6	4	0.02	1	0.2	0.2	0.1	0.004	0.01	0.1	0.4	0.03	0.1	0.1	0.1	0.1
Other	2006	4.0	3.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5
TOTAL	2006	264	189	1	28	4	6	5	0.3	0.4	5	13	2	2	2	1	6

Note: Any differences in totals are due to rounding.

Exhibit 2.21: Distribution of Electricity Consumption, by End Use in the Base Year (2006) for the Labrador Interconnected Service Region



Totals may not add to 100% due to rounding.

3. REFERENCE CASE ELECTRICITY USE

3.1 INTRODUCTION

This section presents the Residential sector Reference Case for the study period (2006 to 2026). The Reference Case estimates the expected level of electricity consumption that would occur over the study period in the absence of new utility-based CDM initiatives. The forecast data provided were based on a set of assumptions that include future rate changes. The Reference Case includes the same assumption and it becomes part of the environment in which conservation potential will be evaluated. The Reference Case, therefore, provides the point of comparison for the calculation of electricity-savings opportunities associated with each of the scenarios that are assessed within this study.

The Reference Case discussion is presented within the following sub sections:

- Estimation of Net Space Heating Loads—New Dwellings
- "Natural" Changes to Space Heating Loads—Existing Dwellings
- "Natural" Changes to Electric Appliance UECs
- Appliance Saturation Trends
- Stock Growth
- Fuel Shares
- Summary of Model Results.

3.2 ESTIMATION OF NET SPACE HEATING LOADS—NEW DWELLINGS

The first task in building the Reference Case involved the development of estimates of the net space heating loads for new dwellings to be built over the study period. As was the case with the existing building stock, the study relied on several sources to prepare these estimates, including:

- Estimated household electricity consumption levels contained in the NLH Long Term Planning Review Forecast, Summer/Fall 2006
- Consultation with housing experts in Newfoundland and Labrador
- Review of experience in other jurisdictions.

Based on consideration of the best available data from the above sources, this study assumes that the net space heating loads in new dwellings remain the same as for the existing dwellings. This conclusion recognizes that while thermal efficiencies are improving in new dwellings, they are being partially, or wholly, offset by changing construction practices.

Examples of these off-setting trends include:

- Overall, window, wall and roofing thermal efficiency levels have increased in new residential buildings and air leakage rates have been reduced by more than 40% compared to typical existing dwellings.

- The amount of window area in new houses has increased by up to 20% compared to typical existing homes.

- The new stock tends to have floor areas that are 15%-20% larger, on average.
- Buildings also feature an increase in exterior wall surface area of between 5%-20%. This reflects both the increased floor area and a tendency for homes to include architectural features with more corners and details that diverge from the standard rectangular shapes.

Exhibit 3.1 summarizes the resulting new net space heating loads.

Exhibit 3.1: New Residential Units—Net Space Heating Loads[19] by Dwelling Type and Service Region, (kWh/yr.)[20]

Dwelling Type	Island and Isolated	Labrador Interconnected
Single Family Detached, Electric Heat	12,554	29,966
Single Family Detached, Non-Electric Heat	16,700	39,863
Attached, Electric Heat	11,377	27,840
Attached, Non-Electric Heat	15,134	37,035
Apartment, Electric Heat	5,742	8,920
Apartment, Non-Electric Heat	5,742	8,920
Isolated	12,293	N/A
Other	10,036	5,630

3.2.1 Development of Thermal Archetypes – New Stock

Although the study assumes that the net space heating loads remain approximately the same for both new and existing dwellings, the physical and thermal specifications of the new dwellings differ from the existing dwellings. Thus, as in the Base Year discussion, a thermal archetype for each of the major new dwelling types was developed using HOT2000.

For the new housing stock, archetypes were created for the two primary dwelling types in each service region: single-family detached and attached. A brief description of each housing archetype is provided below.

❑ **Single-family Dwellings**

For the Island and Isolated service region, a "typical" existing, single-detached dwelling can be defined as a single-story bungalow of approximately 110 m^2 (1184 ft^2) with an unheated basement. This home has 9.6 m^2 (103 ft2) of windows, defined as double-glazed, mostly with vinyl frames. Walls are represented by RSI-3.0 (R-17) insulation values, ceilings RSI-5.5 (R-31) and no basement insulation. The houses are reasonably

[19] Net space heating load is the space heating load of a building that must be met by the space heating system over a full year. This is equal to the total heat loss through the building envelope minus solar and internal gains. Values shown for non-electrically heated dwellings are shown in kilowatt hours for format consistency.
[20] Vacant and partially-occupied dwelling units are not shown in this exhibit.

airtight with about 2.87 air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

For the Labrador Interconnected service region, a “typical” existing, single-detached dwelling can be defined as a single-story bungalow of approximately 110 m^2 (1184 ft^2) with a heated basement. This home has 9.6 m^2 (103 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-3.0 (R-17) insulation values, ceilings RSI-5.5 (R-31) and there is no insulation in the basement. The houses are typically not very airtight with about 4.55 air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

❑ **Attached Dwellings**

For the Island and Isolated service region, a “typical” existing attached dwelling can be defined as a two-story home of approximately 130 m^2 (1400 ft^2) with an unheated basement. This home has 9.6 m^2 (103 ft^2) of windows, defined as double-glazed, mostly with vinyl frames. Walls are represented by RSI-3.0 (R-17) insulation values, ceilings RSI-5.5 (R-31) and there is no basement insulation. The houses are average in terms of air tightness with about 3.57 air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

For the Labrador Interconnected service region, a “typical” existing single-detached dwelling can be defined as a single-story bungalow of approximately 130 m^2 (1400 ft^2) with a heated basement. This home has 9.6 m^2 (103 ft^2) of windows, defined as double-glazed, mostly with wood or vinyl frames. Walls are represented by RSI-2.5 (R-14) insulation values, ceilings RSI-5.0 (R-28) and there is no insulation in the basement. The houses are typically not very airtight with about 4.55 air changes per hour (ac/h) at 50 Pascal (Pa) depressurization. Typically, there is no central ventilation system.

3.3 “NATURAL” CHANGES TO SPACE HEATING LOADS – EXISTING DWELLINGS

In addition to new dwellings, space heating loads in existing dwellings are also expected to change over the study period. However, no specific data are available and, as outlined in the preceding discussion of new dwellings, contrary trends[21] are occurring. Consequently, this analysis assumes that net space heating loads in existing buildings remain unchanged in the reference case.

Examples of trends that tend to decrease the net space heating loads include:

- Insulation and other improvements that occur when renovation projects are undertaken
- Replacement of old windows with new models that provide comfort and aesthetic benefits as well as improved energy efficiency
- Installation of more efficient thermostatic controls.

[21] Replacement of the heating equipment itself is not one of these factors, first, because it does not actually change the net heating load and second, because electric space heating in Newfoundland and Labrador is mainly done with baseboard strip, already at 100% efficiency.

Examples of trends that tend to increase net space heating loads include:

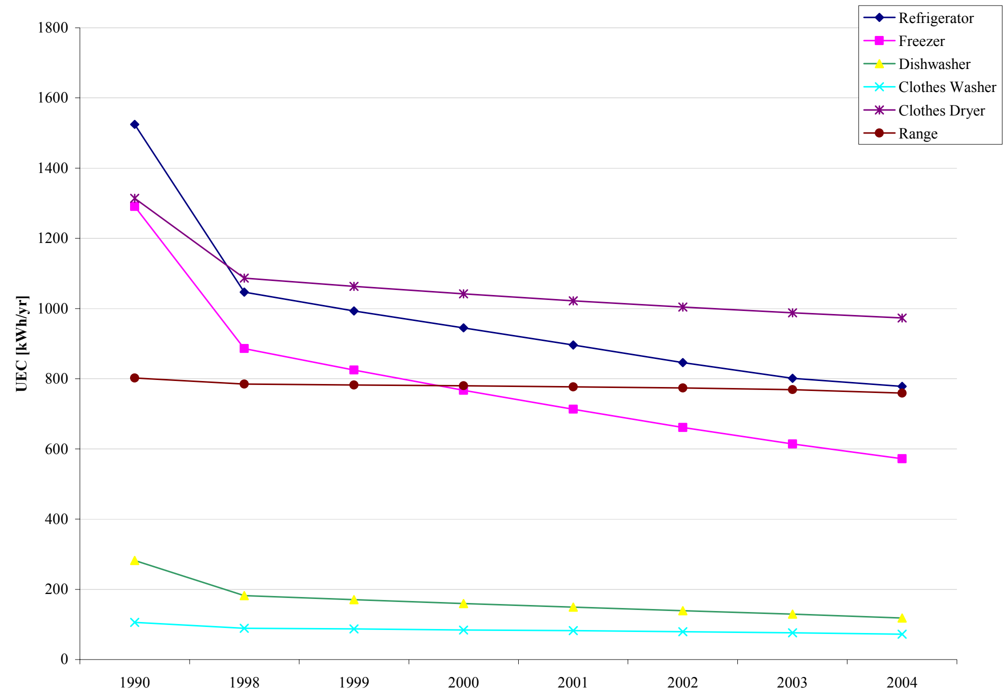
- Enlargement of houses with additions
- Reductions in internal gains due to more efficient appliances and lights.

3.4 "NATURAL" CHANGES TO ELECTRIC APPLIANCE UECS

This section identifies the annual unit electricity consumption (UEC) for the major household appliances and equipment for both "stock in place" and new sales for the period 2006 to 2026.

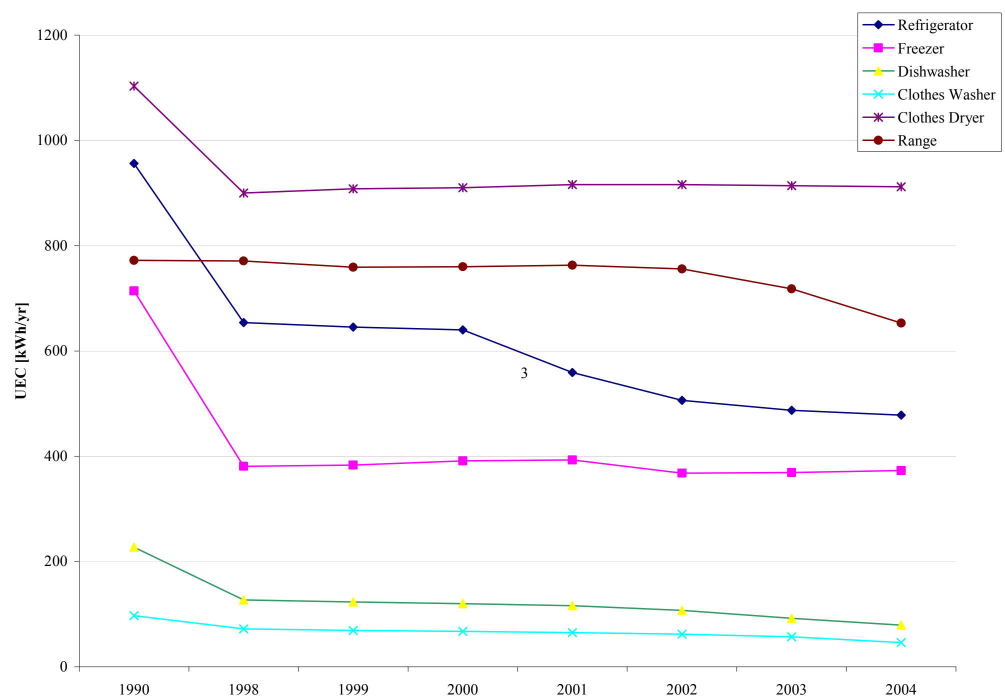
Exhibits 3.2 and 3.3 show Canadian trend information for both the existing stock and new sales of white goods for the period 1990 to 2004.

Exhibit 3.2: Canadian White Goods UECs for Existing Stock



Source: NRCan, Energy Efficiency Trends in Canada 1990 and 1998–2004, August 2006.

Exhibit 3.3: Canadian White Goods UECs for New Sales



Source: NRCan, Energy Efficiency Trends in Canada 1990 and 1998–2004, August 2006.

As shown in Exhibit 3.2, the annual UEC for major household white good type appliances in existing stock declined steadily between 1990 and 2000, due to stock turnover and to continuing improvements in new stock. However, as shown in Exhibit 3.3, the majority of efficiency improvements to large electrical appliances took place in the early to mid 1990s with the trend line levelling off after that for most appliances (except refrigerators and ranges, which show further improvement post 2000). In the future, federal energy-efficiency regulations will continue to regulate additional appliances and to revise existing regulations, suggesting that additional minor improvements in the UECs for new white goods will take place.

Further discussion of the modelled assumptions applied to each of the major appliances follows.

Note: Assumptions for cooking appliances, refrigerators, freezers, dishwashers, clothes washers and clothes dryers are based on appliance energy use trend data compiled by Natural Resources Canada and reported in Energy Efficiency Trends in Canada 1990 and 1998–2004 (NRCan, August 2006) and Marbek's Appliance Replacement Model.

- **Cooking**

A UEC, which includes both ranges and microwave ovens, of 770 kWh/yr. is assumed in the Base Year, adjusted for occupancy and region declining to 730 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 750 kWh/yr. to 700 kWh/yr.

- **Refrigerator**

A UEC of 830 kWh/yr. is assumed in the Base Year, adjusted for occupancy and service region declining to 510 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 680 kWh/yr. to 450 kWh/yr.

- **Freezer**

A UEC of 650 kWh/yr. is assumed in the Base Year, adjusted for occupancy and service region declining to 480 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 560 kWh/yr. to 420 kWh/yr.

- **Dishwasher**

A UEC of 92 kWh/yr. is assumed in the Base Year, adjusted for occupancy and region declining to 83 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 88 kWh/yr. to 81 kWh/yr.

The values shown are for mechanical energy only; hot water use is included with the DHW UEC.

- **Clothes Washer**

A UEC of 78 kWh/yr. is assumed in the Base Year, adjusted for occupancy and region declining to 71 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 75 kWh/yr. to 68kWh/yr.

The values shown are for mechanical energy only; hot water use is included with the DHW UEC.

- **Clothes Dryer**

A UEC of 1,000 kWh/yr. is assumed in the Base Year, adjusted for occupancy and region declining to 850 kWh/yr. in the final milestone year. In new stock, the UEC was assumed to decrease from 940 kWh/yr. to 800 kWh/yr.

- **Ventilation**

Ventilation energy in existing stock is assumed to remain constant. This assumption recognizes that there are a number of competing trends that remain unresolved at this time. On the one hand, there is a trend towards manufacturers' use of larger fan motors (1/2-HP versus 1/3-HP) in new oil and propane furnaces. This means that furnaces replaced in the study period may have a larger furnace fan motor. However, the trend towards larger fan motors is at least partially offset by efficiency improvements. For example, an earlier study for the Canadian Electricity Association (CEA) noted that improved fan design, combined with the use of permanent split capacitor fan motors, had improved furnace fan efficiency by between 13% and 19%.[22]

In new stock, average ventilation energy was assumed to increase to around 450 kWh/yr. from the current average of approximately 340 kWh/yr. This value was based on the HOT2000 modelled results and assumes compliance with municipal building codes. Building codes in Newfoundland and Labrador are based on the National Building Code (for example, the St. John's building bylaw references the 2005 edition of the National Building Code).

- **Domestic Hot Water**

Exhibit 3.4 summarizes DHW UECs by end use for new dwellings. A comparison with the values presented previously for existing dwellings (see Section 2) shows significant reductions for hot water use in dishwashing and clothes washing; however, slightly more modest changes have been assumed for personal consumption.

DHW electricity for new and existing appliances is obtained from NRCan (NRCan, 2005), augmented by results from conditional demand analysis and customer survey work done by both NP and NLH in the 1990s. For existing and retrofitted buildings, the DHW UEC is assumed to

[22] Phillips, B. Blower. *Efficiency in Domestic Heating Systems*, CEA Report No. 9202-U-921, 1995 and *Optimizing Heat and Air Distribution Systems when Retrofitting Houses with Energy Efficient Equipment*, Canada Mortgage and Housing Corporation, 2002. Ventilation UECs will be higher in dwellings that have air conditioning and/or continuous ventilation.

decrease by 0.2% per year based on data from NRCan.[23] The UEC for DHW in new buildings is assumed to be constant.

Exhibit 3.4: Distribution of DHW Electricity Use by End Use in New Stock, (kWh/yr.)

End Use	Sample Electricity Use Single Family Detached (kWh/yr.)	%
Personal Use	1,075	38
Dishwashing	600	21
Clothes Washing	750	26
Standby Losses	425	15
Total	2,850	100

❑ Lighting

The lighting UEC was assumed to decrease at a rate of 0.2% per year. This value is based on the results of analysis undertaken by Natural Resources Canada and reported in their *Energy End Use Data Handbook* (NRCan, June 2005).

❑ Televisions

The North American television industry has announced its commitment to convert all analog television to digital broadcasting within the next five years. These broadcast changes are occurring at a time when television technology and programming options are also rapidly changing. Some television technology changes, such as the introduction of liquid crystal display (LCD) and plasma models, may also have significant impacts on household electricity consumption. It is also possible that these changes will result in an increased rate of turnover in the current stock of televisions to models that are better able to take advantage of the high definition (HD) digital signal.

LCD is expected to become the dominant television technology by 2010, capturing approximately 57% of sales in that year. Although LCD screens typically use less electricity on a per inch basis, consumers typically choose screens that are larger when purchasing an LCD screen compared to cathode ray tube screens (CRTs). The most popular television on the market today is the 27” CRT but this is expected to shift within the next five years to the 32” LCD television. This trend has the effect of reducing the electricity advantage that would be gained from a direct switch to the new LCD technology.

In addition to the increase in screen size, HD television models typically consume more power than equivalent standard definition televisions for all technology types. Since the trend with televisions is towards HD sets with greater resolution, television unit electricity use is expected to increase in the future.

[23] Natural Resources Canada. *Energy Efficiency Trends in Canada*, 1990–2000, June 2002.

The growing popularity of larger and higher resolution screens means that, by 2010, national television electricity consumption is expected to grow by 40% to 45%.

In light of these changes, UECs for televisions are assumed to increase from 178 kWh/yr. to 250 kWh/yr. over the study period. These assumptions are based on market and energy use data collected as part of a 2006 study *Technology and Market Profile: Consumer Electronics.*[24]

- **Television Peripherals**

One implication of the pending changes towards digital television broadcasting is that new signal adaptors, commonly referred to as set-top boxes (STBs), will need to be added to nearly two-thirds of Canadian households to receive a television signal.

Industry representatives estimate that each Canadian subscriber household has, on average, 1.5 set-top boxes.[25] They also note that the trend is towards a greater number of STBs per household and, by 2010, the industry estimates that the average will have increased to approximately two STBs per subscriber household.

When complete, the switch to digital broadcasting is expected to increase national STB electricity consumption by up to four times its current level due to the added requirement for STBs among those televisions currently operating on analog cable or over-the-air broadcast signals. Moreover, within these STBs, the most significant trend is towards greater functionality, which is directly associated with further increases in unit electricity consumption.

In light of these changes, UECs for television peripherals are assumed to increase from 220 kWh/yr. to 310 kWh/yr. over the study period.[26]

- **Computers and Peripherals**

Electricity consumption for personal computers is expected to increase despite the move to more energy-efficient flat screen technology. This is due in part to the growing preference for larger screens but mainly due to a trend towards longer operating hours both in full operating mode and in idle mode. There is also a move towards increasing numbers and functionality of computer peripherals, further increasing consumption.

UECs for personal computers and their peripherals are assumed to increase from 390 kWh/yr. to 560 kWh/yr. over the study period.

- **Other Electronics**

As functionality increases, other entertainment devices, such as computer games and music systems are becoming more powerful. For example, the new PlayStation 3 games console uses 360 Watts compared to its predecessor, which uses only 45 Watts. One of the selling features of

[24] Marbek Resource Consultants. *Technology and Market Profile: Consumer Electronics*, September 2006.
[25] Ibid.
[26] Ibid.

the Nintendo Wii and other next generation products is that they can be left on-line for 24 hours a day.

UECs for other electronics are assumed to increase from 160 kWh/yr. to 190 kWh/yr. over the study period.

❑ **Small Appliances and Other**

The UECs for the small appliances and other categories increase over the study period in anticipation of new end uses, but there is considerable uncertainty in the amount of this increase.

Based on the changes observed in previous studies, new end uses are constantly emerging, some of which are substantial consumers of electricity. One example is electric vehicle charging. Electric cars and plug-in hybrids could achieve substantial penetration by the end of the study period; charging of a typical electric vehicle would require approximately 7,000 kWh/yr.[27]

3.5 APPLIANCE SATURATION TRENDS

To develop estimates of the future saturation of residential equipment, references from NLH were reviewed along with data on trends in the increasing use of entertainment-based electronics.

The saturation of most end-use appliances has remained relatively constant in recent years, suggesting that further changes to saturations are unlikely within the study period. There are two main exceptions:[28] computers and television peripherals. Based on current trends and industry data,[29] the following assumptions have been incorporated into the Reference Case.

- Computer saturation levels increase by approximately 60% over the study period
- Television peripherals saturation levels increase by more than 100%.

3.6 STOCK GROWTH

The next step in developing the Reference Case involved the development and application of estimated levels of growth in each dwelling type and service region over the study period. The number of dwelling units, by type and service region were provided by NLH and match exactly those contained in NLH Long Term Planning (PLF) Review Forecast, Summer/Fall 2006.

Exhibit 3.5 presents a summary of the resulting percentage stock growth, by year and dwelling type in each service region.

[27] California EPA, Air Resources Board. *Fact Sheet: Battery Electric Vehicles*, Sacramento, CA, 2003, http://www.arb.ca.gov/msprog/zevprog/factsheets/evinformation.pdf.
[28] Some increase in space cooling saturation levels may also occur over the 20-year period and it may become material by the end of the period; however, based on client discussions it was agreed that residential space cooling consumption would experience minimal predicted growth with considerable uncertainty in that growth, and therefore it has not been addressed separately.
[29] Op. cit. *Technology and Market Profile: Consumer Electronics.*

Exhibit 3.5: Residential Stock Growth Rates by Service Region, 2011 to 2026,

Region and Period	Electric Accounts					Non-Electric Accounts				
	Single Family	Attached	Apart ment	Isolated	Other	Single Family	Attached	Apart ment	Isolated	Other
Island and Isolated										
2006-2011	1.5%	1.5%	1.5%	0.6%	0.4%	0.1%	0.1%	0.1%	0.6%	0.4%
2011-2016	1.2%	1.2%	1.2%	0.5%	0.3%	0.1%	0.1%	0.1%	0.5%	0.3%
2016-2021	1.1%	1.1%	1.1%	0.5%	0.2%	-0.1%	-0.1%	-0.1%	0.5%	0.2%
2021-2026	1.1%	1.1%	1.1%	0.5%	0.1%	-0.2%	-0.2%	-0.2%	0.5%	0.1%
Labrador Interconnected										
2006-2011	0.7%	0.7%	0.7%	N/A	0.7%	0.0%	0.0%	0.0%	N/A	0.0%
2011-2016	0.5%	0.5%	0.5%	N/A	0.5%	0.0%	0.0%	0.0%	N/A	0.0%
2016-2021	0.5%	0.5%	0.5%	N/A	0.5%	0.6%	0.6%	0.0%	N/A	0.0%
2021-2026	0.5%	0.5%	0.5%	N/A	0.5%	0.6%	0.6%	0.0%	N/A	0.0%

3.7 FUEL SHARES

The only change in fuel shares assumed in the study period is the relative growth in electrically heated versus non-electrically heated dwellings. No changes are assumed in the fuel shares for any of the other end uses.

3.8 SUMMARY OF MODEL RESULTS

This section presents the results of the model runs for the entire study period. The results are measured at the customer's point-of-use and do not include line losses. They are presented in two exhibits:

- Exhibits 3.6 and 3.7 present the model results for the Island and Isolated service region. The results are broken out by dwelling type, end use and milestone year.
- Exhibits 3.8 and 3.9 present the model results for the Labrador Interconnected service region. The results are broken out by dwelling type, end use and milestone year.

Selected highlights of electricity use in 2026 are provided below.

❑ By Dwelling Type

Single-family detached dwellings continue to account for the overwhelming majority of total residential electricity consumption in both the Island and Isolated (79%) and the Labrador Interconnected (74%) service regions.

❑ By End Use

Space heating continues to account for the largest share of residential electricity use in both service regions (41% in Island and Isolated and 71% in Labrador Interconnected), followed by DHW (15% in Island and Isolated and 9% in Labrador Interconnected).

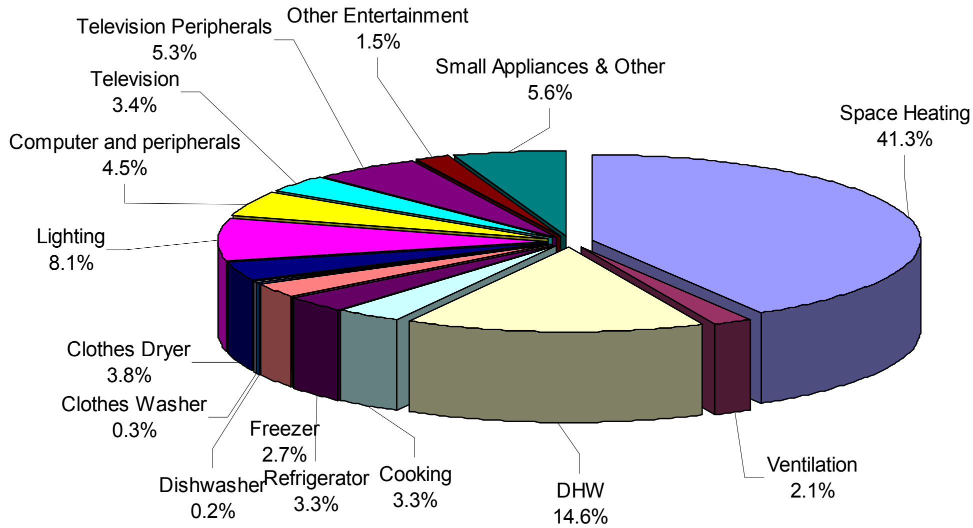
The most notable increase in electricity consumption occurs in the group of electronic end uses represented by televisions, television peripherals, computers and other entertainment. By 2026, these combined end uses are expected to account for approximately 15% of residential electricity use in the Island and Isolated service region and 6% in the Labrador Interconnected service region.

Exhibit 3.6: Reference Case Electricity Consumption for the Island and Isolated Service Region, Modelled by End Use, Dwelling Type and Milestone Year (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Entertainment	Small Appliances & Other
Single Family	2006	2,569	1,006	69	420	97	152	109	6	10	122	234	47	67	55	36	139
	2011	2,757	1,076	70	431	99	136	104	6	10	123	241	69	87	112	39	152
	2016	2,873	1,139	72	439	101	125	100	6	10	125	247	91	94	119	42	166
	2021	3,016	1,211	72	446	103	114	95	6	10	125	252	114	100	144	45	179
	2026	3,125	1,264	73	452	104	103	90	6	10	126	256	141	108	152	48	193
Attached	2006	340	168	5	49	11	20	10	0	1	11	28	7	8	7	5	9
	2011	377	180	6	52	11	18	10	0	1	12	29	10	11	23	5	10
	2016	398	191	6	53	12	17	9	0	1	12	30	13	12	25	6	11
	2021	420	201	6	55	12	16	9	1	1	12	31	17	13	28	6	12
	2026	441	212	6	57	12	15	9	1	1	12	32	21	15	30	7	13
Apartment	2006	193	90	2	40	7	11	4	0	0	5	13	4	6	5	3	3
	2011	218	97	2	42	8	11	4	0	0	5	14	6	8	15	3	3
	2016	233	103	2	43	8	11	4	0	0	5	15	9	8	18	4	3
	2021	250	109	2	45	8	11	4	0	0	6	15	11	9	22	4	4
	2026	264	115	2	46	8	11	3	0	0	6	16	14	10	24	4	4
Isolated	2006	34	2	0	10	3	2	3	0	0	2	5	0	1	1	1	3
	2011	35	2	0	10	3	2	3	0	0	2	5	1	1	2	1	3
	2016	36	2	0	10	3	2	3	0	0	2	5	1	1	2	1	4
	2021	37	2	0	10	3	1	3	0	0	2	5	1	1	2	1	4
	2026	38	2	0	10	3	1	3	0	0	2	6	1	2	2	1	4
Other	2006	31	15	0	1	0	0	0	0	0	0	4	0	0	0	0	10
	2011	32	15	0	1	0	0	0	0	0	0	4	0	0	0	0	11
	2016	33	15	0	1	0	0	0	0	0	0	4	0	0	0	0	12
	2021	34	15	0	1	0	0	0	0	0	0	4	0	0	0	0	12
	2026	34	16	0	1	0	0	0	0	0	0	4	0	0	0	0	13
TOTAL	2006	3,228	1,298	77	530	120	189	128	6	12	144	291	60	83	69	45	175
	2011	3,483	1,388	79	545	124	170	123	6	12	146	300	87	109	154	49	191
	2016	3,637	1,467	80	556	126	157	118	7	12	147	307	115	118	167	53	207
	2021	3,821	1,557	81	566	128	144	112	7	12	149	314	146	126	200	57	224
	2026	3,968	1,626	82	575	130	132	107	7	12	149	320	180	136	211	61	241

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) Rounding reduces many non-zero values in this table to apparent zeroes.

Exhibit 3.7: Distribution of Electricity Consumption, by End Use in 2026 for the Island and Isolated Service Region



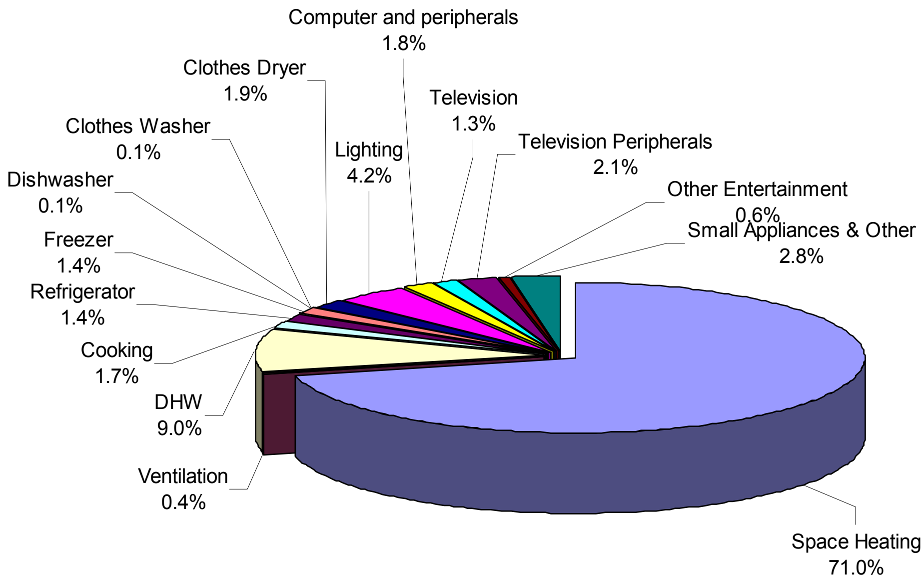
Totals may not add to 100% due to rounding.

Exhibit 3.8: Reference Case Electricity Consumption for the Labrador Interconnected Service Region, Modelled by End Use, Dwelling Type and Milestone Year (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Entertainment	Small Appliances & Other
Single Family	2006	195	139	1	20	3	4	3	0	0	4	9	1	2	1	1	5
	2011	205	147	1	21	3	4	3	0	0	4	10	2	2	3	1	5
	2016	210	150	1	21	3	3	3	0	0	4	10	2	2	3	1	5
	2021	215	154	1	21	3	3	3	0	0	4	10	3	2	3	1	6
	2026	220	158	1	21	3	3	3	0	0	4	10	4	3	4	1	6
Attached	2006	59	43	0	6	1	1	1	0	0	1	3	0	1	0	0	1
	2011	62	45	0	6	1	1	1	0	0	1	3	1	1	1	0	1
	2016	64	46	0	6	1	1	1	0	0	1	3	1	1	1	0	1
	2021	65	47	0	6	1	1	1	0	0	1	3	1	1	2	0	1
	2026	67	49	0	6	1	1	1	0	0	1	3	1	1	2	0	1
Apartment	2006	6	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	2011	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	2016	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	2021	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	2026	8	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Other	2006	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2016	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	2021	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	2026	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	2006	264	189	1	28	4	6	5	0	0	5	13	2	2	2	1	6
	2011	279	199	1	28	4	5	4	0	0	5	13	2	3	4	1	6
	2016	285	204	1	28	4	5	4	0	0	5	13	3	3	5	1	7
	2021	292	209	1	28	4	4	4	0	0	5	13	4	3	5	1	7
	2026	300	215	1	29	4	4	4	0	0	5	14	5	4	6	2	8

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) Rounding reduces many non-zero values in this table to apparent zeroes.

Exhibit 3.9: Distribution of Electricity Consumption, by End Use in 2026 for the Labrador Interconnected Service Region



Totals may not add to 100% due to rounding.

4. CONSERVATION & DEMAND MANAGEMENT (CDM) MEASURES

4.1 INTRODUCTION

This section identifies and assesses selected energy-efficiency, fuel switching and peak load reduction measures for the Residential sector. The discussion is organized and presented as follows:

- Methodology for Assessment of Energy-efficiency Measures
- Description of Energy-efficiency Technologies
- Summary of Energy-efficiency Results
- Peak Load Reduction Measures.

4.2 METHODOLOGY FOR ASSESSMENT OF ENERGY-EFFICIENCY MEASURES

The following steps were employed to assess the energy-efficiency measures:

- Select candidate energy-efficiency measures
- Establish technical performance for each option within a range of applicable load sizes and/or service region conditions (e.g., degree days)
- Establish the capital, installation and operating costs for each option
- Calculate the cost of conserved energy (CCE) for each technology and O&M measure.

Step 1 Select Candidate Measures

The candidate measures were selected in collaboration with the Utilities and from a literature review and previous study team experience. The selected measures are all considered to be technically proven and commercially available, even if only at an early stage of market entry. Technology costs, which will be addressed in this section, were not a factor in the initial selection of candidate technologies.

Step 2 Establish Technical Performance

Information on the performance improvements provided by each measure was compiled from available secondary sources, including the experience and on-going research work of study team members.

Step 3 Establish Capital, Installation and Operating Costs for Each Measure

Information on the cost of implementing each measure was also compiled from secondary sources, including the experience and on-going research work of study team members.

The incremental cost is applicable when a measure is installed in a new facility, or at the end of its useful life in an existing facility; in this case, incremental cost is defined as the cost difference for the energy-efficiency measure relative to the “baseline” technology. The full cost is applicable when an operating piece of equipment is replaced with a more efficient model prior to the end of its useful life.

In both cases, the costs and savings are annualized, based on the number of years of equipment life and the discount rate, and the costs incorporate applicable changes in annual O&M costs. All costs are expressed in constant (2007) dollars.

Step 4 Calculate CCE for Each Measure

One of the important sets of information provided in this section is the CCE associated with each energy-efficiency measure. The CCE for an energy-efficient measure is defined as the annualized incremental cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs required to achieve full use of the technology or measure. All cost information presented in this section and in the accompanying tables (see Appendix A) are expressed in constant (2007) dollars.

The CCE provides a basis for the subsequent selection of measures to be included in the Economic Potential Forecast. The CCE is calculated according to the following formula:

$$\frac{C_A + M}{S}$$

Where:

C_A is the annualized installed cost
M is the incremental annual cost of O&M
S is the annual kWh energy savings.

And A is the annualization factor.

Where: $A = \frac{i(1+i)^n}{(1+i)^n - 1}$ i is the discount rate
n is the life of the measure.

The detailed CCE tables (see Appendix A) show both "incremental" and "full" installed costs for the energy-efficiency measures, as applicable. If the measure or technology is installed in a new facility or at the point of natural replacement in an existing facility, then the "incremental" cost of the measure versus the cost of the baseline technology is used. If, prior to the end of its life, an operating piece of equipment is replaced with a more efficient model, then the "full" cost of the efficient measure is used.

The annual saving associated with the efficiency measure is the difference in annual electricity consumption with and without the measure.

The CCE calculation is sensitive to the chosen discount rate. In the CCE calculations that accompany this document, three discount rates are shown: 4%, 6% and 8%. The 6% real discount rate was used for the primary CCE calculation. The CCE was also calculated using the 4% and 8% real discount rates to provide sensitivity analysis.

Selection of the appropriate discount rate to be used in this analysis was guided by the intended use of the study results. This study seeks to identify the economic potential for DSM in Newfoundland and Labrador from a provincial perspective. Therefore, the appropriate discount rate is the social opportunity cost of capital, which is the estimated average pre-tax rate of return on public and private investments in the provincial economy.[30]

4.3 DESCRIPTION OF ENERGY-EFFICIENCY TECHNOLOGIES

This subsection provides a brief description of each of the energy-efficiency technologies and measures that are included in this study, as listed in Exhibit 4.1.

Exhibit 4.1: Energy-efficiency Technologies and Measures - Residential Sector

Existing Building Envelope
- High- & super high-performance windows
- Air leakage Sealing
- Attic insulation
- Wall insulation
- Foundation insulation
- Crawl space insulation

New Building Design
- R-2000 Home
- EnerGuide for Housing 80
- Energy-efficient new apartment building construction

Space Heating and Ventilation Equipment
- Programmable thermostat
- Electronic and high-efficiency thermostats
- Air source heat pump for homes
- Ground source heat pump for homes
- Low-temperature heat pump for apartments
- Ground source heat pump for apartments
- Integrated heating and DHW heat pumps
- High-efficiency heat recovery ventilator
- Electronically commutated permanent magnet (ECPM) motors for furnace fans
- Premium motors for apartment building ventilation systems
- Building recommissioning – apartment buildings
- Oil-fired central forced air heating system

Domestic Hot Water
- Low-flow shower heads and faucets
- Water tank insulation
- Pipe insulation

Major Appliances
- Microwave/convection oven
- ENERGY STAR refrigerator
- ENERGY STAR freezer
- ENERGY STAR dishwasher
- ENERGY STAR front loading clothes washer
- ENERGY STAR top loading clothes washer

Household Electronics
- Reduction in standby losses
- ENERGY STAR compliant computer
- ENERGY STAR television
- LCD television

Lighting
- CFLs
- Replacement of T12s with T8s
- LED holiday Lighting
- Lighting timers
- Motion sensors

[30] This discount rate allows for analytic consistency with the earlier NERA Marginal Cost Study, which used a nominal discount rate of 8.4% (approximately 6% real, i.e. net of inflation). NLH lowered its nominal discount rate in the summer of 2007 to 7.75%; however, this change has no material impact on the results of this study.

The discussion is organized by major end use and is presented in the following subsections:

- Existing building envelope
- New building design
- Space heating and ventilation equipment
- Domestic hot water
- Major appliances
- Household electronics
- Lighting.

Each energy-efficiency improvement opportunity is discussed below, with a brief description of the technology, savings relative to the baseline with respect to detached homes in the Island and Isolated service region (with savings ranges provided for other dwelling types and climate regions), typical installed costs, applicability and co-benefits.[31]

4.3.1 Existing Building Envelope

Building envelope measures improve the thermal performance of the building's walls, roof and/or windows. These measures also provide significant co-benefits, such as increased occupant comfort, improved resale value, etc. Ten energy-efficiency upgrade options were identified and assessed for this end use. They are:

- High-performance (ENERGY STAR) windows
- Super high-performance windows
- Air leakage sealing
- Attic insulation
- Wall insulation
- Foundation insulation
- Crawl space insulation
- High-performance glazing systems for apartment buildings
- Upgrade wall insulation for apartment buildings
- Upgrade roof insulation for apartment buildings.

❑ **High-Performance (ENERGY STAR) Windows**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$4 per square foot incremental cost in existing $2 per square foot incremental cost in new
Savings	3%-7% HVAC energy, depending on dwelling type, vintage, and region
Useful Life	25 years

[31] Measure inputs not otherwise sourced are based on the consultants' recent work with BC Hydro and other utility clients.

High-performance windows are double glazed with a ½-inch air space; they incorporate a number of additional energy-saving features including low-e (soft coating), insulating spacers, argon fill and low conductivity frames (a mix of sliders, hinged and picture). The more efficient windows reduce heat loss through the window by 20% or more, compared to the average low- or mid-efficiency replacement window depending on dwelling type and region. High-performance windows have an RSI value of 0.5 (R-2.8) or higher, compared to standard double glazed windows, which are clear with no gas filling and typically have an RSI value of 0.34 (R-1.9) or less. High-performance windows also provide occupant co-benefits, such as reduced interior noise, reduced air leakage, greater thermal comfort and fewer condensation problems.

This analysis employs an incremental cost of $4 per square foot[32] to renovate an attached or detached dwelling to high-performance windows as opposed to standard windows; the corresponding savings are approximately 3%-7% of space heating, depending on housing type and climate.

If the upgrade is chosen as part of a new construction, the incremental cost is $2 per square foot[33] and the potential savings are higher because new homes tend to have more and larger windows. They are also a larger proportion of the heating energy consumption; because the other building shell components are better in a new home, windows account for a larger fraction of the heat loss than they do in an older home. The product lifetime for windows is approximately 25 years.[34]

- ❑ **Super High-Performance Windows**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$8 per square foot
Savings	5%-11% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

Super high-performance windows incorporate additional features such as triple glazing, transparent insulating films or fibreglass frames as well as the low-e coating, argon fill and insulating spacers, giving them an equivalent R-value of up to R-11. These windows are approximately twice the cost of the high-performance windows; incremental costs would be approximately $8 per square foot and the corresponding savings are approximately 5%-11% of space heating, depending on housing type and climate. Triple glazed units are considerably heavier and present fastening issues for existing vinyl window frame extrusions.

[32] Cost data from product review undertaken for Terasen Gas, 2006.
[33] Incremental costs are generally lower for windows installed in new homes, because tract builders are able to purchase windows in the wholesale market where the incremental cost of efficient windows is usually smaller than it is in the retail marketplace.
[34] BC Hydro Power Smart. *QA STANDARD Technology: Effective Measure Life*. September 11, 2006.

❑ Air Leakage Sealing

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$900 incremental cost in existing $600 incremental cost in new
Savings	8%-26% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

Air sealing of building envelopes includes completion of a blower door test to quantify leakage levels and to identify the location of air leaks. Generally, major leakage occurs at window-to-wall interfaces, around doors, through electrical and plumbing penetrations, at the top of foundation walls and around chimneys and fireplaces.[35] Installation of sealant and gaskets are generally accepted methods for reducing air leakage in buildings.

Air sealing also provides important co-benefits, including reduced drafts, increased occupant comfort and greater control over ventilation capability. In addition, reduced air leakage around windows and attic penetrations eliminates one of the key contributors to water ingress into exterior envelope assemblies.

HOT2000 simulations for Newfoundland showed significant HVAC savings in the range of 8% to 26% due to air leakage sealing, depending on housing type and climate. Electricity savings from ventilation fans, if applicable, would be approximately the same percentage. The cost of leakage control is approximately $900 per existing single-family dwelling if undertaken by an air sealing contractor who can perform an air test as part of the work. If homeowners undertake the air sealing work, significant cost savings can be achieved, but the resulting energy savings would be substantially reduced as well.

The incremental cost of improved air sealing in a new construction project used in this analysis is $600. The life of this measure is approximately 25 years; however, some elements of air leakage sealing, such as weather stripping, will require more frequent replacement and an annual O&M cost of $50 has been added in to account for this.[36]

[35] Fireplaces are particularly challenging to seal around, because of the difficulty of obtaining high-temperature sealants. Selection of fireplaces and woodstoves with outside air intake and proper air sealing built into them avoids this problem.
[36] Energy impacts are from HOT2000 simulations; cost data are based on discussions with installation contractors.

❑ Attic Insulation

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$600 incremental cost
Savings	2%-6% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

Insulation levels can be increased in attics by blowing insulation into the attic spaces to fill and cover the space within the roof frame. One technique is to make sure loose-fill or batt insulation fills the attic floor joists fully, then add an additional layer of unfaced fibreglass batt insulation across the joists. This analysis assumed attic insulation is improved to RSI-7.0.

This analysis estimates the incremental cost of this measure to be about $600, with a resulting savings of approximately 2%-6% of the space heating costs depending on housing type and climate. Electricity savings from ventilation fans, if applicable, would be approximately the same percentage. The life of this measure is estimated at 25 years.[37]

❑ Wall Insulation

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$750-$2,400
Savings	3%-11% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

Wall insulation is usually challenging to retrofit in an existing house because the inside surfaces of the exterior walls are already finished and in place. Adding insulation is only possible by blowing insulating materials into the wall cavity, if sufficient space exists, or by adding insulation to the exterior of the building under the siding. Insulation levels are assumed to increase to RSI-3.5.

The incremental cost of adding the exterior insulation (as not all walls have sufficient space for blown-in insulation) used in this analysis is $750-$2,400 depending on dwelling vintage.[38] Savings are estimated to be 3%-11% of space heating costs depending on housing type and climate. Electricity savings from ventilation fans, if applicable, would

[37] Energy impacts are from HOT2000 simulations; cost data are based on discussions with retailers and installation contractors.
[38] Cost does not include siding. If insulation cannot be blown in, the rigid foam is assumed to be added in conjunction with an already-planned project to replace the siding. The insulation cost is incremental to the siding job.

be approximately the same percentage. The life of this measure is approximately 25 years.[39]

❑ Foundation Insulation

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	$40 per square meter
Savings	18%-43% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

In older homes the basement is often under insulated or even left uninsulated. Increasing the insulation level in basements can be achieved in a number of ways including: constructing a new insulated frame wall or moving the existing frame wall to increase the insulation level, adding extra insulation to the existing frame wall, adding rigid board insulation to the exterior of the foundation or using a combination of interior and exterior rigid board insulation. For the purposes of this report, increased basement insulation was assumed to be either moving an existing frame wall or constructing a new frame wall with an upgrade to RSI-4 insulation. The cost of adding insulation to the foundation, including labour and finishing, is approximately $40 per square meter ($3.70 per square foot) of basement wall area.[40]

HOT2000 simulations for Newfoundland showed significant HVAC savings in the range of 18% to 43% depending on housing type and climate. Electricity savings from ventilation fans, if applicable, would be approximately the same percentage. This measure has a life of approximately 25 years.[41]

❑ Crawl Space Insulation

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing
Costs	$1,000 incremental cost in existing
Savings	10%-25% HVAC energy, depending on dwelling type, vintage and region
Useful Life	25 years

Insulation levels may be inadequate in some homes that include a crawl space as part of the basement design. Co-benefits of improved crawl space insulation include improved thermal comfort, fewer drafts and less condensation.

[39] Op. cit., footnote 36.
[40] Cost does not include adding or rebuilding the basement interior walls. The insulation is assumed to be added in conjunction with an already planned basement renovation. The insulation cost is incremental to the renovation cost.
[41] Op. cit., footnote 36.

The addition of crawl space insulation in existing houses to bring the thermal resistance values up to existing code levels of RSI-2.1 provides annual energy savings of approximately 10%-25% of HVAC energy use. Electricity savings from furnace fans, if applicable, would be approximately the same percentage. This measure has a life of approximately 25 years.[42] Typical installed costs are approximately $1,000.

- ❑ **High-performance Glazing Systems for Apartment Buildings**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	$2.00/ft^2 (floor area) incremental cost
Savings	28% to 34% of heating and cooling energy
Useful Life	20 years

High-performance glazing systems consist of low-e coated films suspended inside an insulating glass unit. These units can be incorporated into both window and curtain wall systems. In addition to superior insulating performance and lower energy costs, the co-benefits include enhanced comfort, noise reduction, the elimination of perimeter heating and reduced HVAC equipment costs.

Visionwall window and curtain wall systems manufactured by Visionwall Corporation[43] have thermal resistance R-values ranging from 3 to 7 hr.ft^2.^{o}F/Btu, low shading coefficients and high visible light transmission. The highest performing product on the market is Superglass Quad (R-value 12.5 hr.ft^2.^{o}F/Btu) manufactured by Southwall Technologies.[44] It features two films suspended inside an insulating glass unit creating three krypton-filled air spaces. A tape system is used for gas retention and a thermally broken insolating spacer stops the conduction through the edge of the glass.

This upgrade is a high-performance glazing system with an overall U-value of 0.25 Btu/hr.ft^2.^{o}F (R-4). It is applicable to both existing buildings (at end of window life cycle) and new construction. The baseline is an electrically heated commercial building with standard double-glazed windows with an overall U-value of 0.45 Btu/hr.ft^2.^{o}F (R-2.2). The incremental cost is $2.00 per square foot of floor area, the savings range from 28% to 34% of the heating and cooling energy and the service life is 20 years.

- ❑ **Upgrade Wall Insulation for Apartment Buildings**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	$1.38/ft^2 (floor area) incremental cost
Savings	18% of heating energy
Useful Life	25 years

[42] Op. cit., footnote 36.
[43] http://www.visionwall.com.
[44] http://www.southwall.com.

Various insulating materials and methods can be used to upgrade wall insulation including applying rigid polystyrene board to the exterior of a building or installing fibreglass batts between interior wall studs.

This measure involves upgrading wall insulation to R-24. It is applicable to both existing buildings (at time of recladding) and new construction. The baseline is an electrically heated commercial building with R-12 wall insulation. The incremental cost is $1.38 per square foot of floor area, the savings are 18% of heating energy and the service life is 25 years.

❑ **Upgrade Roof Insulation for Apartment Buildings**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	$\$1.00/ft^2$ (floor area) incremental cost
Savings	13% of heating energy
Useful Life	25 years

Upgrading insulation on a built-up roofing system typically involves adding additional layers of rigid insulation at the time of re-roofing.

This measure involves upgrading roof insulation to R-30. It is applicable to both existing buildings (at time of re-roofing) and new construction. The baseline is an electrically heated commercial building with R-20 roof insulation. The incremental cost is $1.00 per square foot of floor area, the savings are 13% of heating energy and the service life is 25 years.

4.3.2 New Building Design

New building design integrates advances in both building envelope and space/water conditioning technologies. Three energy-efficiency upgrades were addressed:

- R-2000 Home
- Construction of new homes to achieve an EnerGuide rating of 80 (EG80)
- Energy-efficient new apartment construction.

❑ **R-2000 Home**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New
Costs	$7,500 incremental cost for bungalow $9,000 incremental cost for 2-story
Savings	30% to 50% of HVAC
Useful Life	30 years

R-2000 homes are required to achieve a stringent energy budget that is determined by a combination of factors related to heating fuel, house size and climatic data. In addition, R-2000 homes are required to achieve an air tightness level of 1.5 ac/h at 50 Pa. A number of co-benefits are associated with R-2000 construction, such as improved occupant comfort, improved air quality due to the mandatory use of heat recovery ventilators, higher resale value and reduced environmental impact.

This analysis estimates that annual space heating savings are 30%[45] relative to standard, electrically heated new houses. Actual performance verification performed by an R-2000 builder in Newfoundland showed energy savings of between 30% and 50%[46] relative to standard practice. Fuel savings for non-electrically heated homes would be approximately the same percentage. Typical incremental construction costs for an R-2000 home are assumed to be $7,500 to $9,000.[47]

- **EnerGuide 80 Home**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New
Costs	$7,500 incremental cost for bungalow $9,000 incremental cost for 2-story
Savings	30% to 50% of space heating energy
Useful Life	30 years

An EnerGuide for Houses rating is a standard measure of a home's energy performance, calculated by a professional EnerGuide for Houses advisor. The rating is based on information on the construction of the home and the results of a blower door test performed once the house has been built. A blower door test measures air leakage when the air pressure within the house is lowered a specified amount below the air pressure outside. EnerGuide ratings for new houses fall within the following ranges:

- Typical new houses: 72 to 74
- Energy-efficient new houses: 77 to 82
- R-2000 houses: 80 minimum
- Highly energy-efficient new houses: 80 to 90
- Advanced houses using little or no purchased energy: 91 to 100.

The key difference between the R-2000 standard and the more flexible requirement to meet the EG80 rating is that builders do not need to install a heat recovery ventilator to achieve a rating of EG80, nor meet other environmental requirements of the R-2000 program. This substantially reduces the cost of the measure. However, in St. John's where electric heating is in the majority of homes, heat recovery ventilation is standard

[45] Energy impacts are from HOT2000 simulations; cost data are based on information from a paper by Anil Parekh of NRCan, *Cost Impact of the New R-2000 Technical Standard – Summary Report*, March 2000. Supplemented by discussions with installation contractors.
[46] Discussion with Greg Hussey of Karwood Contracting, an R-2000 builder in Newfoundland, August, 2007.
[47] Ibid.

practice,[48] meaning there will be no cost difference between a home achieving EG80 and an R-2000 home.

This analysis estimates that annual space heating savings are 30% to 50% relative to standard electrically heated new houses. Fuel savings in non-electrically heated homes would be approximately the same percentage. Typical incremental construction costs for an EG80 home are assumed to be $7,500 to $9,000.[49]

❑ **Energy-efficient New Apartment Construction**

New construction refers to new high-efficiency buildings designed using the integrated design process that achieve substantial improvements over conventional new buildings through the application and integration of energy-efficiency technologies and design approaches.

Baseline new construction is assumed to follow the MNECB and ASHRAE 90.1 - 1999 standards.

Two energy-efficiency upgrade options were evaluated for new construction:

- New apartment building - 25% more efficient than current standards
- New apartment building - 40% more efficient than current standards.

❑ **New Apartment Building - 25% More Efficient Than Current Standards**

Measure Profile	
Applicable Dwelling Type(s)	Apartment buildings
Vintage	New
Costs	$1.00/ft^2 incremental cost
Savings	25%
Useful Life	30 years

The integrated design approach (IDA) to new building design is predicated on a systematic application of energy measures to all end uses at the design stage. This includes targeting the building envelope, lighting, HVAC equipment (fans and pumps) and, finally, the heating and cooling plants. Savings of 25% are achievable at an average incremental cost of $1/ft^2. The 25% measure is a subset of the 40% measure and is, therefore, not considered separately in cases where the 40% measure passes the CCE test. If the 40% measure fails the CCE test for a particular region or dwelling type, the analysis falls back to the 25% improvement. If the latter passes the CCE test, it would be included in the potential.

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[48] Ibid.
[49] Cost is based on R-2000 incremental cost, less the cost of installing an HRV.

❑ New Apartment Building - 40% More Efficient Than Current Standards

Measure Profile	
Applicable Dwelling Type(s)	Apartment buildings
Vintage	New
Costs	$4.50/ft^2 incremental cost
Savings	40%
Useful Life	30 years

A new apartment building that is 40% more efficient than current design practice will require a very high-performance design, equivalent to C-2000 levels. This requires a full IDA that takes advantage of costs trade-offs from equipment downsizing. The design will require the most energy-efficient technologies, extremely efficient lighting designs and heating/cooling plants with very high part-load efficiencies. Savings of 40% are achievable at an average incremental cost of $4.50/ft^2.

4.3.3 Space Heating and Ventilation Equipment

Space heating and ventilation equipment refers to the equipment and controls used to heat and ventilate residential dwellings. The following energy-efficiency upgrade options were identified and assessed for this end use.[50]

- Programmable thermostat
- High-efficiency thermostat
- Low-temperature air source heat pumps for new homes
- Ground source heat pump for new homes
- Low-temperature heat pumps for apartments
- Ground source heat pump for apartments
- Integrated heating and DHW heat pumps
- High-efficiency heat recovery ventilator
- Electronically commutated permanent magnet (ECPM) motors for furnace fans
- Oil-fired central forced air heating system.
- Premium motors for apartment building ventilation systems
- Building recommissioning—apartment buildings.

[50] Duct sealing is not included due to the negligible number of homes with ducted electric heating systems in Newfoundland and Labrador. It should be noted that 27% of the electrically heated homes in the Labrador Interconnected service region do have ducts. Including both detached and attached dwellings, this would total approximately 1,800 dwellings. In a dwelling where the ducts run within the conditioned space (as is typical of Canadian homes), duct sealing saves approximately 5%. It costs approximately $1,000 per home, mostly in labour, and would not pass the CCE test in Labrador.

❑ Programmable Thermostat

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New and existing
Costs	$70 incremental cost
Savings	6% of HVAC energy
Useful Life	18 years

Digital programmable thermostats provide improved temperature setting accuracy and are capable of multiple time settings. When combined with an assumed 4ºC temperature setback during night and unoccupied periods, typical space heat savings are in the range of 10% to 15%[51] relative to the baseline, depending on the dwelling's vintage and type of dwelling. Other utility studies[52] have indicated that a lower savings percentage should be used, to reflect the fact that the thermostat's setback capabilities do not completely reflect how they are used, e.g., some home occupants reliably set back manual thermostats, and some home occupants do not use the setback features on their electronic thermostats. Accordingly a value of 6% savings has been used in this study.

These thermostats can be installed in both new and existing dwellings. The typical incremental installed cost for a programmable versus non-programmable thermostat is about $70[53] per thermostat and the units have an expected life of 15-20[54] years.

❑ High-efficiency Thermostat

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New and existing
Costs	$30 incremental cost
Savings	3% of HVAC energy
Useful Life	18 years

Digital programmable thermostats are, in general known for their increased accuracy and energy savings potential due to setback features. Recently, less expensive thermostats with the same accuracy, but without the programming functions, have become available. These improved electronic thermostats help reduce temperature fluctuations to less than 0.5-1°C, whereas fluctuations usually range on an average from 1.5-2°C. This increased sensitivity helps to ensure that electric furnaces or baseboard heaters start up as close as possible to the desired temperature set point. One model used with baseboard electric heaters will switch the heater on and off to maintain an ambient temperature within +/-

51 Canadian ENERGY STAR Calculator.
52 Enbridge Gas Distribution, Inc., consumer awareness campaign literature, supported by unpublished internal studies.
53 From retail outlets e.g., Home Hardware and Canadian Tire.
54 Canadian ENERGY STAR Calculator.

0.5°C of the set point. It could save around 3%[55] of energy use while improving comfort considerably. This model, however, is not recommended for fuel fired furnaces or wherever short cycling is not desirable.

It should be noted that increased temperature sensing precision may not have any significant impact on energy savings since the temperature setting in a home is generally linked to homeowner comfort and preference, not to the number displayed on the thermostat. The assumption would also need to be made that the less precise thermostat allows homes to overheat by 1 degree, not be under heated by 1 degree. Based on the NRCan 3% savings information, the assumption used in the analysis will be that this type of thermostat saves 3% compared to a regular thermostat. It is assumed to cost approximately $30.

- ❑ **Low-temperature Air Source Heat Pumps for New Homes**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New
Costs	$8,000 incremental cost
Savings	50% of space heating energy in Island houses 43% of space heating energy in Labrador houses
Useful Life	20 years

When outdoor air temperatures drop below freezing, standard air source heat pump (ASHPs) systems switch to auxiliary electric resistance heaters to meet the space heating requirements. This limitation has served to minimize the penetration of ASHPs in cold climates. However, a low-temperature air source heat pump (LTHP) developed by Hallowell International[56] is capable of operating at 0°F with a coefficient of performance (COP) of greater than two. At this temperature, standard ASHPs operate less efficiently, produce less than half their rated capacity, and rely primarily on backup electric resistance heaters to maintain comfort.

The LTHP features a two-speed, two-cylinder compressor for efficient operation, a back-up booster compressor that allows the system to operate efficiently down to 15ºF and a plate heat exchanger called an "economizer" that further extends the performance of the heat pump to well below 0ºF.

LTHPs were considered as an alternative for new dwellings only.[57] In new dwellings, LTHPs can provide increased efficiency compared to the more common electric baseboard heaters.[58] Energy savings in the Island and Isolated service region were

[55] NRCan Office of Energy Efficiency, *Heating with Electricity*, March 2003, http://oee.nrcan.gc.ca/publications/infosource/pub/home/Heating_With_Electricity_Chapter2.cfm?attr=4.
[56] www.gotohallowell.com
[57] In existing homes, it would be practical to install an ASHP only in electrically heated homes that already have ducts. The number of such homes in Newfoundland and Labrador is so small that the potential from this measure in existing homes was deemed negligible.
[58] It is assumed that the additional duct work required to install an ASHP in an existing home with electric baseboard heaters is prohibitive.

estimated to be 50% relative to baseboard heaters. In the Labrador Interconnected region, the more severe winters reduced the savings estimate to 43% relative to baseboard heaters. LTHPs can also provide space cooling in summer months at no incremental capital cost, which can improve the CCE slightly.

Typical installed costs in new dwellings are approximately $8,000 to $12,000, including duct work (the lower number has been used in the model, as more representative of a mature market price), and units can last from 15-25 years.[59]

- **Ground Source Heat Pumps for New Homes**

Measure Profile	
Applicable Dwelling Type(s)	Single detached
Vintage	New
Costs	$18,200 incremental cost
Savings	65% of space heating energy in Island houses 62% of space heating energy in Labrador houses
Useful Life	20 years

Ground source heat pumps (GSHP) utilize the relatively constant temperature properties of the earth or ground water to provide heating and cooling to homes. Although they offer further savings relative to other heat pump types, they are expensive and cannot be used in many urban applications.[60]

Typical HSPF values for regions in Canada experiencing a winter similar to St John's are 8.9-10.6, which equates to energy savings of 65% relative to baseboard heaters in new homes. Typical HSPF values for regions in Canada experiencing a more severe winter such as in Labrador are 8-10, which equates to energy savings of 62% relative to baseboard heaters.[61] In both regions GSHP save approximately 30% to 45% compared to ASHP in new buildings.

Installed costs are approximately $20,000 for a closed loop system in a typical dwelling, or $18,200 more than a conventional system.[62]

Again, the addition of cooling at no incremental cost can improve the savings relative to the baseline.

[59] Heating seasonal performance factors (HSPF), savings, costs and lifetimes from NRCan Office of Energy Efficiency, *Heating and Cooling with a Heat Pump*. Data checked with manufacturers and contractors.
[60] In most urban locations, there is insufficient room for trenching to install horizontal ground loops for GSHPs. At best, there may be room to drill the vertical holes for vertical ground loops. In many locations, there is no space even for that. In some cases where there is room, it is impossible to gain access with the drilling rig because of surrounding structures.
[61] Ibid.
[62] Earth Energy Society of Canada. http://www.earthenergy.ca/saving.html.

❑ Low-temperature Air Source Heat Pumps for Apartments

Measure Profile	
Applicable Dwelling Type(s)	Apartments
Vintage	Existing and new
Costs	$1.80 to $2.50/ft^2 incremental cost
Savings	56% to 59% of space heating and cooling energy
Useful Life	15 years

When outdoor air temperatures drop below freezing, standard air source heat pump systems switch to auxiliary electric resistance heaters to meet the space heating requirements. This limitation has served to minimize the penetration of air source heat pumps in cold climates. However, as indicated earlier, Hallowell International's low-temperature air source heat pump is capable of operating at 0°F with a COP of greater than two. At this temperature, standard air source heat pumps operate less efficiently, produce less than half their rated capacity and rely primarily on backup electric resistance heaters to maintain comfort.

The LTHP features a two-speed, two-cylinder compressor for efficient operation, a backup booster compressor that allows the system to operate efficiently down to 15ºF and a plate heat exchanger called an "economizer" that further extends the performance of the heat pump to well below 0ºF.

This measure involves upgrading a standard HVAC system with an equivalent LTHP system. This could include, for example, replacing a standard ASHP system with a LTHP system. The target market is both residential and small commercial buildings and the baseline is electric resistance heating and direct expansion cooling. This technology is applicable to existing buildings (at the end of HVAC life cycle) and new construction. The incremental cost ranges between $1.80 and $2.50 per square foot, the savings range between 56% and 59% of space heating and cooling energy and the service life is 15 years.

Currently, the LTHP is available only as a 3.0 and 3.5 ton split system, however Hallowell International expects to launch an expanded product line targeting the commercial market including a packaged rooftop heat pump and a packaged terminal heat pump (PTHP) as early as 2008.[63]

[63] Conversation with James Bryant of Hallowell International, [September, 2007]

❑ Ground Source Heat Pumps for Apartments

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	Existing & new
Costs	$4.90/ft^2 incremental cost
Savings	61% to 64% of space heating & cooling energy
Useful Life	20 years

Ground source heat pump (GSHP) systems are more efficient than conventional heat pump systems, with higher COPs and energy-efficiency ratios (EERs). GSHPs also replace the need for a boiler in winter by utilizing heat stored in the ground; this heat is upgraded by a vapour-compressor refrigeration cycle. In summer, heat from a building is rejected to the ground, eliminating the need for a cooling tower or a heat rejector. They also lower operating costs because the ground is cooler than the outdoor air.

Water-to-air heat pumps are typically installed throughout a building with duct work serving only the immediate zone; a two-pipe water distribution system conveys water to and from the ground source heat exchanger. The heat exchanger field consists of a grid of vertical boreholes with plastic u-tube heat exchangers connected in parallel.

This measure involves upgrading a standard HVAC system with a GSHP system and is applicable to existing building (at the end of HVAC life cycle) and new construction. The baseline is a commercial building with standard electric resistance heating and direct expansion cooling. The incremental cost is $4.90 per square foot, the savings range between 61% and 64% of heating and cooling energy and the service life is 20 years.

❑ Integrated Heating and Hot Water (Heat Pump)

Measure Profile	
Applicable Dwelling Type(s)	Single detached
Vintage	New and existing
Costs	$1,000 incremental on top of GSHP costs
Savings	35% DHW plus heating savings as above
Useful Life	20 years

GSHP can also reduce DHW energy consumption through the addition of a desuperheater. A desuperheater is a small, refrigerant/water heat exchanger that transfers superheated gases from the heat pump's compressor to a water pipe that runs to a home's hot water storage tank. In the cooling season, the desuperheater uses excess heat extracted from the home and in the heating season it uses any excess heat that is not needed for space heating. At peak heating times a conventional water heater can meet additional needs.

A desuperheater can purportedly result in DHW energy savings of 25%-50%[64] (35% has been used in the model, as an approximate midpoint) and costs approximately $1,000.[65]

- **High-efficiency Heat Recovery Ventilators (HRV)**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New
Costs	$650 incremental cost
Savings	7% of HVAC energy
Useful Life	15 years

Heat recovery ventilators (HRV) are installed to recover wasted heat energy from centralized exhausts. Such units typically result in a 13% reduction in space heating costs.[66] New, high-efficiency HRV units recover approximately 50% more of the energy escaping in ventilation air, resulting in an additional 7%[67] reduction in space heating costs.

This analysis assumes that a high-efficiency HRV costs approximately $3,150[68] compared to a standard unit, which costs $2,500. The technology has an estimated life of 15 years. New HRV also have an energy-efficiency option, utilizing a variable speed DC motor instead of the less efficient PSC motor, cutting consumption from 150 Watts to less than 50 Watts on low speed.

- **Electronically Commutated Permanent Magnet (ECPM) Furnace Fan Motor**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	New and existing
Costs	$140 incremental cost
Savings	40% of ventilation energy
Useful Life	20 years

Furnace fan motors are typically designed with permanent split capacitors (PSC) and achieve efficiencies in the range of 50%-60%. In contrast, ECPM motors have operating efficiencies in the range of 80%. Furnace fan motors are used in houses with central,

64 NRCan Office of Energy Efficiency, *Heating and Cooling with a Heat Pump*.
65 Earth Energy Society of Canada http://www.earthenergy.ca/saving.html.
66 The standard HRV is not a separate measure in this analysis. Based on discussions with local contractors, installing HRVs is becoming standard practice in electrically heated new homes in Newfoundland and Labrador. It should be noted, however, that, for the existing vintage, with an installed cost of $2,500 (nearly four times the incremental cost of the above measure) and savings of 13% (only double the savings of the above measure), the standard HRV would not pass the CCE test.
67 E Source Heating Technology Atlas.
68 Cost based on discussions with contractors.

forced air heating systems. When operated exclusively in space heating mode, ECPM motors reduce fan motor electricity use[69] by approximately 40%.[70]

Typical installed costs are approximately $140[71] more than for a standard fan motor. ECPM motors also reduce fan noise.

- **Oil-fired Forced Air Heating System for New Homes[72]**

Measure Profile	
Target Segments	All
Vintage	New
Costs	$4,300 incremental cost
Electricity Savings	Approximately 95%[73]
Useful Life	15 years

Space heating in new homes can be provided by an ENERGY STAR (83% efficiency) oil-fired furnace instead of electric baseboard heating. The installed cost of a direct vent forced air furnace with oil tank and duct work in a new single family home is in the range of $6,500 to $7,000. This compares with an estimated installed cost of up to $2,700 for electric baseboard heating, which includes the cost of a larger electrical panel, wiring, heaters and thermostats. The oil-fired system also uses approximately 420 kWh of fan electricity (in this analysis, assumed to be powered by an ECPM motor).

- **Premium Motors for Apartment Building Ventilation systems**

Measure Profile	
Applicable Dwelling Type(s)	Apartment buildings
Vintage	Existing & new
Costs	20% incremental cost
Savings	1.4% of ventilation energy
Useful Life	10 years

Premium efficiency motors typically have reduced losses of 10%-40%, thereby increasing motor efficiency by 1%-10%.[74] In a retrofit situation it is considered best

[69] As noted in earlier sections, this end use is currently the focus of extensive research efforts. Recent end-use metering results suggest that, in heating mode, ECPM motor savings are fully offset by increased space heating fuel consumption. This is because waste heat generated by the fan motor is captured in the distributed hot air. Therefore, if the fan motor's waste heat is reduced due to increased efficiency, the primary heating fuel must make up the difference. If used to distribute cooled air, the increased fan motor efficiency (i.e., reduced waste heat) would reduce both motor consumption and the total cooling load.
[70] Canadian Centre For Housing Technology, *Effects of ECM Furnace Motors on Electricity and Gas Use*.
[71] Canadian Centre for Housing Technology, *Effects of ECM Furnace Motors on Electricity and Gas Use*, and discussion with retailers.
[72] This measure has been included as it may offer a net benefit to the NLH system. This is because a portion of the electricity generated will be from thermal sources if the Island and Isolated service region remains an isolated grid.
[73] Electricity savings require use of another fuel, assumed to be oil in this case; residual electricity use is for circulation fan operation.
[74] BC Hydro. *Power Smart Tips & Practices*.

practice to replace failed motors with new premium efficiency motors rather than rewind them since motor rewinding often degrades motor efficiency by 1%-3%.

This measure involves upgrading an induction motor with an equivalent premium efficiency motor. It is applicable to both existing buildings (at end of motor life cycle) and new construction. The baseline is a standard efficiency induction motor. The incremental cost is estimated to be 20% relative to a standard efficiency motor, the savings are 1.4% and the service life is 10 years.

❑ **Building Recommissioning – Apartment Buildings**

Measure Profile	
Applicable Dwelling Type(s)	Apartment buildings
Vintage	Existing
Costs	\$0.60 per ft^2
Savings	20% of HVAC energy use
Useful Life	5 years

Recommissioning is a quality assurance process for ensuring that a building's complex array of mechanical and electrical systems is operated to perform according to the design intent and current operational needs of the building. The process generally involves monitoring and simulation of building systems to gain a thorough understanding of current operation and possibilities for optimization. Energy savings generally result from equipment repairs, air and water rebalancing and control optimization.

Recommissioning is applicable to existing buildings only. The baseline is a typical office building with an electricity intensity of 26 kWh/ft^{2}yr. The full cost is estimated to be \$0.60/ft^2, the savings are 20% of HVAC energy use and the service life is 5 years.

4.3.4 Domestic Hot Water

Domestic hot water (DHW) refers to the heated water used for showers, baths, hand washing and clothes and dishwashing (DHW savings for clothes and dishwashers are treated separately in Section 4.3.5). Four[75] energy-efficiency upgrade options were identified and assessed for this end use, of which three are discussed below:

- Low-flow shower heads and faucets
- Water tank insulation
- Pipe insulation.

[75] The potential for heat traps was deemed negligible in the context of this study due to the relatively high replacement rate of DHW tanks in the Newfoundland residential marketplace (often after 6 years). The discussion was removed accordingly.

❑ Low-flow Showers and Faucets

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing
Costs	$25 incremental cost
Savings	11% of DHW energy in existing
Useful Life	12 years

Energy-efficient showers and faucets have aerators and flow restrictors to reduce water use. DHW used for general use (including showers and faucets) is assumed to account for approximately 35% of total DHW energy.

This analysis estimates that reductions in hot water usage are in the range of 30% relative to traditional models, or 11% of total DHW use. Installed costs are approximately $25 for a single-family dwelling. This measure has an expected life of 12 years.[76]

❑ Hot Water Tank Insulation

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing
Costs	$30 full cost
Savings	6% of DHW energy
Useful Life	10 years

Very energy-efficient water heater storage tanks will have an insulation value of at least RSI-4.2. Adding insulation to an existing hot water tank, purchased before 2004, can reduce standby heat losses resulting in energy savings of 4%–9% (6% has been used in the model as an approximately midpoint).[77]

Pre-cut tank jackets (blankets) are readily available and cost around $15-20[78] in central Canada but are more expensive in Newfoundland and Labrador (approximately $30). They last for 10-15 years. Space limitations restrict the applicability of this measure in some cases. The potential is rapidly eroding as tanks are replaced.

[76] Data used in the BC Hydro 2007 Conservation Potential Review, and in the 2006 Terasen Gas CPR Study. Similar assumptions are used in the American Council for an Energy-Efficient Economy (ACEEE) and Energy Efficiency and Renewable Energy (EERE) *Consumer Tip Sheets* and have been confirmed for 2007.
[77] U.S. Department of Energy. http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13070.
[78] From Canadian retailers.

❑ **Hot Water Pipe Insulation**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing
Costs	$4 incremental cost
Savings	3% of DHW energy
Useful Life	6 years

Hot water pipe insulation reduces the distribution losses for DHW, which account for approximately 5%-10% of the total water heater electricity consumption.

This analysis estimates that hot water pipe insulation reduces total DHW energy consumption by 3%. The materials cost an average of $4 per house and are assumed to be installed by the homeowner. The measure has an expected life of 6 years.[79]

4.3.5 Major Appliances

- Microwave/convection oven
- ENERGY STAR refrigerator
- High-efficiency freezer
- ENERGY STAR dishwasher
- ENERGY STAR front loading clothes washer
- ENERGY STAR top loading clothes washer
- Switch to propane gas for cooking.

❑ **Microwave/Convection Oven**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	$1,400 incremental
Savings	25%
Useful Life	20 years

New stove models combine conventional, microwave and convection ovens into a single appliance. Relative to a conventional oven, these designs provide electricity savings of about 25% and faster cooking times. Typical incremental costs are about $1,400 relative to conventional models and the units have a life of approximately 20 years.

[79] Savings data based on earlier analysis conducted for Terasen Gas. Cost data gathered from retailer scan.

❑ ENERGY STAR Refrigerator

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost $50-$100
Savings	15% -20%
Useful Life	17 years

ENERGY STAR refrigerators achieve substantial savings in electricity consumption through improved insulation and compressor efficiency, as well as better quality door seals and load sensors.[80] ENERGY STAR refrigerators must use 15% less energy than current standards dictate for an upright model, and 20% less energy for a compact design. Incremental cost for an ENERGY STAR fridge is $50-$100.[81]

❑ ENERGY STAR Freezer

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost $50-$100
Savings	10%
Useful Life	17 years

The performance efficiency of freezers has increased significantly over the last 10 years through improved insulation and compressor efficiency. ENERGY STAR freezers must use 10% less energy than current standards dictate. Incremental cost for an ENERGY STAR freezer is $50-$100.[82]

❑ Manual Defrost Freezer

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost $0
Savings	30%
Useful Life	17 years

Freezers without an automatic defrost cycle use approximately 30%[83] less electricity than comparable freezers with the defrost cycle; they also cost the same or less. Chest freezers

[80] A potential pitfall with refrigerator replacement initiatives is that some customers will retain the old refrigerator. For example, it may get moved to the basement and used as a beer fridge. This phenomenon may also affect freezer initiatives. Other utilities have addressed this issue through programs that offer a "bounty" to customers who surrender old second refrigerators and freezers.
[81] Based on scan of retailers.
[82] Based on scan of retailers.
[83] Canadian ENERGY STAR Calculator.

experience only limited amount of frost build up over time and rarely require defrosting and, therefore, for the purposes of this study, the level of service provided is assumed to remain virtually unchanged.

- **ENERGY STAR Dishwasher**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	Incremental cost $50
Savings	41% of DHW and mechanical dishwasher energy
Useful Life	10 years

ENERGY STAR dishwashers save energy by using improved technology for the primary wash cycle and by using less hot water to clean. Construction includes more effective washing action, energy-efficient motors and other advanced technologies, such as sensors, that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes. In addition, some advanced dishwashers can sense and adjust for the amount of soil on dishes, using only as much water as necessary.

As of January 1, 2007 the ENERGY STAR level for dishwashers was changed with a corresponding increase in energy efficiency from 26% better than standard to 41% better. These savings affect both the mechanical energy of the dishwasher and the energy used for heating the water. The incremental cost of a unit meeting these new criteria is assumed to be $50.[84] The estimated life of a dishwasher is 10 years.[85]

- **ENERGY STAR Front Loading Clothes Washer**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	Incremental cost $550
Savings	70% of DHW used for clothes washing 50% of mechanical energy 35% of dryer energy
Useful Life	15 years

Compared to standard models, front loading (horizontal axis) washing machines reduce hot water use by 60%-80% (70% has been used in the model, as an approximate midpoint). Mechanical energy use is also reduced by about 50% and, due to their faster spin speed, they also reduce dryer energy by about 35%.[86]

This analysis assumes the energy savings outlined above. Incremental costs are assumed to be about $550 more than a standard vertical axis machine, although some high-end

[84] Based on discussion with retailers.
[85] Canadian ENERGY STAR Calculator.
[86] Savings data based on earlier analysis conducted for Terasen Gas.

models have incremental costs of about $1,000.[87] They are assumed to have a life of 15 years.

- **ENERGY STAR Top Loading Clothes Washer**

Measure Profile	
Applicable Dwelling Type(s)	Single detached and attached
Vintage	Existing and new
Costs	Incremental cost $250
Savings	60% of DHW used for clothes washing 50% of mechanical energy 35% of dryer energy
Useful Life	15 years

ENERGY STAR clothes washers use approximately 60%[88] less hot water and 50% less mechanical energy per load than standard models. Because ENERGY STAR clothes washers spin faster, there are additional savings in dryer energy of approximately 35%. In January 2007, the ENERGY STAR standard for clothes washers was increased. However, the base regulation was also increased and the savings above the baseline, therefore, remain the same.

The change in standards has, however, resulted in a reduction of the number of qualifying models to only top of the range units and the incremental cost has therefore increased to about $250.[89] The estimated life of a clothes washer is 15 years.

- **Switch to Propane Gas for Cooking[90]**

Measure Profile	
Target Segments	All
Vintage	New
Costs	$245 installed cost for a tank plus $105/yr. rental $400 installed cost for piping
Electricity Savings	100% of on-site cooking electricity [91]
Useful Life	15 years

Propane cooking stoves offer the same perceived advantages in cooking convenience offered by natural gas stoves. Typical installed cost is $645 more than an electric stove due to piping costs (typically $400-500) and the cost of installing a propane tank ($245). The propane tank is typically a rental, costing an additional $105 per year.

[87] Cost data based on retailer scan.
[88] Canadian and U.S. ENERGY STAR Calculator.
[89] From retailer scan.
[90] This measure is not an efficiency measure but has been included for the same reasons as outlined previously in footnote 72, Section 4.3.3, for oil-fired space heating.
[91] Electricity savings require use of another fuel, assumed to be propane in this case.

4.3.6 Household Electronics

Improvements to household electronics enhance the efficacy of entertainment items such as TVs and computers, while maintaining service levels. Four[92] energy-efficiency upgrade options were identified and assessed for this end use as follows:

- Reduction in standby losses
- ENERGY STAR compliant computer
- ENERGY STAR television
- LCD television.

❑ **Standby Losses**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	$40 per dwelling
Savings	16% for computers, 8% for TVs and other electronics, 73% for TV peripherals
Useful Life	10 years

Standby losses, consumed by electrical appliances when they are turned off or not in use, represent a significant component of residential electricity consumption. They account for 16% of computer energy use, 8% of the electricity used by TV and other electronics such as games consoles, and 73% of the electricity use of TV peripherals such as set-top boxes.[93] Technically, these standby losses can be reduced to zero by use of a power bar to completely remove power to the appliance.

In practice, the interaction between the power bar and the electronic device will often need to be more sophisticated than a simple shut-off. Some TVs need fan runtime after the screen is shut off, to avoid heat damage. Some set-top boxes require time to boot up and reconnect to their network before use, suggesting that to avoid user inconvenience they should be turned on in advance of prime viewing hours with a timer. Smart power bars with these capabilities are now making inroads in the marketplace. Over the study period, technical advances will improve these features and, in some cases, may move them from the power bar into the electronic appliance itself.

[92] LCD monitors have become the standard technology and the measure was dropped accordingly.
[93] Alan Fung, Adam Aulenback, Alex Ferguson and V Ismet Ugurssal. *Standby Power Requirements of Household Appliances in Canada*, April 2002.

❑ ENERGY STAR Compliant Computer

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost negligible
Savings	60%
Useful Life	8 years

The ENERGY STAR specification for computers was revised in October 2006 and came into effect in July 2007. The previous specification only addressed energy use during a computer's sleep mode and was not demanding even in this respect with approximately 98% of available computers carrying the ENERGY STAR label. The energy savings were also dependent on the operating mode set by the user. The requirements have been seriously revised in an attempt to offer greater differentiation for innovative, truly energy-efficient models and now address all modes of operation in order to have automatic savings that are not dependent on user behaviour. It is estimated that the new specification will mean that ENERGY STAR computers and computer peripherals use, on average, 60% less energy than conventional models.[94] This premium performance comes at a price that remains comparable to conventional computer models.

❑ ENERGY STAR Television

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost $50
Savings	30%
Useful Life	20 years

ENERGY STAR qualified televisions must use one Watt or less in standby mode, which equates to approximately 30% less energy use annually[95] than a non-qualifying product. An ENERGY STAR TV may be CRT, LCD or plasma technology. The incremental cost of a 32" LCD ENERGY STAR qualified TV compared to its standard counterpart was found to be $20-$100 ($50 has been used in the model, as an approximate midpoint).[96]

[94] ENERGY STAR Press Release, 2006.
[95] Canadian and U.S. ENERGY STAR Calculator.
[96] From retailer scan.

❑ **LCD Television**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	$400 incremental cost
Savings	40%
Useful Life	20 years

Like LCD computer monitors, LCD TVs typically use less energy than CRTs, both when running and when in standby mode. A 27" LCD TV uses approximately 80-100 Watts[97] of power in "on" mode compared to an equivalent CRT monitor, which uses 150 Watts. Energy savings are thus in the order of 40%. LCD TVs are $300-$500[98] more expensive than the CRT equivalents ($400 has been used, as an approximate midpoint). One aspect of consumer behaviour that may complicate analysis of this measure is that people tend to buy larger LCD TVs than CRTs, potentially reducing the savings. We have not included this effect at this stage of the analysis.

4.3.7 Lighting

Lighting improvements enhance the efficacy of lighting fixtures, while maintaining service levels. Seven energy-efficiency upgrade options were identified and assessed for this end use as follows:

- Replacement of incandescent lamps with compact fluorescent lights (CFLs)
- White LED lamp
- Replacement of T12s with T8s (mainly in apartment building common areas)
- Redesign with high-performance T8 lighting systems
- LED holiday lighting
- Lighting timers
- Motion sensors.

❑ **Replacement of Incandescent Lamps with Compact Fluorescent Lights[99]**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Incremental cost $3
Savings	75%
Useful Life	9 years

[97] Marbek Resources Consultants Ltd. *Consumer Electronics Report*.
[98] From review of retailers.
[99] This measure is the replacement of incandescent lamps in standard applications with relatively long hours of use and no requirement for special shapes or dimming capability. A second compact fluorescent measure was added to the model, to address specialty applications where the lamp is more expensive or the hours of use are shorter. Incremental cost for the specialty CFL measure is $9. All other profile assumptions remain the same.

Compact fluorescent lights (CFLs) can be used to replace incandescent bulbs in most applications. A 13-Watt CFL provides a light output similar to that of a 60-Watt incandescent lamp and consumes approximately 75% less electricity. CFLs have come down a lot in price in recent years with the top end of the price range now being about \$3-\$10[100] for one CFL compared to no more than \$1 for an incandescent bulb (\$3 has been used as an incremental cost in the model, as representative of the majority of standard, low-cost applications). A CFL lasts approximately eight to ten times longer.

❑ **White LED Lamp**

Measure Profile	
Applicable Building Types	All
Vintage	Existing and new
Costs	Full \$43/lamp; incremental \$38/lamp
Savings	75% of lighting energy
Useful Life	12 years

This upgrade is a white light-emitting diode (LED) array that displays 800 lumens at 50 lumens per Watt and has a full cost of \$43. Relamping a 65-Watt incandescent reflector lamp with this upgrade results in savings of 75% while producing an equivalent amount of light. In addition, white LEDs currently have a life of 35,000 hours compared to the shorter life of incandescent lamps; this provides additional benefits in the form of lower maintenance and lamp replacement costs. However, this technology is in the early stages of market entry and therefore improvements to the technology in terms of cost and efficacy should be expected in the coming years.

❑ **Replacement of Existing T12 Lamps and Magnetic Ballasts with T8 Fluorescent Lamps and Electronic Ballasts**

Measure Profile	
Applicable Dwelling Type(s)	Detached, attached and apartment
Vintage	New and existing
Costs	Standard: Full \$41/fixture; incremental \$0 High-performance: Full \$50/fixture; incremental \$9/fixture
Savings	Standard T8 lamp and ballast: 26% High-performance T8 lamp and ballast: 39%
Useful Life	16 years

T12 fluorescent lamps and magnetic ballasts can be replaced with standard 32-Watt T8 fluorescent lamps and electronic ballasts or the newer so called “high-performance” T8 lamps and ballasts. T12s still remain in limited applications in detached and attached homes, and in apartment building lobbies and corridors. Standard T8 lighting systems provide savings of approximately 26% relative to the conventional T12 systems in existing buildings. High-performance systems have even greater savings (39%) resulting

[100] From a retailer scan. \$10 is now quite expensive for a singe CFL and might be paid only for a “daylight” model. Lowest prices were in the range of \$3 for one lamp.

from a possible reduction in the number of lamps used due to the superior lumen output of this lighting. In new apartment buildings and other residential applications, the choice of high-performance T8s over standard T8s can save up to 17%.

Typical installed cost can be as little as nothing, when considering the incremental cost of a standard T8 system compared to a T12 system, or $41 per fixture if considering the full cost of a standard T8 system. Typical installed cost can be as little as $9 per fixture when considering the incremental cost of a high-performance T8 system compared to a T12 system, or $50 per fixture if considering the full cost of a high-performance T8 system.

❑ **Redesign with High-performance T8 Lighting Systems**

Measure Profile	
Applicable Building Types	All
Vintage	Existing
Costs	Full $1.72/ft^2; incremental $0.48/ft^2
Savings	62% of lighting energy
Useful Life	16 years

The combination of lighting redesign to lower light levels and next generation T8 lighting systems results in savings of 62% and a lower incremental cost (due to fewer fixtures) relative to baseline T12 systems.

Measure Profile	
Applicable Building Types	All
Vintage	New
Costs	Full $1.72/ft^2; incremental $0.01/ft^2
Savings	48% of lighting energy
Useful Life	16 years

This technology upgrade is the same as previously described in the T12 upgrades discussion above. However, in this case the savings are 48% relative to the baseline standard T8 systems.

❑ **Replacement of Incandescent Holiday Lights with LED Holiday Lights**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	$2 incremental cost
Savings	91%
Useful Life	20 years

LED seasonal decorative lights (including Christmas lights) can replace existing incandescent light strings. A string of LED holiday lights uses 14 Watts on average compared to a string of incandescent lights, which uses 150 Watts on average. LED strings thus consume less than 10% of the electricity used by a comparable string of incandescent holiday lights.

LED holiday lights are now available in most hardware stores at an incremental cost of about $1 to $3 ($2 has been used in the model, as an approximate midpoint). LED holiday lights can also last up to 10 times longer than incandescent holiday lights.

- **Lighting Timers**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Full cost $20
Savings	60%
Useful Life	10 years

Outdoor security lights or aesthetic lights are often fitted with a photo-sensor to run from dusk until dawn. However, if exterior lighting is only required until a certain hour (e.g., 11 pm), a timer can be installed to turn the light off automatically.

This analysis assumes that in the base case an outdoor light operates from dusk to dawn (on average 10 hours a night over the course of the year[101]) and a timer reduces this to an average of 4 hours a night. Energy savings are, therefore, in the range of 60%. Outdoor light timers cost approximately $20.[102]

- **Motion Sensors**

Measure Profile	
Applicable Dwelling Type(s)	All
Vintage	New and existing
Costs	Full cost $50
Savings	95%
Useful Life	10 years

Motion sensors for residential security lighting are designed to switch on the light only if there is movement. This reduces the time that the light is actually on to 30-60 minutes per night on average and results in energy savings of approximately 95%. Motion sensors cost approximately $50.[103]

[101] Marbek Resource Consultants Ltd., *Dusk to Dawn Luminaires*.
[102] From retailer scan.
[103] From retailer scan.

4.4 SUMMARY OF ENERGY-EFFICIENCY RESULTS

The energy-efficiency measures and associated CCEs are summarized in Exhibit 4.2. Note that the negative values shown for selected lighting upgrades indicate that the annualized capital cost of the energy-efficiency measure is less expensive than the baseline technology.

The building-level measures for apartment buildings and their associated CCEs were derived from the results found for the Commercial sector. These are presented in Exhibit 4.3 (numbered Exhibit 4.2 in the Commercial sector report). Note that some measures in this table are not applicable to residential buildings. Measures that apply within the apartment suites are included in Exhibit 4.2 below.

Exhibit 4.2: Residential Energy-efficiency Technologies and Measures – Cost of Conserved Energy

Summary of CCE's - Residential Sector

End Use		Technology	Dwelling Type	Vintage	Sp heating fuel	CCEs (¢/kWh) 4.0% DR Full	4.0% DR Incr.	6.0% DR Full	6.0% DR Incr.	8.0% DR Full	8.0% DR Incr.
Lighting	Upgrade 1	Replace incandescent with CFL	All Detachments	New & Exist.	Elec. & Non-elec.	0.7	-2.3	0.8	-2.3	0.9	-2.3
Lighting	Upgrade 2	Replace incandescent with CFL - Specialized applications	All Detachments	New & Exist.	Elec. & Non-elec.	6.3	-3.8	6.9	-3.3	7.5	-2.9
Lighting	Upgrade 3	Replace incandescent with white LED	All Detachments	New & Exist.	Elec. & Non-elec.	16.6	16.5	19.0	18.8	21.5	21.2
Lighting	Upgrade 4	Replace T12 with T8	Detached/Attached	New & Exist.	Elec. & Non-elec.	4.2		4.8		5.5	
Lighting	Upgrade 5	Replace T12 with T8	Apartment	New & Exist.	Elec. & Non-elec.	0.6		0.7		0.8	
Lighting	Upgrade 6	Replace porchlight with CFL	Detached/Attached	New & Exist.	Elec. & Non-elec.	0.2	-0.7	0.2	-0.7	0.3	-0.7
Lighting	Upgrade 7	Replace porchlight with white LED	Detached/Attached	New & Exist.	Elec. & Non-elec.	5.0	4.9	5.7	5.6	6.5	6.4
Lighting	Upgrade 8	Exterior and holiday lights	All Detachments	New & Exist.	Elec. & Non-elec.	5.6	-9.7	6.6	-9.1	7.7	-8.5
Lighting	Upgrade 9	Motion Sensor	All Detachments	New & Exist.	Elec. & Non-elec.	3.0		3.3		3.6	
Lighting	Upgrade 10	Lighting Timer	All Detachments	New & Exist.	Elec. & Non-elec.	1.9		2.1		2.3	
Existing Building Envelope - Island & Isolated	Upgrade 1	High-performance glazings	Detached	New	Elec		4.2		5.2		6.2
	Upgrade 1	High-performance glazings	Row	New	Elec		3.7		4.5		5.4
	Upgrade 1	High-performance glazings	Detached	Exist.	Elec		3.4		4.2		5.0
	Upgrade 1	High-performance glazings	Row	Exist.	Elec		3.9		4.7		5.7
	Upgrade 2	ENERGYSTAR glazings	Detached	New	Elec		1.6		2.0		2.3
	Upgrade 2	ENERGYSTAR glazings	Row	New	Elec		1.5		1.8		2.1
	Upgrade 2	ENERGYSTAR glazings	Detached	Exist.	Elec		2.4		3.0		3.6
	Upgrade 2	ENERGYSTAR glazings	Row	Exist.	Elec		2.9		3.6		4.3
	Upgrade 3	Wall Insulation	Detached	New	Elec		14.7		18.0		21.5
	Upgrade 3	Wall Insulation	Row	New	Elec		16.1		19.6		23.5
	Upgrade 3	Wall Insulation	Detached	Exist.	Elec		11.7		14.2		17.1
	Upgrade 3	Wall Insulation	Row	Exist.	Elec		15.3		18.8		22.5
	Upgrade 4	Attic Insulation	Detached	New	Elec		10.2		12.5		14.9
	Upgrade 4	Attic Insulation	Row	New	Elec		11.7		14.3		17.2
	Upgrade 4	Attic Insulation	Detached	Exist.	Elec		5.7		6.9		8.3
	Upgrade 4	Attic Insulation	Row	Exist.	Elec		7.6		9.3		11.1
	Upgrade 5	Foundation Insulation	Detached	New	Elec		5.9		7.2		8.6
	Upgrade 5	Foundation Insulation	Row	New	Elec		3.7		4.5		5.4
	Upgrade 5	Foundation Insulation	Detached	Exist.	Elec		6.9		8.4		10.1
	Upgrade 5	Foundation Insulation	Row	Exist.	Elec		4.7		5.7		6.8
	Upgrade 5	Crawlspace Insulation	Detached	New	Elec		2.0		2.5		3.0
	Upgrade 5	Crawlspace Insulation	Row	New	Elec		3.5		4.3		5.1
	Upgrade 5	Crawlspace Insulation	Detached	Exist.	Elec		2.2		2.7		3.2
	Upgrade 5	Crawlspace Insulation	Row	Exist.	Elec		4.0		4.9		5.9
	Upgrade 6	Air leakage sealing	Detached	New	Elec		8.9		9.8		10.7
	Upgrade 6	Air leakage sealing	Row	New	Elec		9.8		10.8		11.8
	Upgrade 6	Air leakage sealing	Detached	Exist.	Elec		9.1		10.2		11.4
	Upgrade 6	Air leakage sealing	Row	Exist.	Elec		10.1		11.3		12.6

Exhibit 4.2: Residential Energy-efficiency Technologies and Measures – Cost of Conserved Energy (cont'd)

End Use		Technology	Dwelling Type	Vintage	Sp heating fuel	CCEs (¢/kWh) 4.0% DR Full	4.0% DR Incr.	6.0% DR Full	6.0% DR Incr.	8.0% DR Full	8.0% DR Incr.
Existing Building Envelope - Labrador Interconnected	Upgrade 1	High-performance glazings	Detached	New	Elec		2.6		3.2		3.8
	Upgrade 1	High-performance glazings	Row	New	Elec		2.4		2.9		3.5
	Upgrade 1	High-performance glazings	Detached	Exist.	Elec		2.5		3.1		3.7
	Upgrade 1	High-performance glazings	Row	Exist.	Elec		2.4		3.0		3.5
	Upgrade 2	ENERGYSTAR glazings	Detached	New	Elec		1.0		1.2		1.4
	Upgrade 2	ENERGYSTAR glazings	Row	New	Elec		0.9		1.1		1.4
	Upgrade 2	ENERGYSTAR glazings	Detached	Exist.	Elec		1.7		2.1		2.5
	Upgrade 2	ENERGYSTAR glazings	Row	Exist.	Elec		1.9		2.3		2.7
	Upgrade 3	Wall Insulation	Detached	New	Elec		12.8		15.7		18.8
	Upgrade 3	Wall Insulation	Row	New	Elec		9.2		11.2		13.5
	Upgrade 3	Wall Insulation	Detached	Exist.	Elec		4.4		5.3		6.4
	Upgrade 3	Wall Insulation	Row	Exist.	Elec		5.5		6.7		8.1
	Upgrade 4	Attic Insulation	Detached	New	Elec		6.8		8.3		9.9
	Upgrade 4	Attic Insulation	Row	New	Elec		6.0		7.3		8.8
	Upgrade 4	Attic Insulation	Detached	Exist.	Elec		2.5		3.1		3.7
	Upgrade 4	Attic Insulation	Row	Exist.	Elec		3.1		3.8		4.6
	Upgrade 5	Foundation Insulation	Detached	New	Elec		1.6		2.0		2.3
	Upgrade 5	Foundation Insulation	Row	New	Elec		1.0		1.2		1.4
	Upgrade 5	Foundation Insulation	Detached	Exist.	Elec		2.0		2.4		2.9
	Upgrade 5	Foundation Insulation	Row	Exist.	Elec		1.5		1.9		2.2
	Upgrade 5	Crawlspace Insulation	Detached	New	Elec		1.0		1.2		1.4
	Upgrade 5	Crawlspace Insulation	Row	New	Elec		1.8		2.2		2.6
	Upgrade 5	Crawlspace Insulation	Detached	Exist.	Elec		1.3		1.6		1.9
	Upgrade 5	Crawlspace Insulation	Row	Exist.	Elec		2.3		2.9		3.4
	Upgrade 6	Air leakage sealing	Detached	New	Elec		3.0		3.2		3.5
	Upgrade 6	Air leakage sealing	Row	New	Elec		3.2		3.5		3.8
	Upgrade 6	Air leakage sealing	Detached	Exist.	Elec		3.7		4.1		4.6
	Upgrade 6	Air leakage sealing	Row	Exist.	Elec		3.9		4.4		4.9
Space Heating and Ventilation Equipment	Upgrade 1	Prog. Tstat - High Cons.	All Detachments	New & Exist.	Elec	0.5		0.6		0.6	
	Upgrade 1	Prog. Tstat - Med Cons.	All Detachments	New & Exist.	Elec	1.0		1.2		1.3	
	Upgrade 1	Prog. Tstat - Low Cons.	All Detachments	New & Exist.	Elec	1.6		1.7		1.9	
	Upgrade 1	Eff. Tstat - High Cons.	All Detachments	New & Exist.	Elec	0.4		0.5		0.5	
	Upgrade 1	Eff. Tstat - Med Cons.	All Detachments	New & Exist.	Elec	0.9		1.0		1.1	
	Upgrade 1	Eff. Tstat - Low Cons.	All Detachments	New & Exist.	Elec	1.3		1.5		1.7	
	Upgrade 1	Air source heat pump	All Detachments - Island	New	Elec	11.7	9.6	13.9	11.4	16.2	13.3
	Upgrade 2	Air source heat pump	All Detachments - Lab	New	Elec	4.7	3.9	5.6	4.6	6.6	5.4
	Upgrade 3	Ground source heat pump	All Detachments - Island	New	Elec	18.0	16.4	21.4	19.4	25.0	22.7
	Upgrade 1	Ground source heat pump	All Detachments - Lab	New	Elec	7.3	6.6	8.6	7.9	10.1	9.2
	Upgrade 3	Integrated Space/DHW heating	All Detachments - Island	New	Elec	15.7	14.4	18.6	17.0	21.8	19.9
	Upgrade 1	Integrated Space/DHW heating	All Detachments - Lab	New	Elec	7.1	6.5	8.4	7.7	9.8	9.0

Exhibit 4.2: Residential Energy-efficiency Technologies and Measures – Cost of Conserved Energy (cont'd)

End Use		Technology	Dwelling Type	Vintage	Sp heating fuel	CCEs (¢/kWh) 4.0% DR Full	4.0% DR Incr.	6.0% DR Full	6.0% DR Incr.	8.0% DR Full	8.0% DR Incr.
Space Heating and Ventilation Equipment	Upgrade1	Electronically commutated permanent magnet motors (ECPM) - High Cons	Detached/Attached	New/Existing	Elec. & Non-elec.		3.7		4.4		5.1
	Upgrade1	Electronically commutated permanent magnet motors (ECPM) - Low Cons	Detached/Attached	New/Existing	Elec. & Non-elec.		7.4		8.7		10.2
	Upgrade1	Electronically commutated permanent magnet motors (ECPM) - Continuous	Detached/Attached	New/Existing	Elec. & Non-elec.		0.9		1.1		1.3
	Upgrade2	Heat Recovery Ventilator - High Cons	Detached/Attached	New & Exist.	Elec. & Non-elec.	15.2	3.1	17.4	3.6	19.7	4.1
	Upgrade2	Heat Recovery Ventilator - Med Cons	Detached/Attached	New & Exist.	Elec. & Non-elec.	35.1	7.2	40.2	8.3	45.6	9.4
	Upgrade2	Heat Recovery Ventilator - Low Cons	Detached/Attached	New & Exist.	Elec. & Non-elec.	39.7	8.2	45.4	9.4	51.5	10.6
Domestic Hot Water	Upgrade1	Efficient shower/faucet	All Detachments	Exist.	Elec DHW	0.9		1.0		1.1	
	Upgrade2	DHW tank insulation	Detached	New & Exist.	Elec DHW	1.9	1.9	2.1	2.1	2.3	2.3
	Upgrade2	DHW tank insulation	Attached	New & Exist.	Elec DHW	4.1	4.1	4.5	4.5	5.0	5.0
	Upgrade 3	Heat trap	All Detachments	New & Exist.	Elec DHW	18.4	18.4	19.2	19.2	20.1	20.1
	Upgrade 4	Pipe Insulation	Detached/Attached	New & Exist.	Elec DHW	0.4	0.4	0.4	0.4	0.5	0.5
Major Appliances	Upgrade 1	Energy Star top-loading clothes washer + Dryer energy	All Detachments	New & Exist.	Elec DHW		7.5		8.6		9.8
	Upgrade 2	Horizontal axis clothes washer + Dryer Energy	All Detachments	New & Exist.	Elec DHW		16.6		19.0		21.5
	Upgrade 3	New Energy Star dishwasher	All Detachments	New & Exist.	Elec DHW		17.4		19.6		21.9
	Upgrade 4	Highest efficiency dishwasher	All Detachments	New & Exist.	Elec DHW		1.5		1.7		1.9
	Upgrade 5	Energy Star 18 Cu Ft New	Detached/Attached	New & Exist.	Elec. & Non-elec.		4.5		5.2		6.1
	Upgrade 6	Highest efficiency refrigerator	Detached/Attached	New & Exist.	Elec. & Non-elec.		74.1		88.1		103.2
	Upgrade 7	Energy Star compact	Apartment	New & Exist.	Elec. & Non-elec.		4.3		5.1		5.9
	Upgrade 8	High efficiency freezer	Detached/Attached	New & Exist.	Elec. & Non-elec.		7.6		8.9		10.3
	Upgrade 9	High efficiency freezer	Apartment	New & Exist.	Elec. & Non-elec.		12.5		14.6		16.9
	Upgrade 10	Microwave/convection oven	All Detachments				50.6		59.9		70.0
Household Electronics	Upgrade 1	ENERGY STAR Computer	All Detachments	New & Exist.	Elec. & Non-elec.		0.0		0.0		0.0
	Upgrade 2	LCD monitors	All Detachments	New & Exist.	Elec. & Non-elec.		-0.8		0.1		1.0
	Upgrade 3	ENERGY STAR television	All Detachments	New & Exist.	Elec.		4.9		5.8		6.8
	Upgrade 3	LCD Television	All Detachments	New & Exist.	Elec.		29.0		34.3		40.1
	Upgrade 4	Miscellaneous reduced standby	All Detachments	New & Exist.	Elec. & Non-elec.		1.4		1.6		1.9
New Building Design	Upgrade 1	R2000 housing	Detached	New	Elec.	252.4	6.8	317.1	8.5	387.8	10.4
	Upgrade 2	EGH 80	Detached	New	Elec.	249.4	3.7	313.3	4.6	383.0	5.7
Fuel Switching	Upgrade 1	Oil Furnace, New Island Detached	Detached	New	Elec.		13.6		14.1		14.6
	Upgrade 1	Oil Furnace, New Labrador Detached	Detached	New	Elec.		10.8		11.0		11.2
	Upgrade 1	Oil Furnace, New Island Attached	Attached	New	Elec.		12.8		13.2		13.7
	Upgrade 1	Oil Furnace, New Labrador Attached	Attached	New	Elec.		10.2		10.4		10.6
	Upgrade 2	Propane Cooking Range	All Detachments	New & Exist.	Elec.		49.0		50.3		51.8

Exhibit 4.3: Commercial (Apartment Buildings) Energy-efficiency Technologies and Measures – Cost of Conserved Energy[104]

Measure/Technology			Vintage	CCEs (¢/kWh)					
				4.0% DR		6.0% DR		8.0% DR	
				Full	Incr.	Full	Incr.	Full	Incr.
Lighting	T12	Standard T8s	Existing	5.4	0.0	6.3	0.0	7.2	0.0
		Low BF T8s	Existing	3.9	0.0	4.6	0.0	5.2	0.0
		High-performance T8s	Existing	4.2	0.5	4.9	0.7	5.7	0.8
		Redesign with standard T8s	Existing	5.1	-2.0	5.9	-2.3	6.8	-2.6
		Redesign with high-performance T8s	Existing	4.9	-1.3	5.6	-1.6	6.4	-1.8
	T8	High-performance T8s	Existing & New	13.1	1.7	15.3	2.1	17.6	2.5
		Redesign with high-performance T8s	Existing & New	8.4	0.0	9.8	0.0	11.2	0.0
		Fully integrated lighting and controls	Existing & New	29.6	22.0	34.3	25.4	39.3	29.2
		Occupancy sensors	Existing & New	6.0	4.3	6.6	4.7	7.2	5.1
	Inc	Compact fluorescent lamps	Existing & New	2.7	-1.1	2.9	-1.0	3.2	-0.8
		Induction lighting	Existing & New	4.5	0.4	4.9	0.7	5.4	1.1
		White LEDs	Existing & New	0.1	-3.5	0.4	-3.2	0.8	-2.8
		Halogen IR	Existing & New	10.1	-4.8	10.5	-4.7	10.8	-4.6
		Ceramic metal halide	Existing & New	4.7	-4.6	5.1	-4.4	5.6	-4.1
		LED exit signs	Existing	1.7	na	2.0	na	2.4	na
	HID	Pulse-start metal halide	Existing & New	9.5	0.3	10.9	0.3	12.5	0.4
		High intensity fluorescents	Existing & New	4.1	0.4	4.8	0.5	5.4	0.5
HVAC		Low temperature heat pumps - Island	Existing & New	na	5.5	na	6.0	na	6.6
		Low temperature heat pumps - Labrador	Existing & New	na	4.8	na	5.3	na	5.8
		Ground source heat pumps - Island	Existing & New	na	6.2	na	7.3	na	8.6
		Ground source heat pumps - Labrador	Existing & New	na	4.5	na	5.4	na	6.3
		Infrared heaters - Island	Existing & New	6.7	6.7	7.4	7.4	8.1	8.1
		Infrared heaters - Labrador	Existing & New	4.8	4.8	5.3	5.3	5.8	5.8
		High-efficiency chillers - Island	Existing & New	na	6.1	na	7.4	na	8.9
		High-efficiency chillers - Labrador	Existing & New	na	8.1	na	9.9	na	11.8
		High-efficiency AC units - Island	Existing & New	na	11.3	na	12.9	na	14.7
		High-efficiency AC units - Labrador	Existing & New	na	18.7	na	21.5	na	24.3
		Adjustable speed drives	Existing & New	5.0	5.0	5.6	5.6	6.1	6.1
		Premium efficiency motors	Existing & New	19.5	2.9	21.5	3.2	23.5	3.6
		Building recommissioning	Existing	4.0	na	4.3	na	4.5	na
		Advanced BAS	Existing & New	4.3	na	4.7	na	5.1	na
		Programmable thermostats - Island	Existing & New	1.8	0.9	2.0	1.0	2.2	1.1
		Programmable thermostats - Labrador	Existing & New	1.6	0.8	1.8	0.9	1.9	1.0
DHW		Low-flow aerators & shower heads	Existing & New	2.6	na	2.8	na	2.9	na
		Tankless water heaters	Existing & New	na	37.4	na	41.2	na	45.2
Building Envelope		High-performance glazings - Island	Existing & New	na	5.5	na	6.5	na	7.5
		High-performance glazings - Labrador	Existing & New	na	3.3	na	4.0	na	4.6
		Wall insulation - Island	Existing & New	na	6.0	na	7.4	na	8.8
		Wall insulation - Labrador	Existing & New	na	4.2	na	5.1	na	6.1
		Roof insulation - Island	Existing & New	na	6.9	na	8.5	na	10.1
		Roof insulation - Labrador	Existing & New	na	4.4	na	5.3	na	6.4
		Air curtains - Island	Existing & New	5.1	5.1	5.8	5.8	6.6	6.6
		Air curtains - Labrador	Existing & New	3.3	3.3	3.8	3.8	4.3	4.3
New Construction		New buildings - 25% more efficient	New	na	0.9	na	1.1	na	1.4
		New buildings - 40% more efficient	New	na	2.5	na	3.1	na	3.8

[104] This exhibit is produced from the measure summary in the Commercial report.

4.5 PEAK LOAD REDUCTION MEASURES

4.5.1 Overview

Electric utilities are typically interested in peak load reduction measures as a means to avoid or defer the costs of capacity expansion. Capacity costs refer to a wide range of capital-based investments, including generating stations (new and upgraded), transmission lines, distribution lines, substations, transformers and other infrastructure required to deliver power.

From the customer's perspective, adoption of peak load reduction measures is typically dependent on the overall benefits to them, such as direct incentive payments or rate benefits. Under most current rate structures, residential customers are billed only for electricity (kWh) regardless of when it is used, and not for "demand." Consequently, in the absence of specific peak-based rate structures, peak load reduction measures that do not also reduce overall energy consumption do not provide financial benefits to customers.

The current trend throughout much of the North American utility industry is towards more specific pricing, such as time-of-use and even hourly pricing, or peak incentives that pass along some of the utility benefits to customers on a performance basis. These new pricing structures provide incentive for even residential customers to implement measures or to participate in utility peak load reduction programs, as long as the differential between peak and off-peak prices is sufficient to provide a noticeable financial benefit to the customer. To date, effective implementation of many of the potential peak load reduction options has been limited by the availability and cost of suitable metering and data communications technology.

Currently, several Canadian jurisdictions[105] are in the early stages of implementing pilot Residential sector load reduction initiatives. These initiatives are designed to test:

- New metering technologies, such as advanced meters (also referred to as "smart meters")
- New rate structures, such as real-time feedback, pay-as-you-go billing and critical peak pricing
- Direct load control.

Most conventional meters monitor electricity consumption (kWh) but do not track *when* the electricity is used. Instead, conventional meters are occasionally read and reported to electric utilities, which then bill customers every one or two months. As a result, customers only find out their electricity usage after the fact.

In contrast, advanced meters (known in some industry circles as "smart meters") record how much electricity is used and when. Advanced meters, through their interval metering

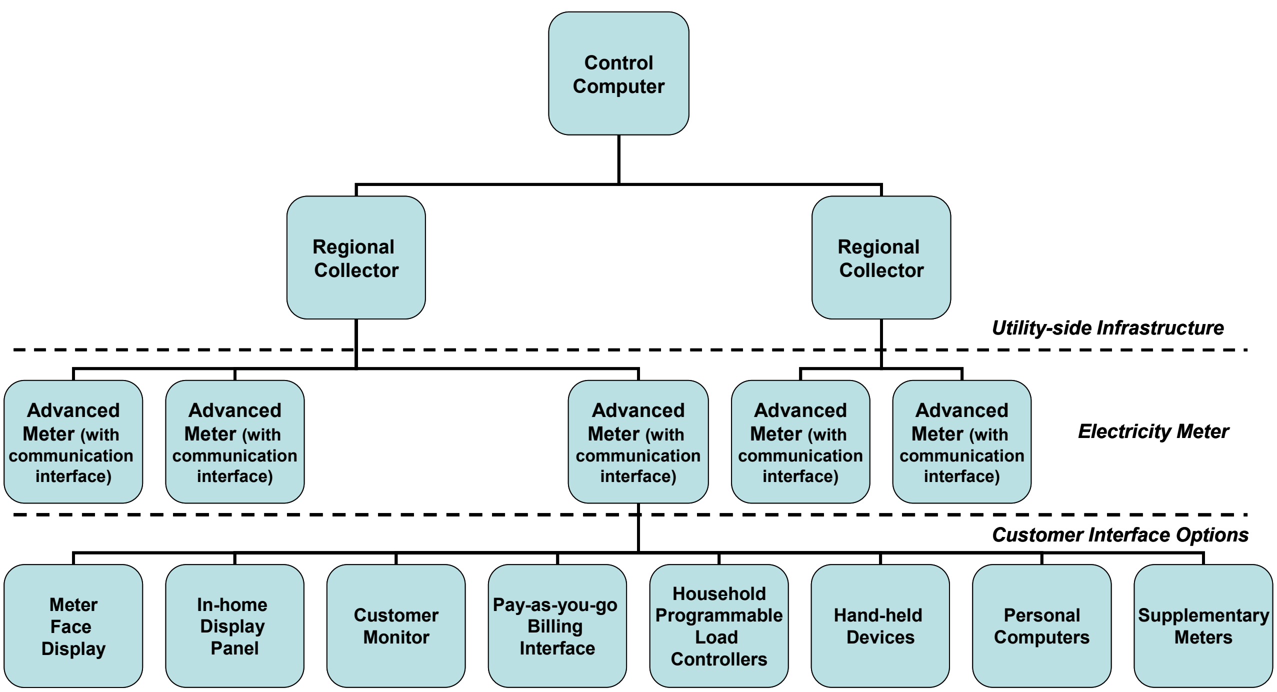
[105] Marbek Resource Consultants; *Technology & Market Assessment of Residential Electricity Advanced Metering In Canada*. Prepared for Natural Resources Canada, November 2006.

and two-way communications, allow the implementation of numerous utility programs and services that encourage customers to reduce or shift (i.e., change the time of) their electricity consumption, particularly away from peak times when the cost of supply is becoming increasingly more expensive.

Exhibit 4.4 presents an illustrative schematic of an advanced metering system. As illustrated, there are three major levels of system components:

- **Customer Interface Options** — The hardware interfaces that can be used for the advanced meter to communicate with the customer and, to a certain extent, any applicable electrical load controllers in the customer's household.
- **Electricity Meter** — The advanced meter itself, equipped with a communication interface to facilitate communication to other devices and the utility.
- **Utility-side Infrastructure** — The infrastructure required for two-way communication between the utility and the advanced meter.[106]

Exhibit 4.4: Illustrative Schematic of an Advanced Metering System



[106] Ibid, *Technology & Market Assessment of Residential Electricity Advanced Metering In Canada*. page 4

As illustrated in Exhibit 4.4, there is wide range of technical options available at each level in a typical advanced metering system. This is particularly the case at the customer interface level where there is a growing number of devices that can be used to provide real-time feedback to customers in a convenient and understandable manner. Typically, these devices provide a numerical or graphical display that is either wired into the same room as the meter, wired next to the main thermostat, or is a wireless panel that can be placed anywhere in the home. Alone, none of these devices save energy per se, though the information provided may enable consumer behaviour change.

In summary, new electric metering and customer interface technologies, when combined with the applicable utility infrastructure, have the potential to support a wide range of utility-sponsored peak load reduction and load shifting initiatives via pricing and promotional initiatives. Within the agreed study scope, it is not feasible to provide further specific rate design or system infrastructure specifications. However, further information is provided below on selected direct load control options.

4.5.2 Peak Load Reduction Measures – Direct Load Control

Consistent with the agreed study scope, the information provided below is based on existing secondary data sources and does not include a detailed analysis of specific peak load conditions of the Utilities. Much of the information provided draws from work that the consultant team recently completed for BC Hydro.[107] To that end, the material presented is intended to be indicative of general trends and costs but would also need to be adjusted for specific application to NLH/NP peak load conditions.[108]

The remainder of this subsection provides an overview of the following Residential sector peak load reduction measures:

- Utility control of space heating equipment using remote thermostat or switch
- Utility control of DHW heater using remote switch.

❑ Utility-Based Control of Space Heating Equipment

Utility-based control of space heating equipment can be thermostat-based or switch-based. Thermostat-based control typically applies to those applications where there is one thermostat that controls a central furnace (or air conditioner) that provides space conditioning for the entire home. Switch-based control, on the other hand, applies to those applications where space heating is provided by baseboard heaters with individual (or multiple) thermostats. As virtually all of the residential electric space heating in Newfoundland and Labrador is baseboard heating, the remainder of this discussion focuses on switch-based space heating load control.

[107] Marbek Resource Consultants and Applied Energy Group. *BC Hydro Conservation Potential Review – 2007*. Prepared for BC Hydro, 2007.

[108] As both BC Hydro and NLH/NP are winter peaking utilities and both are hydro-based with fossil fuel plants serving peak load conditions, the information provided is expected to be generally applicable to the NLH/NP context.

Switch-based space heating load control is accomplished by the installation of a remote control switch on either the heating unit itself or on the circuits controlling the heating unit. This measure primarily addresses units where temperature control is on each room unit, without a central thermostat capability. Typically this would include baseboard units with individual controls or where one or more units are controlled from an electrical circuit. Typically, units are not shut off for the entire control period but rather "cycled" to limit the on time to a predetermined number of minutes per control cycle. Installations are also equipped with an owner-operated override to ensure that the customer's comfort is not adversely impacted.

The control technology is commercially available and has been implemented in millions of sites in the U.S. However, in the overwhelming majority of applications, this control technology has been applied to air conditioning loads, not space heating loads.

The research conducted for the BC Hydro study[109] noted that switches cost approximately $285 ($170 device plus $115 installation), plus 10% annual equipment maintenance ($12/year). The installation cost is higher for the switch because it involves a high voltage connection and would thus require a higher skilled installer (in many locales this would be a licensed electrician). Installation costs are the same in both new and existing homes.

Actual peak load reduction is difficult to predict due to the impacts of customer override to mitigate adverse comfort impacts, which depend heavily on the degree of over- or under-sizing of the units as well as the overall thermal characteristics of the home. Override control is critical to ensure that customers with undersized systems, poor insulation or low tolerance for cold would not be too adversely affected.

On a household basis, the BC Hydro study concluded that the potential peak load reduction (during the 8 am to 1 pm period on a typical winter peak day) would be in the range of 0.74-0.92 kW per single-family dwelling (annual space heat load of about 13,000 kWh), assuming a comparable level of overrides and system failures to current thermostat programs. Previous experience has also shown that reductions may erode over time due to a number of factors, including signal strength losses and customer overrides.

Based on a one-time cost of approximately $285 ($170 device plus $115 installation), plus 10% annual equipment maintenance ($12/year), and estimated annual impacts of 0.74-0.92 kW per household, the BC Hydro study estimated that the cost would be in the range of about $30-$40[110] per kW/year when applied to single-family dwellings with 100% electric fuel use. Utility infrastructure costs as well as program promotion or incentive costs are in addition.

Caveat

The experience in this technology has primarily been for central air conditioning and water heater load control. As there are no customer benefits inherent in the technology, a

[109] Op. cit., BC Hydro Conservation Potential Review – 2007, p. 140.
[110] Assumes 15-year life, 6% discount rate.

cash incentive would typically be expected for each season that the measure was needed, payable either by season or by event (or both).

- **Utility Control of Domestic Hot Water Heater Using Remote Switch**

Switch-based water heater load control is accomplished by the installation of a remote control switch on either the water heater itself or on the circuits controlling the water heater. In older systems, this type of control has been accomplished via radio frequency (RF) control, which allows remote shut off of the water heater under specific capacity-constrained conditions during a limited number of pre-specified hours during winter peak months. In the systems that are currently offered, pager-based communications is used. An even more economic solution is to piggyback off an existing communications system. For example, if space heat control already exists, water heat control can be added via a hard-wired or wireless connection. This can reduce the total cost of the water heater control by up to 40%.

Depending upon the length of the control and the size of the water heater tank, units can be shut off for the entire control period or “cycled” to limit the on time to a predetermined number of minutes per control cycle. Water heat control is commercially available and implemented in hundreds of thousands of sites in the U.S.

Applicable dwelling types should have a water heater that has at least a 40-gallon tank. The size of the tank is important because it provides hot water during times when the control is in effect. The larger the water heater tank, the longer the control can be in place without disrupting the customer’s comfort.

Switches cost about $100 per unit, plus $150 for installation, plus maintenance. Costs are reduced to $150 (i.e., $50 incremental installation) if the control switch can be added to an existing control system at the same time, including one-way/two-way thermostats and switches for space heating. Installation costs are the same in both new and existing homes.[111]

On a household basis, the BC Hydro study concluded that the potential peak load reduction (during the 8 am to 1 pm period on a typical winter peak day) would be about 0.66 kW. This assumes annual DHW electricity consumption of about 3,300 kWh/yr. per household.

Based on a one-time cost of approximately $250, ongoing maintenance of 5% (about $12/year) and estimated annual impacts of 0.63-0.70 kW, the BC Hydro study estimated that the cost would be in the range of about $49-$55[112] per kW/year when applied to single-family dwellings. As an incremental option to space heating load control, the installation costs would be reduced by $100 and the resulting cost of electric peak reduction (CEPR) would be $35-$39 per kW. Utility infrastructure costs as well as program promotion or incentive costs are in addition.

[111] Op. cit., BC Hydro Conservation Potential Review – 2007, p. 146.
[112] Assumes 15-year life, 6% discount rate.

Because there are no customer benefits inherent in the technology, a cash incentive would typically be expected for each season that the measure was needed, payable either by season or by event (or both). Additional work would be required to maintain, verify and evaluate the system performance to the same degree of accuracy as two-way thermostat systems due to the lack of confirmation and higher incidence of removals and failures.

Caveat

This water heater control measure would not provide customers with any ancillary benefits and thus the only incentive for their participation would be monetary, likely on a per annum or per control event basis.

5. ECONOMIC POTENTIAL ELECTRICITY FORECAST

5.1 INTRODUCTION

This section presents the Residential sector Economic Potential Forecast for the study period 2006 to 2026. The Economic Potential Forecast estimates the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the long run avoided cost of electricity in the Newfoundland Labrador service area. In this study, "cost effective" means that the technology upgrade cost, referred to as the cost of conserved energy (CCE) in the preceding section, is equal to, or less than, the economic screen.[113]

The discussion in this section is organized according to the following sub sections:

- Avoided Cost Used for Screening
- Major Modelling Tasks
- Technologies Included in Economic Potential Forecast
- Summary of Results
- CDM Measure Supply Curves.

5.2 AVOIDED COST USED FOR SCREENING

NLH has determined that the primary avoided costs of new electricity supply to be used for this analysis are \$0.0980/kWh for the Island and Isolated service region and \$0.0432/kWh for the Labrador Interconnected service region. These avoided costs represent a future in which the Lower Churchill project is not built and there is no DC link from Labrador to the Island.[114]

Therefore, the Economic Potential Forecast incorporates all the CDM measures reviewed in Section 4 that have a CCE equal to or less than the avoided costs.

NLH is currently studying the Lower Churchill/DC Link project. However, a decision on whether to proceed is not expected until 2009 and, even if the project proceeds, the earliest completion date would be in late 2014. This means that, regardless of the decision, the avoided cost values shown above will be in effect until the approximate mid point of the study period.

If the Lower Churchill/DC Link project does proceed, the avoided costs presented above are expected to change. To provide insight into the potential impacts of the Lower Churchill/DC Link project on this study, it was agreed that the consultants would provide a high-level sensitivity analysis.

[113] Costs related to program design and implementation are not yet included.
[114] The avoided costs draw on the results of the earlier study conducted by NERA Economic Consulting, which is entitled: Newfoundland and Labrador Hydro. *Marginal Costs of Generation and Transmission*. May 2006. The avoided costs used in this study include generation, transmission and distribution.

5.3 MAJOR MODELLING TASKS

By comparing the results of the Residential sector Economic Potential Electricity Forecast with the Reference Case, it is possible to determine the aggregate level of potential electricity savings within the Residential sector, as well as identify which specific dwelling and end uses provide the most significant opportunities for savings.

To develop the Residential sector Economic Potential Forecast, the following tasks were completed:

- The CCE for each of the energy-efficient upgrades presented in Exhibits 4.2 and 4.3 were reviewed, using the 6% (real) discount rate. [115]

- Technology upgrades that had a CCE equal to, or less than, the avoided cost threshold were selected for inclusion in the economic potential scenario, either on a “full cost” or “incremental” basis. It is assumed that technical upgrades having a “full cost” CCE that met the cost threshold were implemented in the first forecast year. It is assumed that those upgrades that only met the cost threshold on an “incremental” basis are being introduced more slowly as the existing stock reaches the end of its useful life.

- Electricity use within each of the dwelling types was modelled with the same energy models used to generate the Reference Case. However, for this forecast, the remaining “baseline” technologies included in the Reference Case forecast were replaced with the most efficient “technology upgrade option” and associated performance efficiency that met the cost threshold of $0.0980/kWh for the Island and Isolated service region and $0.0432/kWh for the Labrador Interconnected service region.

- When more than one upgrade option was applied to a given end use, the first measure selected was the one that reduced the electrical load. For example, measures to reduce the overall DHW load (e.g., low-flow showerheads and more efficient dishwashers) were applied before the heat pump water heater. Similarly, the cost effectiveness of the heat pump water heater was tested at the new, lower annual load and included only if it continued to meet the CCE threshold.

- The economic potential analysis includes full consideration of interaction between measures and interaction between end uses. Measures applied to the same end use are applied sequentially, so that there is no “double-counting” of savings. The second measure applied to an end use takes its savings from the energy consumption remaining after the first measure has been applied. Interaction between end uses affects space heating, because measures that reduce internal loads (lighting, appliances, electronics, etc.) tend to increase the space heating consumption. In extreme cases, where few space heating measures are applied and the savings in other end uses are large, the space heating may actually increase.

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[115] See Section 4.2.

- A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC Link.

5.4 TECHNOLOGIES INCLUDED IN ECONOMIC POTENTIAL FORECAST

Exhibits 5.1 and 5.2 provide a listing of the technologies selected for inclusion in this forecast for, respectively, the Island and Isolated and Labrador Interconnected service regions. In each case, the exhibits show the following:

- End use affected
- Upgrade option(s) selected
- Dwelling types to which the upgrade options were applied
- Rate at which the upgrade options were introduced into the stock.

Exhibit 5.1: Technologies Included in Economic Potential Forecast for the Island and Isolated Service Region

End Use	Upgrade Option	Applicability of Upgrade Options by Dwelling Type	Rate of Stock Introduction
Existing Building Envelope	ENERGY STAR Windows	Detached and Attached	New construction, immediate Existing homes, at rate of window replacement
	Super high-performance windows	Detached and Attached	New construction, immediate Existing homes, at rate of window replacement
	Air leakage sealing	Detached and Attached	Immediate
	Attic insulation	Detached and Attached	Immediate
	Wall insulation	Detached and Attached	Immediate where insulation can be blown in; where rigid foam external insulation is needed, at rate of siding replacement
	Foundation insulation	Detached and Attached	At rate of installation or replacement of finished basement walls
New Building Design	New house designed to an EG80 rating	Detached and Attached	Immediate
	New apartment building designed to 40% better energy consumption than current standard	Apartment	Immediate
Space Heating and Ventilation Equipment	Efficient (programmable and highly accurate) thermostats	All Residential	Immediate
	High-efficiency HRV	Detached and Attached	New construction, immediate Existing homes, at rate of unit replacement
	Cold climate heat pumps	Apartment	Immediate in new construction
Domestic Hot Water	DHW pipe wrap	Detached and Attached	Immediate
	Low-flow shower heads and faucets	All Residential	Immediate
Major Appliances	ENERGY STAR fridge	All Residential	At rate of unit replacement
	Energy-efficient freezer	All Residential	At rate of unit replacement
	ENERGY STAR top loading clothes washer	All Residential	At rate of unit replacement
Lighting	CFLs, including both standard and specialized	All Residential	Immediate
	LED holiday lights	All Residential	At rate of unit replacement
	Outdoor lighting timer	Detached and Attached	Immediate
	Motion sensor	Detached and Attached	Immediate
	T8 lighting in common areas	Apartment	New construction, immediate Existing, at rate of renovation
Computers & Peripherals	ENERGY STAR computer	All Residential	At rate of unit replacement
	Reduce standby losses	All Residential	Immediate
Television	ENERGY STAR TV	All Residential	At rate of unit replacement
	Reduce standby losses	All Residential	Immediate

End Use	Upgrade Option	Applicability of Upgrade Options by Dwelling Type	Rate of Stock Introduction
Television Peripherals	Reduce standby losses	All Residential	Immediate
Other Electronics	Reduce standby losses	All Residential	Immediate

Exhibit 5.2: Technologies Included in Economic Potential Forecast for the Labrador Interconnected Service Region

End Use	Upgrade Option	Applicability of Upgrade Options by Dwelling Type	Rate of Stock Introduction
Existing Building Envelope	ENERGY STAR Windows	Detached and Attached	New construction, immediate Existing homes, at rate of window replacement
	Super high-performance windows	Detached and Attached	New construction, immediate Existing homes, at rate of window replacement
	Air leakage sealing	Detached and Attached	Immediate
	Attic insulation	Detached and Attached	Immediate
	Wall insulation	Detached and Attached	Immediate where insulation can be blown in; where rigid foam external insulation is needed, at rate of siding replacement
	Foundation insulation	Detached and Attached	At rate of installation or replacement of finished basement walls
Space Heating and Ventilation Equipment	Efficient (programmable and highly accurate) thermostats	All Residential	Immediate
	Cold climate heat pumps	Apartment	Immediate in new construction
Domestic Hot Water	DHW pipe wrap	Detached and Attached	Immediate
	Low-flow shower heads and faucets	All Residential	Immediate
Lighting	CFLs, standard only	All Residential	Immediate
	Outdoor lighting timer	Detached and Attached	Immediate
	Motion sensor	Detached and Attached	Immediate
	T8 lighting in common areas	Apartment	New construction, immediate Existing, at rate of renovation
Computers & Peripherals	ENERGY STAR computer	All Residential	At rate of unit replacement
	Reduce standby losses	All Residential	Immediate
Television	Reduce standby losses	All Residential	Immediate
Television Peripherals	Reduce standby losses	All Residential	Immediate
Other Electronics	Reduce standby losses	All Residential	Immediate

5.5 SUMMARY OF RESULTS[116]

This section compares the Reference Case and Economic Potential Electricity Forecast levels of residential electricity consumption for the two service regions. In each case, the results are presented as electricity savings that would occur at the customer's point-of-use. The results are presented in the following exhibits:

- Exhibits 5.3 and 5.4 present the results by end use, dwelling type and milestone year for, respectively, the Island and Isolated and Labrador Interconnected service regions.

[116] All results are reported at the customer's point-of-use and do not include line losses.

Exhibit 5.3: Total Potential Electricity Savings by End Use, Dwelling Type and Milestone Year for the Island and Isolated Service Region (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	330.28	48.79	2.50	35.97		0.00	0.00		0.00	0.00	138.91	23.97	4.93	73.00	2.22	
	2016	440.92	98.72	2.86	40.89		3.23	1.70		1.44	11.95	142.22	52.60	8.43	74.69	2.18	
	2021	568.49	159.79	3.21	53.98		6.63	3.65		2.90	24.04	145.00	65.73	14.34	87.11	2.11	
	2026	688.16	223.58	3.23	67.62		9.39	5.39		4.36	36.19	147.50	80.37	21.26	87.26	2.02	
Attached	2011	40.62	0.35	0.20	4.26		0.00	0.00		0.00	0.00	16.79	3.44	0.64	14.66	0.29	
	2016	54.57	5.40	0.23	4.91		0.60	0.00		0.14	1.16	17.41	7.65	1.11	15.69	0.28	
	2021	70.22	12.49	0.26	6.61		1.25	0.00		0.29	2.36	17.99	9.69	1.91	17.11	0.28	
	2026	86.25	20.63	0.27	8.44		1.78	0.00		0.44	3.59	18.55	12.01	2.87	17.39	0.27	
Apartment	2011	27.64	3.03	0.79	2.24		0.00	0.00		0.00	0.00	8.82	2.26	0.43	9.89	0.19	
	2016	38.48	5.88	0.80	3.98		0.37	0.00		0.07	0.52	9.26	5.04	0.75	11.62	0.19	
	2021	49.82	10.03	0.81	5.80		0.84	0.00		0.13	1.06	9.68	6.43	1.30	13.55	0.19	
	2026	58.07	12.25	0.82	7.68		1.30	0.00		0.21	1.62	10.17	8.01	1.97	13.85	0.19	
Isolated	2011	5.36	0.12	0.02	0.81		0.00	0.00		0.00	0.00	3.04	0.23	0.07	1.04	0.03	
	2016	6.31	0.22	0.02	0.91		0.04	0.05		0.03	0.24	3.09	0.51	0.12	1.05	0.03	
	2021	7.49	0.33	0.02	1.19		0.08	0.11		0.05	0.47	3.14	0.63	0.20	1.22	0.03	
	2026	8.52	0.44	0.02	1.48		0.11	0.16		0.08	0.71	3.19	0.77	0.30	1.22	0.03	
Other	2011	2.16	-0.10	0.01	0.00		0.00	0.00		0.00	0.00	2.26	0.00	0.00	0.00	0.00	
	2016	2.18	-0.10	0.01	0.00		0.00	0.00		0.00	0.00	2.27	0.00	0.00	0.00	0.00	
	2021	2.18	-0.10	0.01	0.00		0.00	0.00		0.00	0.00	2.27	0.00	0.00	0.00	0.00	
	2026	2.18	-0.09	0.01	0.00		0.00	0.00		0.00	0.00	2.26	0.00	0.00	0.00	0.00	
Vacant and Partial	2011	2.98	-0.12	0.01	0.00		0.00	0.00		0.00	0.00	3.09	0.00	0.00	0.00	0.00	
	2016	2.96	-0.11	0.01	0.00		0.00	0.00		0.00	0.00	3.06	0.00	0.00	0.00	0.00	
	2021	2.93	-0.11	0.01	0.00		0.00	0.00		0.00	0.00	3.03	0.00	0.00	0.00	0.00	
	2026	2.91	-0.10	0.01	0.00		0.00	0.00		0.00	0.00	3.00	0.00	0.00	0.00	0.00	
TOTAL	2011	409.05	52.07	3.51	43.28		0.00	0.00		0.00	0.00	172.91	29.89	6.07	98.59	2.73	
	2016	545.41	110.01	3.93	50.69		4.25	1.76		1.67	13.86	177.31	65.80	10.40	103.04	2.69	
	2021	701.13	182.43	4.32	67.57		8.80	3.76		3.37	27.93	181.11	82.48	17.76	118.99	2.61	
	2026	846.09	256.72	4.36	85.22		12.58	5.55		5.09	42.11	184.67	101.17	26.40	119.72	2.50	

Notes: 1) Savings for dishwasher and clothes washer are for mechanical energy only; hot water savings are reported in DHW. All savings at customer's point-of-use. 2) Any differences in totals are due to rounding. 3) Negative values in the space heating end use for "Other" and "Vacant and Partial" dwellings are a result of interaction between end uses; the reduction in internal heat gains due to lighting measures is greater than the savings from space heating measures.

Exhibit 5.4: Total Potential Electricity Savings by End Use, Dwelling Type and Milestone Year for the Labrador Interconnected Service Region (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	33.69	24.78	0.02	1.73							4.62	0.61	0.12	1.76	0.05	
	2016	40.43	31.36	0.02	1.09							4.69	1.33	0.11	1.78	0.05	
	2021	47.92	38.46	0.02	0.81							4.76	1.65	0.11	2.06	0.05	
	2026	55.82	46.22	0.02	0.53							4.82	2.01	0.11	2.06	0.05	
Attached	2011	6.39	3.29	0.01	0.53							1.42	0.21	0.04	0.87	0.02	
	2016	8.05	4.84	0.01	0.33							1.44	0.47	0.04	0.91	0.02	
	2021	9.87	6.55	0.01	0.25							1.46	0.58	0.04	0.97	0.02	
	2026	11.80	8.42	0.01	0.16							1.48	0.71	0.03	0.97	0.02	
Apartment	2011	0.60	0.11	0.01	0.06							0.20	0.02	0.01	0.20	0.00	
	2016	0.72	0.19	0.01	0.05							0.20	0.03	0.01	0.23	0.00	
	2021	0.84	0.27	0.01	0.04							0.21	0.04	0.01	0.26	0.00	
	2026	0.93	0.36	0.01	0.03							0.22	0.05	0.01	0.26	0.00	
Other	2011	0.19	0.09	0.00	0.00							0.10	0.00	0.00	0.00	0.00	
	2016	0.19	0.09	0.00	0.00							0.10	0.00	0.00	0.00	0.00	
	2021	0.20	0.10	0.00	0.00							0.10	0.00	0.00	0.00	0.00	
	2026	0.20	0.10	0.00	0.00							0.10	0.00	0.00	0.00	0.00	
TOTAL	2011	40.87	28.27	0.04	2.32							6.33	0.84	0.17	2.83	0.07	
	2016	49.39	36.48	0.04	1.47							6.43	1.83	0.16	2.91	0.07	
	2021	58.82	45.37	0.04	1.10							6.52	2.27	0.15	3.29	0.07	
	2026	68.75	55.09	0.04	0.73							6.62	2.77	0.15	3.29	0.07	

Notes: 1) Savings for dishwasher and clothes washer are for mechanical energy only; hot water savings are reported in DHW. All savings at customer's point-of-use. 2) Any differences in totals are due to rounding.

5.5.1 Interpretation of Results

Highlights of the results presented in the preceding exhibits are summarized below.

❑ **Electricity Savings by Service Region**

The Island and Isolated service region accounts for 92% of the potential savings.

❑ **Electricity Savings by Milestone Year**

Approximately 48% of the savings are available by the first milestone year because some of the efficiency upgrades are economically attractive at full replacement cost. Under the economic scenario, therefore, they are implemented immediately.

❑ **Electricity Savings by Segment**

Single-family detached dwellings account for more than 80% of the potential savings, which reflects their dominant market share within the overall Residential sector and their generally higher electrical intensity per dwelling.

❑ **Electricity Savings by End Use – Island and Isolated Service Region**

- Space heating accounts for 30% of the total electricity savings in the Economic Potential Forecast. Of this, approximately 53% come from foundation insulation, 13% come from more efficient windows, 9% come from programmable thermostats and 8% come from improved new building design. It should be noted that space heating savings are substantially reduced by decreases in internal loads associated with savings to electronics, lighting and appliances within the home.

- The new buildings account for a larger fraction of space heating savings than of other end use savings. Savings in new buildings are 37% of space heating savings, whereas savings in new buildings are 21% of overall savings. This is because the new building design measures save a disproportionate amount of space heating energy.

- Four electronic end uses (computers, televisions, television peripherals and other electronics) account for 30% of the total electricity savings in the Economic Potential Forecast. Of this, reducing standby losses accounts for 58% of the savings and ENERGY STAR computers account for 34%.

- Savings from lighting account for 22% of the total electricity savings in the Economic Potential Forecast. Of this, compact fluorescent lamps (both standard and specialized) account for over 90% of the savings.

- DHW accounts for 10% of the total electricity savings in the Economic Potential Forecast. Of this, nearly 83% are from DHW savings associated with ENERGY STAR clothes washers.

- **Electricity Savings by End Use – Labrador Interconnected Service Region**

- Space heating accounts for 81% of the total electricity savings in the Economic Potential Forecast. Approximately 67% of space heating savings are from foundation insulation and approximately 23% are from air leakage sealing.

- Lighting and the four electronic end uses referred to above each account for approximately 9% of the savings in the Economic Potential Forecast.

- Appliance measures are not included in the economic potential results for the Labrador Interconnected Service Region. The lower electricity rates in that region caused those measures to fail the CCE test.

5.5.2 Caveats

A systems approach was used to model the energy impacts of the CDM measures presented in the preceding section. In the absence of a systems approach, there would be double counting of savings and an accurate assessment of the total contribution of the energy-efficient upgrades would not be possible. More specifically, there are two particularly important considerations:

- **More than one upgrade may affect a given end use**. For example, improved insulation reduces space heating electricity use, as does the installation of new energy-efficient windows. On its own, each measure will reduce overall space heating electricity use. However, the two savings are not additive. The order in which some upgrades are introduced is also important. In this study, the approach has been to select and model the impact of "bundles of measures" that reduce the load for a given end use (e.g., wall insulation and window upgrades that reduce the space heating load) and then to introduce measures that meet the remaining load more efficiently (e.g., a high-efficiency space heating system).

- **There are interactive effects among end uses**. For example, the electricity savings from more efficient appliances and lighting result in reduced waste heat. During the space heating season, this appliance and lighting waste heat contributes to the building's internal heat gains, which lower the amount of heat that must be provided by the space heating system.

- The magnitude of the interactive effects can be significant. Based on selected building energy use simulations, a 100 kWh savings in appliance or lighting electricity use could result in an increased space heating load of 50 to 70 kWh, depending on housing dwelling type and geographical location. This is higher than the ratio of approximately 0.5 more typical of other jurisdictions. It is credible that the fraction would be higher in Newfoundland and Labrador because it is dependent more on the length of the heating season than on its severity. Newfoundland and Labrador experience more months in which heating is required than most other jurisdictions in Canada. Nonetheless, given that some fraction of the heat energy from lighting and other end uses escapes to the outside, the simulation may somewhat overstate the interaction. A ratio of 0.6 has been incorporated into the model to account for this uncertainty.

5.5.3 Sensitivity Analysis – Alternative Avoided Costs

A sensitivity analysis was conducted using preliminary avoided cost values that assume development of the Lower Churchill/DC link. The sensitivity analysis reviewed the scope of measures that would pass or fail the economic screen under the changed avoided costs. Based on the preliminary avoided cost values assessed, the analysis concluded that any impacts would be modest.

5.6 CDM MEASURE SUPPLY CURVES

A supply curve was constructed for each of the two service regions based on the economic potential savings associated with the above measures. The following approach was followed:

- Measures are introduced in sequence to see incremental impact and cost
- Sequence is determined by principle of 1) reduce load 2) meeting residual load with most efficient technology
- Is organized by CCE levels.

Exhibits 5.5 and 5.6 show the supply curves for, respectively, the Island and Isolated and the Labrador Interconnected service regions. Exhibits 5.7 and 5.8 show the measures included in each of the supply curves.

Exhibits 5.5 and 5.6 both show measures with CCEs above the thresholds for the two regions. This is because the economic screening process did not consider either interaction between measures or interaction between end uses. All measures were included in the analysis if their CCE values were below the threshold, excluding interactive effects. In the economic potential analysis itself, however, these interactive effects are included in full. Measures that apply to the same end use are applied in sequence, as described above, substantially reducing the savings available to those applied later. Furthermore, measures that reduce the internal heat loads produced by lighting, electronics and appliances tend to increase the need for space heating. This space heating penalty is applied against the savings from those measures. For consistency with previous exhibits, the supply curve shows all the measures that were included in the economic potential analysis, including those that now exceed the economic threshold.

Exhibit 5.5: Supply Curve for Residential Sector, Island and Isolated Service Region, 2026

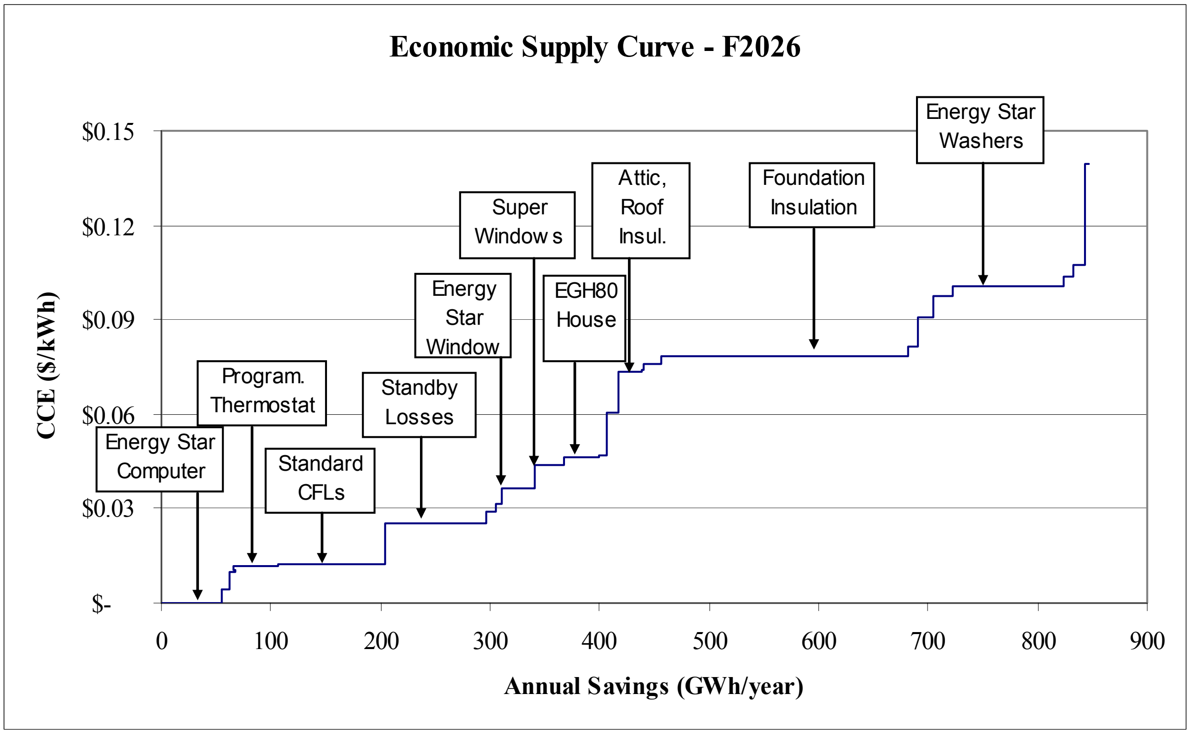


Exhibit 5.6: Supply Curve for Residential Sector, Labrador Interconnected Service Region, 2026

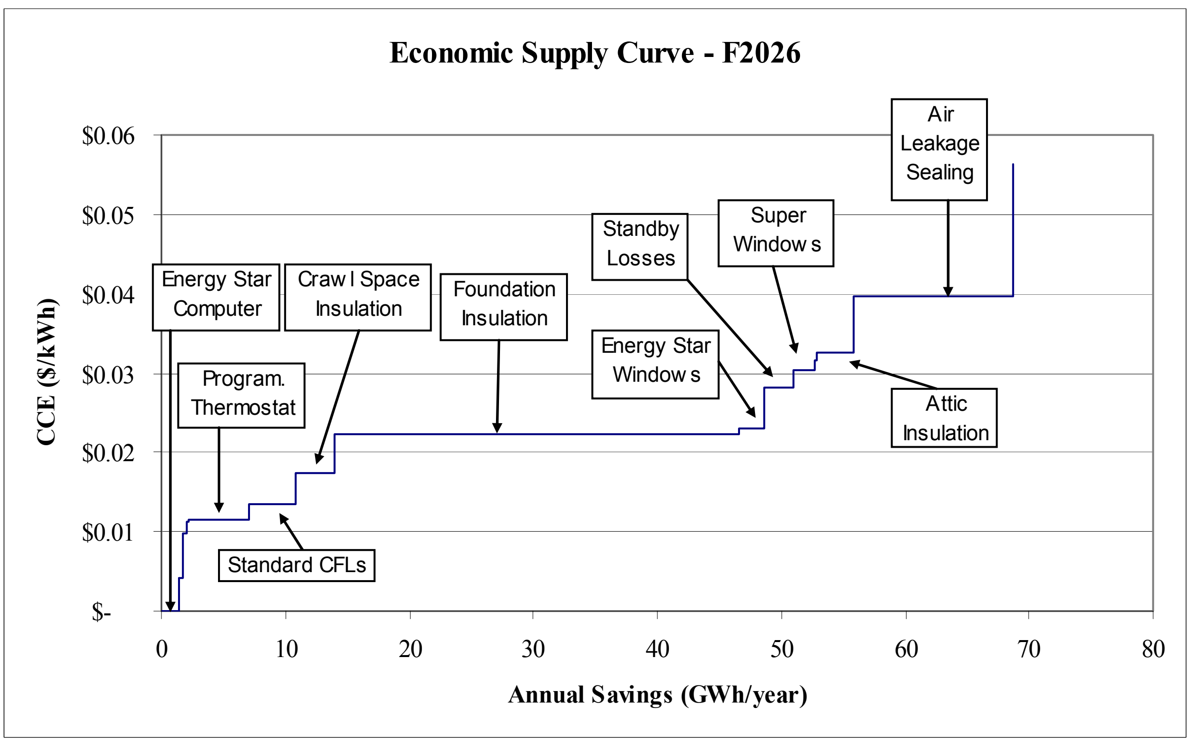


Exhibit 5.7: Summary of Residential Sector Energy-efficiency Measures, Island and Isolated Service Region 2026[117]

Measure	Average CCE ($/kWh)	Annual Savings (GWh/year)
Energy Star Computer	$0.00	55
DHW Pipe Wrap	$0.00	7
Low-Flow Showerheads and Faucets	$0.01	6
Standard T8 Lighting - Common Areas	$0.01	0.1
25% Lower Energy Apartment Building	$0.01	-1
Programmable Thermostats	$0.01	40
CFLs - Standard	$0.01	97
Standby Losses	$0.03	92
Crawl-space Insulation	$0.03	10
40% Lower Energy Apartment Building	$0.03	4
Timer	$0.03	1
Energy Star Windows , Advanced Glazing	$0.04	29
Super High Performance Windows	$0.04	28
New House Designed to an EGNH 80 Rating	$0.05	32
Building recommissioning	$0.05	6
Motion Sensor	$0.05	1
Air Source Heat Pump	$0.06	11
Ground Source Heat Pump	$0.07	0.4
Attic Insulation, Roof Insulation	$0.07	21
Wall Insulation	$0.07	1
High Efficiency HRV	$0.08	16
Foundation Insulation	$0.08	225
Energy Star Fridge	$0.08	8
Redesign with high performance T8s	$0.09	1
Energy Star TV	$0.09	13
Air Leakage Sealing	$0.10	19
Energy Star Top Loading Clothes Washer	$0.10	102
LED Holiday Lights	$0.10	9
CFLs Specialised	$0.11	10
Energy Efficient Freezer	$0.14	4

[117] The above exhibit includes measures with a CCE that exceeds the study's avoided cost threshold. The increased CCE is due to the impact of interactive effects. The measures are shown to maintain consistency with previous exhibits. The inclusion of interaction between measures has a particularly large effect on space heating savings. More efficient lighting and appliances contribute less waste heat to the home and therefore the space heating requirement is greater. In the 25% Lower Energy Apartment Building, for example, the savings in space heating energy are actually overwhelmed by the increased load because the lights and appliances are more efficient. This is less of an issue in Labrador, where fewer appliance measures pass the economic screen.

Exhibit 5.8: Summary of Residential Sector Energy-efficiency Measures, Labrador Interconnected Service Region 2026[118]

Measure	Average CCE ($/kWh)	Annual Savings (GWh/year)
Redesign with high performance T8s	-$0.03	0.004
Energy Star Computer	$0.00	1
DHW Pipe Wrap	$0.00	0.4
Low-Flow Showerheads and Faucets	$0.01	0.3
25% Lower Energy Apartment Building	$0.01	0.1
Standard T8 Lighting - Common Areas	$0.01	0.002
Programmable Thermostats	$0.01	5
CFLs - Standard	$0.01	4
Crawl-space Insulation	$0.02	3
Foundation Insulation	$0.02	33
Energy Star Windows , Advanced Glazing	$0.02	2
Standby Losses	$0.03	2
Super High Performance Windows	$0.03	2
40% Lower Energy Apartment Building	$0.03	0.1
Attic Insulation, Roof Insulation	$0.03	3
Timer	$0.04	0.02
Air Leakage Sealing	$0.04	13
Building recommissioning	$0.04	0.1
Motion Sensor	$0.06	0.03

[118] The above exhibit includes measures with a CCE that exceeds the study's avoided cost threshold. The increased CCE is due to the impact of interactive effects. The measures are shown to maintain consistency with previous exhibits. The measure for redesign with high-performance T8s has a negative CCE for the Labrador Interconnected service region because the only circumstance under which it passes for Labrador is when a renovation is planned that already involves lighting replacement. The advanced T8s with redesign would incorporate fewer fixtures than a standard lighting replacement and therefore capital cost would actually be lower. In the Island and Isolated service region, there would certainly be cases where the measure would be installed as part of an already planned renovation (and hence would have a negative incremental cost), but the measure passes at full cost as well, so the average CCE is $0.09/kWh.

6. ACHIEVABLE POTENTIAL

6.1 INTRODUCTION

This section presents the Residential sector Achievable Potential electricity savings for the study period (2006 to 2026). The Achievable Potential is defined as the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to the Estimation of Achievable Potential
- Workshop Results
- Summary of Achievable Electricity Savings
- Peak Load Impacts.

6.2 DESCRIPTION OF ACHIEVABLE POTENTIAL

Achievable Potential recognizes that it is difficult to induce all customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

- Higher first cost of efficient product(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Lack of product availability
- Consumer awareness.

The rate at which customers accept and purchase energy-efficient products can be influenced by a variety of factors including the level of financial incentives, information and other measures put in place by the Utilities, governments and the private sector to remove barriers such as those noted above.

Exhibit 6.1 presents the level of electricity consumption that is estimated in the Achievable Potential scenarios. As illustrated, the Achievable Potential scenarios are “banded” by the two forecasts presented in previous sections, namely, the Economic Potential Forecast and the Reference Case.

Electricity savings under Achievable Potential are typically less than in the Economic Potential Forecast. In the Economic Potential Forecast, efficient new technologies are assumed to fully penetrate the market as soon as it is financially attractive to do so. However, the Achievable Potential recognizes that under “real world” conditions, the rate at which customers are likely to implement new technologies will be influenced by additional practical considerations and will, therefore, occur more slowly than under the assumptions employed in the Economic Potential Forecast. Exhibit 6.1 also shows that future electricity consumption under the Reference Case is greater than in either of the two Achievable Potential forecasts. This is because the Reference Case represents a "worst case" situation in which there are no additional utility market interventions and hence no additional electricity savings beyond those that occur "naturally."

Exhibit 6.1 presents the achievable results as a band of possibilities, rather than a single line. This recognizes that any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty and that there are different levels of potential CDM program intervention.

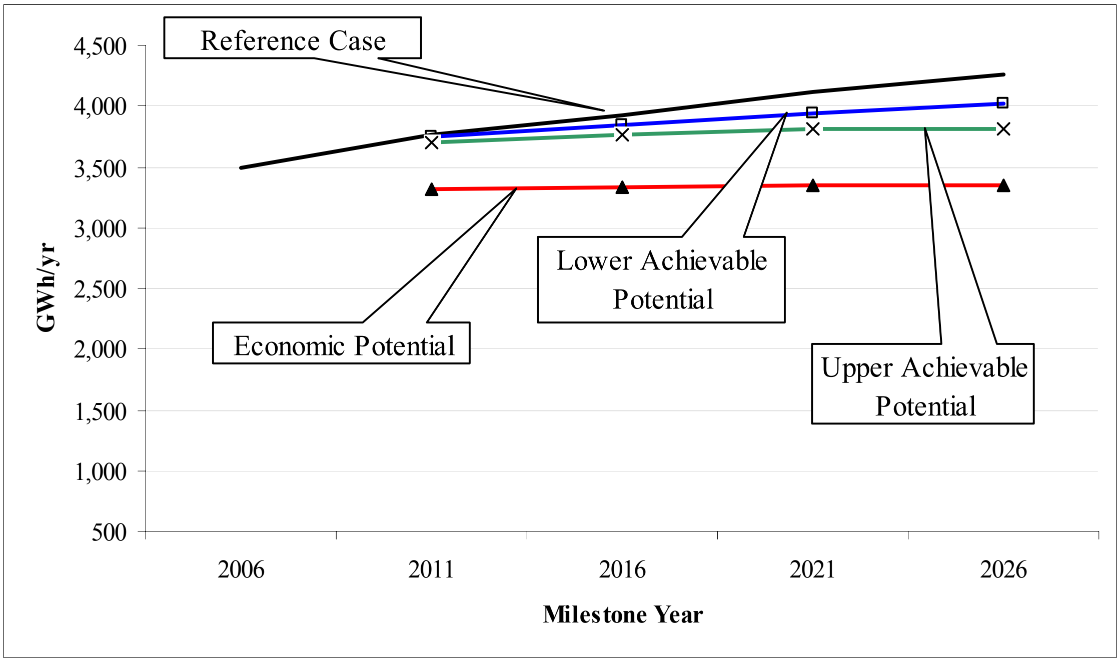
- **The Upper Achievable Potential** assumes both an aggressive program approach and a very supportive context, e.g., healthy economy, very strong public commitment to climate change mitigation, etc.

  However, the Upper Achievable Potential scenario also recognizes that there are limits to the scope of influence of any electric utility. It recognizes that some markets or submarkets may be so price sensitive or constrained by market barriers beyond the influence of CDM programs that they will only fully act if forced to by legal or other legislative means. It also recognizes that there are practical constraints related to the pace that existing inefficient equipment can be replaced by new, more efficient models or that existing building stock can be retrofitted to new energy performance levels

  For the purposes of this study, the Upper Achievable Potential can, informally, be described as: "*Economic Potential less those customers that "can't" or "won't" participate."*

- **The Lower Achievable Potential** assumes that existing CDM programs and the scope of technologies addressed are expanded, but at a more modest level than in the Upper Achievable Potential. Market interest and customer commitment to energy efficiency and sustainable environmental practices remain approximately as current. Similarly, federal, provincial and municipal government energy-efficiency and GHG mitigation efforts remain similar to the present.

Exhibit 6.1: Annual Electricity Consumption – Illustration of Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Residential Sector (GWh/yr.)



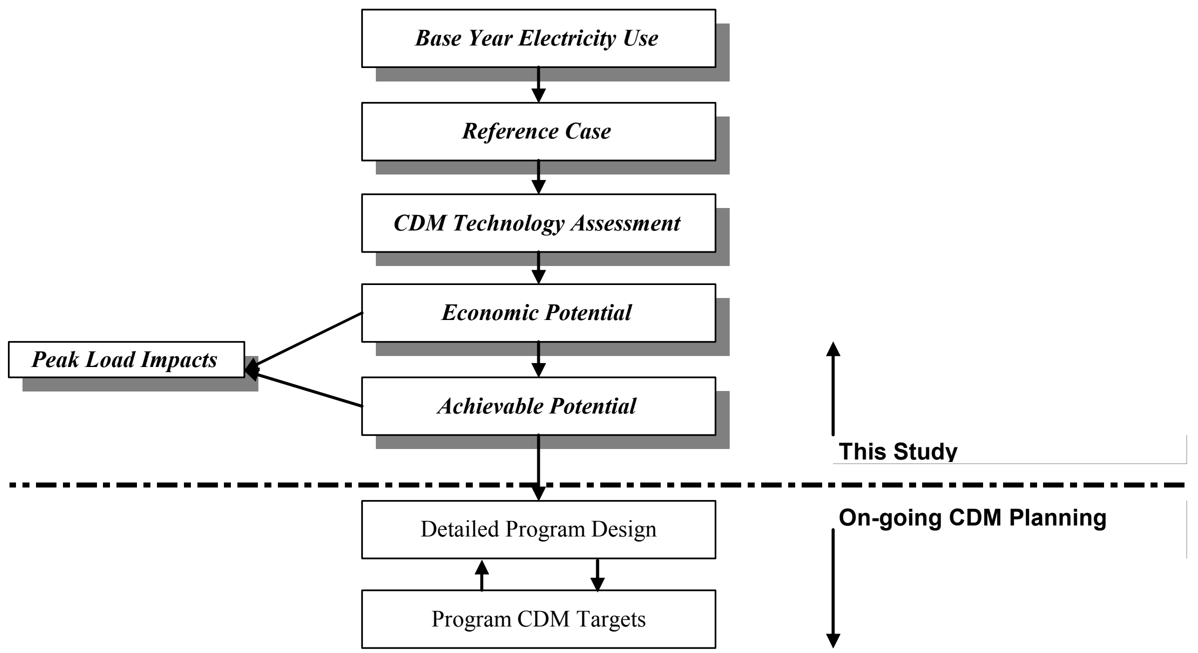
❑ Achievable Potential versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.[119]

Exhibit 6.2 illustrates the relationship between Achievable Potential and the more detailed program design.

[119] The Achievable Potential savings assume program start-up in 2007. Consequently, electricity savings in the first milestone year of 2011 will need to be adjusted to reflect actual program initiation dates. This step will occur during the detailed program design phase, which will follow this study.

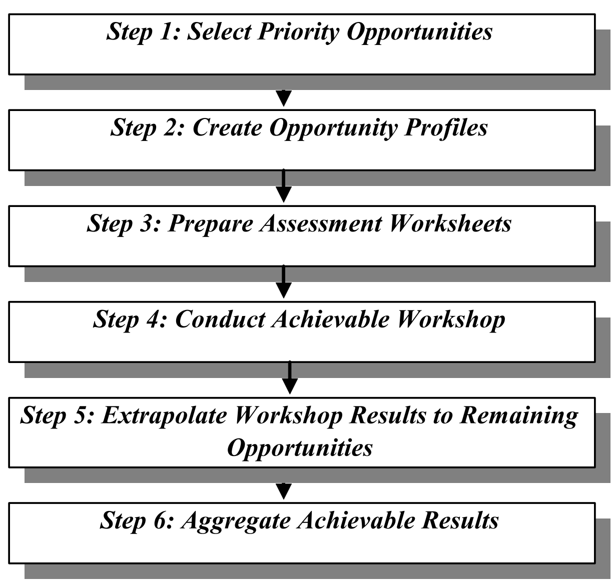
Exhibit 6.2: Achievable Potential versus Detailed Program Design



6.3 APPROACH TO THE ESTIMATION OF ACHIEVABLE POTENTIAL

Achievable Potential was estimated in a six-step approach. A schematic showing the major steps is shown in Exhibit 6.3 and each step is discussed below.

Exhibit 6.3: Approach to Estimating Achievable Potential



- **Step 1: Select Priority Opportunities**

The first step in developing the Achievable Potential estimates required that the energy saving opportunities identified in the Economic Potential Forecasts be "bundled" into a set of opportunity areas that would facilitate the subsequent assessment of their potential market penetration.

The amount of time available in the Achievable Potential workshop for the discussion of energy-efficiency opportunities was limited. Consequently, the energy-efficiency opportunity areas shown in Exhibit 6.4 were selected based primarily on the basis that they represent a significant portion of the energy savings potential identified in the Economic Potential Forecast. Where two or more opportunities offered similar levels of potential energy savings, consideration was also given to whether discussion of the selected opportunity area in the workshop would provide insights into the participation rates to be used for related opportunities that could not be covered during the workshop.

Nine energy-efficiency opportunity areas were selected for discussion in the Residential sector workshop that was held on October 30, 2007. Exhibit 6.4 identifies the opportunity areas and shows the approximate percentage that each represents of the total Residential sector potential contained in the Economic Potential Forecast.

Exhibit 6.4: Residential Sector Opportunity Areas

Opportunity Area	Title	Approximate % of Economic Savings Potential
R1	Programmable thermostats	5%
R2	Convert incandescent lighting to CFL	11%
R3	Foundation insulation	28%
R4	Air leakage sealing	3%
R5	Efficient windows	6%
R6	EnerGuide 80 (EG80) for new housing	3%
R7	Power bar with integrated timer	10%
R8	ENERGY STAR computer	6%
R9	ENERGY STAR clothes washer	11%
	Total	83%

- **Step 2: Create Opportunity Profiles**

The next step involved the development of brief profiles for the priority opportunity areas noted above in Exhibit 6.4. A sample profile for Opportunity R1 (programmable thermostats) is presented in Exhibit 6.5; the remaining Opportunity Profiles are provided in Appendix B.

The purpose of the Opportunity Profiles was to provide a "high-level" logic framework that would serve as a guide for participant discussions in the achievable workshop. These Profiles state technical and program assumptions upon which to base an estimate of potential market penetration. The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project.

Exhibit 6.5: Sample Opportunity Profile

R1: Programmable Thermostat

Overview:

Digital programmable thermostats provide improved temperature setting accuracy and are capable of multiple time settings. When combined with an assumed 4ºC temperature setback during night and unoccupied periods, typical space heat savings are in the range of 10% to 15% relative to the baseline, depending on the type of dwelling and its vintage.

Other utility studies have indicated that a lower savings percentage should be used to reflect the fact that the thermostat's setback capabilities do not completely reflect how they are used, e.g., some home occupants reliably set back manual thermostats, and some home occupants do not use the setback features on their electronic thermostats. Accordingly a value of 6% savings has been used in this study.

Target Technologies and Dwelling Types:

- The programmable setback thermostat is a mature technology
- This technology is applicable to all dwelling types but is most easily applied where a limited number of thermostats can be used to control all the heating devices in the dwelling.

Opportunity Costs and Savings Profile:

- This technology is assumed to cost an average of $70 per dwelling.
- In single-family dwellings with baseboard electric heating, it is possible, in most cases, to combine more than one baseboard per thermostat so that three to four thermostats can be used.[120] In dwellings with forced air systems, one thermostat will usually control the whole dwelling.
- Customer payback is approximately one year, somewhat longer in Labrador.
- The CCE for this measure in detached dwellings ranges from 0.6 in Labrador to 1.2 on the Island, or somewhat higher for attached dwellings and apartments.
- Potential energy performance or technology price trends affecting this opportunity include:
- Pricing and performance are relatively stable for this technology.
- For homes with a need for more thermostats because of multiple baseboards, another option is the high-efficiency (more accurate) thermostat, which is lower cost but is still expected to save approximately 3%.
- There is added uncertainty in the savings estimates for this technology because of the behavioural aspect.

Target Audience(s)& Potential Delivery Allies:

- Homeowners and renters
- HVAC contractors and retailers

Constraints & Challenges:

- Some consumers still think a thermostat behaves like a gas pedal (the higher you set it, the faster the house warms up!)
- Tendency for some users to override the setback
- Installation is simple for central thermostats on 24-V loops, but not for in-line thermostats controlling a powerful baseboard.

Opportunities & Synergies:

- Could build on/expand previous thermostat rebate programs
- Could be offered in conjunction with other programs, through trade allies or even used as a premium to entice consumers to participate in other programs
- Amenable to use of point-of-sale rebates or other in-store promotions.

Experience Related to Possible Participation Rates:

[120] Workshop discussion found that the use of one thermostat to control multiple baseboard heaters was rarely practical.

As illustrated in Exhibit 6.5, each Opportunity Profile addresses the following areas:

- ***Overview*** – provides a summary statement of the broad goal and rationale for the opportunity.
- ***Target Technologies and Dwelling Types*** **–** highlights the major technologies and the dwelling types where the most significant opportunities have been identified in the Economic Potential Forecast.
- ***Opportunity Costs and Savings Profile*** – provides information on the financial attractiveness of the opportunity from the perspective of both the customer and NLH or NP.
- ***Target Audiences and Potential Delivery Allies*** – identifies key market players that would be expected to be involved in the actual delivery of services. The list of stakeholders shown is intended to be "indicative" and is by no means comprehensive.
- ***Constraints and Challenges*** **–** identifies key market barriers that are currently constraining the increased penetration of energy-efficient technologies or measures. Interventions for addressing the identified barriers are noted. Again, it is recognized that the interventions are not necessarily comprehensive; rather, their primary purpose was to help guide the workshop discussions.
- ***Opportunities and Synergies*** **–** identifies information or possible synergies with other opportunities that may affect workshop participant views on possible customer participation rates.
- ***Experience Related to Possible Participation Rates*** – provides benchmark data on the past performance of the Utilities' programs, where available.

❑ **Step 3: Prepare Draft Opportunity Assessment Worksheets**

A draft Assessment Worksheet was prepared for each Opportunity Profile in advance of the workshop. The Assessment Worksheets complemented the information contained in the Opportunity Profiles by providing quantitative data on the potential energy savings for each opportunity as well as providing information on the size and composition of the eligible population of potential participants. Energy impacts and population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

A sample Assessment Worksheet for Opportunity R1 – Programmable Thermostats is presented in Exhibit 6.6 (worksheets for the remaining opportunity areas are provided in Appendix B). As illustrated in Exhibit 6.6, each Assessment Worksheet addresses the following areas:

- ***Economic Potential Annual Savings*** **–** shows the total economically attractive potential for electricity savings, by milestone period, for the measures included in the opportunity area.

- ***Cumulative Thousands of Dwellings Affected*** – shows the total population of potential participants that could theoretically take part in the opportunity area. Numbers shown are from the eligible populations used in the Economic Potential Forecasts. The definition of "participant" varies by opportunity area. In the example shown, a participant is defined as a "dwelling."

- ***Achievable Participation*** **–** show the percentage of economic savings that workshop participants concluded could be achieved in each milestone period. As noted in the introduction to this section, two achievable scenarios are shown: Lower and Upper. For example, Exhibit 6.6 shows a participation rate of 20% (Lower) and 90% (Upper) in existing single-family dwellings by the year 2026. This means that by 2026, between 20% and 90% of the potential savings contained in the Economic Potential Forecast could be achieved.

- ***Achievable Potential Annual Savings*** **–** shows the calculated electricity savings in each milestone period based on the savings and participation rates presented in the preceding columns of the Worksheet.

- ***Achievable Thousands of Dwellings Affected*** – shows the number of participants that would be affected in order to achieve the electricity savings shown.

Exhibit 6.6: Sample Residential Sector Opportunity Assessment Worksheet[121]

*R1: Space heating, Programmable Thermostats: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

					Lower Achievable Scenario						Upper Achievable Scenario					
Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Thous. Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	31	27	79	79		20%		5		16		90%		24		71
Attached	5	5	10	10												
Apartment	3	2	10	10												
Other	1	1	11	11		20%		0		2						
Total	40	35	110	109				6		18				24		71

New

Curve B

Curve C

Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Thous. Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	2	5	3	12	20%	20%	0	1	1	2	20%	20%	0	1	1	2
Attached	0	1	1	2	20%	20%	0	0	0	0	20%	20%	0	0	0	0
Apartment	0	1	1	2	20%	20%	0	0	0	0	20%	20%	0	0	0	0
Other	0	0	0	0	20%	20%	0	0	0	0	20%	20%	0	0	0	0
Total	3	7	5	16			1	1	1	3			1	1	1	3
Grand Total	42	41	114	125			1	7	1	21			1	25	1	74

NOTES:
* Includes savings of heating and ventilation.

[121] This exhibit shows the worksheet as it was after the workshop. Discussion focused on the existing detached dwellings for the Island and Isolated service region, developing Upper and Lower participation estimates for the milestone year 2026, and a curve shape between 2006 and 2026. All other percentage values shown are either left blank or are placeholders that were in the worksheet before the workshop. Only the values for existing detached Island and Isolated dwellings were transferred to the RSEEM model. Values for other types of dwellings were based on those and on the discussions with workshop participants about how participation might vary between regions, housing types, and vintages. Any differences in totals are due to rounding.

❑ Step 4: Achievable Potential Workshop

The most critical step in developing the estimates of Achievable Potential was the one-day workshop held October 30, 2007. Workshop participants consisted of core members of the consultant team, program personnel from the Utilities and local trade allies.

The purpose of this workshop was twofold:

- Promote discussion regarding the technical and market conditions confronting the identified energy-efficiency opportunities

- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

The discussion of each opportunity area began with a brief consultant presentation. The floor was then opened to participant discussion. Key areas that were explored for each opportunity area included:

- Target audiences and potential delivery allies
- Constraints, barriers and challenges
- Potential opportunities and synergies
- Estimates of Lower Achievable and Upper Achievable for milestone years
- Guidelines for consultants for extrapolating to related sub sectors.

Following discussion of the broad market and intervention conditions affecting each opportunity area, workshop participant views were recorded on Lower and Upper customer participation rates. To facilitate this portion of the workshop, the discussion of the Residential sector opportunity areas focused initially on single-family detached dwellings in the Island and Isolated service region. The following process was employed:

- The participation rate for the Upper Potential in 2026 was estimated. As noted previously, this participation rate was "roughly" defined as 100% of the Economic Potential minus the market share represented by the "can't" or 'won't" population.

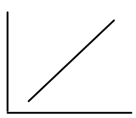
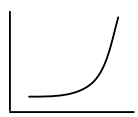
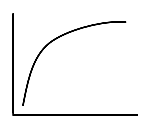
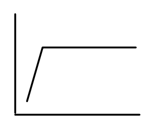
- The shape of the adoption curve was selected for the Upper scenario. Rather than seek consensus on the specific values to be employed in each of the intervening milestone years, workshop participants selected one of four curve shapes that best matched their view of the appropriate "ramp-up" rate for each opportunity.

- The preceding process was repeated for the Lower scenario.

Exhibit 6.7 shows the four curves that were used in the workshop discussions.

- **Curve A** represents a steady increase in the expected participation rate over the 20-year study period
- **Curve B** represents a relatively slow participation rate during the first half of the 20-year study period followed by a rapid growth in participation during the second half of the 20-year study period
- **Curve C** represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the 20-year study period
- **Curve D** represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first milestone period of the 20-year study period.

Exhibit 6.7: Adoption Curve Shapes (2006 to 2026)

Curve A	Curve B	Curve C	Curve D
			

Finally, as applicable, workshop participants provided guidelines to the consultants for extrapolating the results of the workshop discussion to the remaining sub sectors and service regions.

❑ Step 5: Extrapolate Workshop Results to Remaining Opportunities

As noted earlier, it was not possible to fully address all opportunities in the one-day workshop. Consequently, the workshop focused on the "big ticket" opportunities. Participation rates for the remaining opportunities were completed by the consultants, guided by the workshop results and discussions. The values shown in the summary tables incorporate the results of the two sets of inputs.

❑ Step 6: Aggregate Achievable Potential Results

The final step involved aggregating the results of the individual opportunity areas to provide a view of the potential Achievable savings for the total Residential sector.

6.4 WORKSHOP RESULTS

The following subsection provides a summary of the participation rates established by the workshop participants for each of the opportunity areas discussed during the workshop.[122] As noted previously, the Residential sector opportunity areas were:

- R1 - Programmable thermostats
- R2 - Convert incandescent lighting to CFL
- R3 - Foundation insulation
- R4 - Air leakage sealing
- R5 - Efficient windows
- R6 - EnerGuide 80 (EG80) for new housing
- R7 - Power bar with integrated timer
- R8 - ENERGY STAR computer
- R9 - ENERGY STAR clothes washer.

Further detail on each of the above opportunity areas is provided below; as applicable, the following information is provided for each:

- Summary of Upper and Lower Achievable participation rates
- Shape of Adoption Curve selected by the workshop participants
- Highlights of key issues arising during the workshop discussions
- Summary of major assumptions employed by the consultants for extrapolating the workshop results to other sub sectors.

6.4.1 R1 – Programmable Thermostats

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 90% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve C represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 20% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. Participation rates in the

[122] Measures from the Commercial sector that were applicable to apartment buildings were discussed in the commercial Achievable workshop. Refer to the companion report on the Commercial sector for details on the workshop discussions. Apartment measures discussed in the commercial Achievable workshop included: C1, Standard T8 Lighting and Redesign with High-performance T8s - Common Areas, Existing Buildings; C2, Redesign with high-performance T8s, New Buildings; C4, High-performance glazings; C5, Building recommissioning; C6, Ground source heat pumps; and C7, 40% Lower Energy Apartment Building.

Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

- Discussion focused on the high-efficiency thermostats with accuracy within 0.5ºC. Programmable thermostats were regarded as having much lower potential because of the low incidence of electrically heated houses that can be controlled with a small number of thermostats (such as one thermostat controlling a forced air system). The cost of a large number of programmable thermostats to control individual baseboards would generally not be justified.
- Behaviour is a major factor in savings from programmable thermostats (e.g., some people with manual thermostats diligently set them back, and some people with programmable thermostats do not).
- Humidity control is a concern with set-back strategies in some houses, where condensation on windows can cause damage and mould. Ability to adopt temperature setback could be a selling point for efficient windows.
- The presence of thermostats accurate to within 1ºC was estimated to be approximately 65% of existing stock, with lower penetration in rural areas. Many rural houses have baseboards installed with only the built-in thermostatic control on the baseboard itself.
- There is potential for using the high-efficiency thermostats through most of the house and installing programmable thermostats in main living areas (such as the living room or the most-used bedroom).

6.4.2 R2 – Convert Incandescent Lighting to CFLs

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 98% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 90% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve A represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

-
- There are fewer barriers to uptake of CFLs than for other measures. There is continuing improvement in quality and the suitability of lamps to more applications continues to broaden.
- There are still issues around disposal, light quality, product quality and lighting levels, some of them real and some of them perceptions based on earlier products. Workshop participants expected these issues to be addressed during the timeframe of the study.
- Uptake of CFLs has been high in Labrador. It tends to be lower in rural areas.

The preceding results were used as a reference point for estimating participation rates related to other opportunities in the Residential sector.

Highlights:

- Participation rates for standard CFLs were also applied to LED holiday lighting, motion sensors and timers.
- Participation rates for specialized CFLs were also informed by the discussion on standard CFLs.
- Other technologies that are well established in the marketplace were estimated to have similar uptake if supported by the Utilities' program activity. These included ECPM furnace fan motors, low-flow showerheads and faucets, DHW tank insulating blankets and DHW piping insulation.
- T8 lighting in apartment buildings drew on the participation rates identified during the Commercial sector workshop (see Section 6.4.1 in the companion Commercial report.

6.4.3 R3 – Insulate Foundations

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 75% in existing single-family detached homes and up to 98% in new single-family detached homes could be achieved in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B for existing homes and Curve C for new homes represented the best fits with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 25% in existing single-family detached homes and up to 55% in new single-family detached homes could be achieved in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B for existing homes and Curve A for new homes represented the best fits with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. The measure is not applicable to apartment buildings. Participation rates in the Labrador Interconnected service region were assumed to be somewhat lower than those for the Island and Isolated service region because there are fewer basements and more crawl spaces. If the program could be broadened to include crawl space insulation, overall savings potential in the Labrador Interconnected service region would be increased.

Selected highlights:

- Code for basement insulation is often ignored (up to 90%) because of lack of enforcement. Insulation is often installed within a few years as part of basement refinishing
- NP has had surprisingly good uptake for a program on foundation insulation, without a great deal of marketing. NLH has had smaller uptake in Labrador Interconnected due to the lack of financial drivers
- There were concerns about encouraging consumers to install insulation as a do-it-yourself project (e.g., consumers may not be familiar with code)
- Technical innovation is a possibility in future, lowering the installation cost and the payback.

The preceding results were used as a reference point for estimating participation rates related to other insulation opportunities in the Residential sector.

Highlights:

- Participation rates for foundation insulation were also applied to crawl space insulation
- The estimate of participation for attic insulation was also informed by the discussion of foundation insulation.

6.4.4 R4 – Seal Air Leaks

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 90% could be achieved in new single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 55% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

The workshop discussions focused on single-family detached homes and did not include consideration of other dwelling types. Participation rates in the Labrador Interconnected service region were assumed to be somewhat lower than those for the Island and Isolated service region, because of lower electricity prices.

Selected highlights:

- Opinions ranged widely on the capital cost of undertaking this upgrade, from as little as $400 to over $1,000 per house. Opinions on savings ranged from 10% of heating energy to as much as 15%
- For the purposes of discussion, reduction of leakage to 1.75 air changes per hour was considered a target
- Improved comfort in the home is likely to be an attractive selling feature.

6.4.5 R5 – Upgrade to ENERGY STAR Windows at Time of Window Replacement or New Installation

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 100% could be achieved in both existing and new single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B in existing homes and Curve C in new homes represented the best fits with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 80% in existing single-family detached homes and up to 85% in new single-family detached homes could be achieved in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B for existing homes and Curve C for new homes represented the best fits with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. The measure is replaced by the high-performance glazing commercial measure in apartment buildings. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

- Workshop participants questioned the assumption that incremental cost of high-efficiency windows in the replacement (retail) market is higher than it is in the new construction (wholesale) market. Although high mark ups on the increment are the pattern in other jurisdictions, workshop participants said that retailers in Newfoundland and Labrador are not following that pattern. The measure already passes the economic screens with the current assumptions so this change would not increase the potential.

The preceding results were used as a reference point for estimating participation rates related to other window opportunities in the Residential sector.

Highlights:

- Participation rates for the super high-performance windows were assumed to trail participation rates for ENERGY STAR windows by approximately 10 years.

6.4.6 R6 – Construct New Houses to Achieve EG80 Rating

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 98% could be achieved in new single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve D represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario. Curve D rises linearly and reaches a plateau; for this technology and scenario, that is assumed to occur in 2015.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 10% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve A represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

- A relatively small number of builders can be targeted for program activity (approximately 15-20 builders construct 50% of the homes each year)
- Provincial legislation may change the building code to require this level of energy performance at some point in the study period. That change is occurring in Nova Scotia as of 2011
- In the absence of legislation, education will be a critical program component. It is particularly important to involve the real estate community.

6.4.7 R7 – Reduce Standby Losses for Household Electronics using Power Bar Timers

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 25% could be achieved in single-family detached homes in the Island and Isolated service region by 2021; these rates would then descend to 0% as the technology is superseded by features built into the electronic devices. Workshop participants created Adoption Curve E to represent this bell curve shape.

The Lower Achievable scenario was assumed to be similar to the Upper Achievable scenario for this technology.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.
Selected highlights:

- Discussions focused on a specific technology solution to standby losses, namely a power bar with a built-in timer that controls several of the outlets. These power bars are available in the marketplace. Discussion also focused on the television and its peripherals (especially set-top boxes), although the approach is applicable to other household electronics
- There were concerns that this device may not be suitable for some television peripherals, because power loss will erase their programming
- Workshop participants believed that a combination of technology improvements and energy standards would result in manufacturers incorporating power management features into the electronic devices themselves, eventually rendering this technology obsolete.

6.4.8 R8 – Upgrade to New ENERGY STAR Computer at Time of Replacement or New Purchase

Workshop participants concluded that, under the conditions represented by the Upper Achievable scenario, participation rates up to 80% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Upper Achievable scenario.

Under the more modest market conditions represented by the Lower Achievable scenario, participation rates up to 15% could be achieved in single-family detached homes in the Island and Isolated service region by 2026. Workshop participants agreed that Adoption Curve B represented the best fit with the pace of participation in the intervening years from 2007 to 2026 under this Lower Achievable scenario.

Based on the workshop discussions, it was assumed that participation rates in the remaining dwelling types would be similar to the above values. Participation rates in the Labrador Interconnected service region were assumed to be similar to those for the Island and Isolated service region.

Selected highlights:

- ENERGY STAR for most appliances has generally been lower in Newfoundland and Labrador than in other jurisdictions, partly because of poor product availability. ENERGY STAR computers may fare somewhat better because there is no incremental cost.

The preceding results were used as a reference point for estimating participation rates related to other opportunities in the Residential sector.

Highlights:

- The discussion of ENERGY STAR computers informed the participation rates used for ENERGY STAR appliances, such as fridges, freezers, clothes washers and televisions.

6.4.9 R9 – Upgrade to New ENERGY STAR Clothes Washer at Time of Replacement or New Purchase

Workshop participants did not discuss this measure separately, but did discuss ENERGY STAR appliances in general during the discussion of computers. The clothes washer measure, although it has a large potential, has a CCE very close to the threshold. This leaves very little room for program activity or incentives. It would therefore be difficult to achieve significant penetration. Further, the efficient top loading clothes washer is the one that passes the CCE test. It is very rare in the marketplace, with only one or two models available in Canada. The front loading washer is more available and is even more efficient, but is also more expensive and does not pass the CCE test. For these reasons this measure was seen as a lower priority for workshop discussion.

6.4.10 Extrapolated Participation Rates – Remaining Energy-efficiency Opportunities

As noted previously, the workshop results and follow up email responses were used as a reference point, combined with consultant experience, to estimate participation rates for the remaining energy-efficiency opportunities that are contained in the Economic Potential Forecast.

Exhibits 6.8 and 6.9 provide, respectively, a summary of the estimated Upper and Lower participation rates for the remaining energy-efficiency opportunities. As illustrated, each exhibit shows:

- Workshop reference number, which refers to the package of Opportunity Profiles that were provided to workshop participants
- The affected technology
- The participation rates for each of the milestone years
- Notes that illustrate sources used by the consultants when estimating the participation rates shown.

Exhibit 6.8: Participation Rates – Upper Achievable Potential[123]

Measure Information		Participation Rates		
Workshop Reference #	Technology	F2026	Curve	Notes
R1	Efficient (More Accurate) Thermostat	90%	B	R1: Workshop input.
R2	CFLs - Standard	98%	B	R2: Workshop input.
R3	Foundation Insulation, Existing	75%	B	R3: Workshop input.
R3	Foundation Insulation, New	98%	A	R3: Workshop input.
R4	Air Leakage Sealing	90%	B	R4: Workshop input.
R5	Energy Star Windows , Existing	100%	B	R5: Workshop input.
R5	Energy Star Windows , New	100%	C	R5: Workshop input.
R6	New House Designed to an EGNH 80 Rating	98%	A	R6: Workshop input.
R7	Standby Losses	0%	E*	R7: Workshop input.
R8	Energy Star Computer	80%	B	R8: Workshop input.
C1	Standard T8 Lighting - Common Areas, Existing Bldgs	97%	A	C1: Workshop input.
C1	Redesign with high performance T8s, Existing Bldgs	40%	A	C1: Workshop input.
C2	Redesign with high performance T8s, New Bldgs	100%	C	C2: Workshop input.
C4	High performance glazings	20%	A	C4: Workshop input.
C5	Building recommissioning	85%	B	C5: Workshop input.
C6	Ground source heat pumps	20%	A	C6: Workshop input.
C7	40% Lower Energy Apartment Building	56%	A/B**	C7: Workshop input.
	Super High Performance Windows	25%		Trail the participation rates for R5 by 10 years.
	Attic Insulation	56%		Similar participation to R3.
	Crawl-space Insulation	75%		Similar participation to R3, but much smaller incidence of crawlspaces.
	Programmable Thermostats	5%		Not much forced air electric heating (cf R1), but install on grouped baseboards in main areas.
	High Efficiency HRV	25%		Advanced version of accepted technology: use rates for Super windows.
	High Efficiency HRV	75%		Advanced version of accepted technology: use rates for Super windows.
	Furnace Fan Motor (ECPMM)	98%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	Low-Flow Showerheads and Faucets	98%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	DHW Tank Insulating Blanket	98%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	DHW Pipe Wrap	98%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	Energy Star Fridge	80%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star Fridge	80%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Efficient Freezer	80%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star Top Loading Clothes Washer	80%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star TV	80%		Based on Energy Star Computer (R8)
	LED Holiday Lights	98%		Based on CFLs (R2).
	Timer	98%		Based on CFLs (R2).
	Motion Sensor	98%		Based on CFLs (R2).
	CFLs Specialised	98%		Based on CFL standard (R2).
	Replace air-source heat pump with a low temperature heat pump	10%		Not available yet. Use 0% until 2011, climb to 10% by 2026.

* E - this curve, created by the workshop participants, is a bell-shaped curve that peaks in 2021 and descends back to zero after the technology is superseded by other advances
** A/B - this curve is a hybrid between curves A and B

[123] The low-temperature heat pump measure in this exhibit is for apartment buildings only. Units designed for apartments are under development. The low-temperature heat pumps for single detached homes, which are available, did not pass the economic screen and are not included in this exhibit.

Exhibit 6.9: Participation Rates – Lower Achievable Potential [124]

Measure Information		Participation Rates		
Workshop Reference #	**Technology**	**F2026**	**Curve**	**Notes**
R1	Efficient (More Accurate) Thermostat	20%	C	R1: Workshop input.
R2	CFLs - Standard	90%	A	R2: Workshop input.
R3	Foundation Insulation, Existing	25%	B	R3: Workshop input.
R3	Foundation Insulation, New	55%	C	R3: Workshop input.
R4	Air Leakage Sealing	55%	B	W4: Workshop input.
R5	Energy Star Windows , Existing	80%	B	R5: Workshop input.
R5	Energy Star Windows , New	100%	C	R5: Workshop input.
R6	New House Designed to an EGNH 80 Rating	10%	D	R6: Workshop input.
R7	Standby Losses	0%	E*	R7: Workshop input.
R8	Energy Star Computer	15%	B	R8: Workshop input.
C1	Standard T8 Lighting - Common Areas, Existing Bldgs	80%	A	C1: Workshop input.
C1	Redesign with high performance T8s, Existing Bldgs	15%	A	C1: Workshop input.
C2	Redesign with high performance T8s, New Bldgs	80%	C	C2: Workshop input.
C4	High performance glazings	7%	A	C4: Workshop input.
C5	Building recommissioning	40%	A/B**	C5: Workshop input.
C6	Ground source heat pumps	2%	B	C6: Workshop input.
C7	40% Lower Energy Apartment Building	38%	A/B**	C7: Workshop input.
	Super High Performance Windows	20%		Trail the rates for R5 by 10 years.
	Attic Insulation	19%		Similar participation to R3.
	Crawl-space Insulation	25%		Similar participation to R3, but much smaller incidence of crawlspaces.
	Programmable Thermostats	2%		Not much forced air electric heating (informed by R1 discussion).
	High Efficiency HRV	20%		Advanced version of accepted technology: use rates for Super windows.
	High Efficiency HRV	25%		Advanced version of accepted technology: use rates for Super windows.
	Furnace Fan Motor (ECPMM)	90%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	Low-Flow Showerheads and Faucets	90%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	DHW Tank Insulating Blanket	90%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	DHW Pipe Wrap	90%		Based on CFLs - standard, where it passes, because it can have high adoption if pushed
	Energy Star Fridge	15%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star Fridge	15%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Efficient Freezer	15%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star Top Loading Clothes Washer	15%		R8 input probably reasonable for participation above E* reference penetration.
	Energy Star TV	15%		Based on Energy Star Computer (R8)
	LED Holiday Lights	90%		Based on CFLs (R2).
	Timer	90%		Based on CFLs (R2).
	Motion Sensor	90%		Based on CFLs (R2).
	CFLs Specialised	90%		Based on CFL standard (R2).
	Replace air-source heat pump with a low temperature heat pump	5%		Not available yet. Use 0% until 2011, climb to 5% by 2026.

* E - this curve, created by the workshop participants, is a bell-shaped curve that peaks in 2021 and descends back to zero after the technology is superseded by other advances
** A/B - this curve is a hybrid between curves A and B

[124] The low-temperature heat pump measure in this exhibit is for apartment buildings only. Units designed for apartments are under development. The low-temperature heat pumps for single detached homes, which are available, did not pass the economic screen and are not included in this exhibit.

6.5 SUMMARY OF ACHIEVABLE ELECTRICITY SAVINGS

Exhibit 6.10 provides a summary of the Achievable electricity savings under both the Lower and Upper scenarios for the Island and Isolated service region.

As illustrated, under the Reference Case residential electricity use would grow from the Base Year level of 3,228 GWh/yr. to approximately 3,968 GWh/yr. by 2026. This contrasts with the Upper Achievable scenario in which electricity use would increase to approximately 3,529 GWh/yr. for the same period, a difference of approximately 439 GWh/yr., or about 11% reduction. Under the Lower Achievable scenario, electricity use would increase to approximately 3,732 GWh/yr. for the same period, a difference of approximately 236 GWh/yr., or about 6% reduction.

Exhibit 6.10: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in Residential Sector for the Island and Isolated Service Region (GWh/yr.)

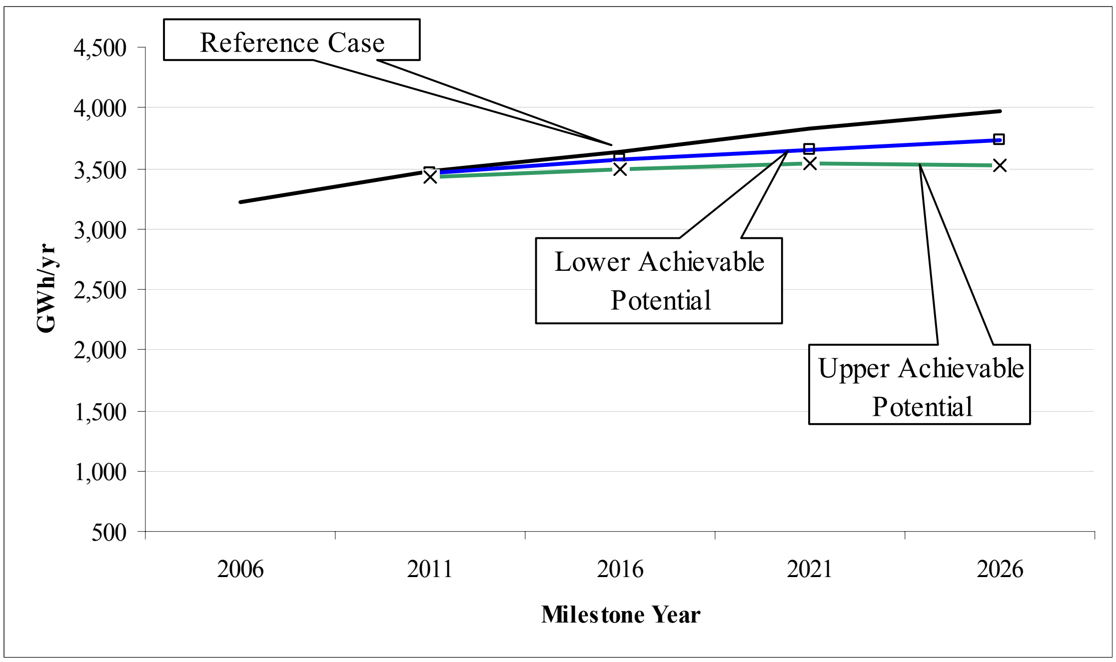
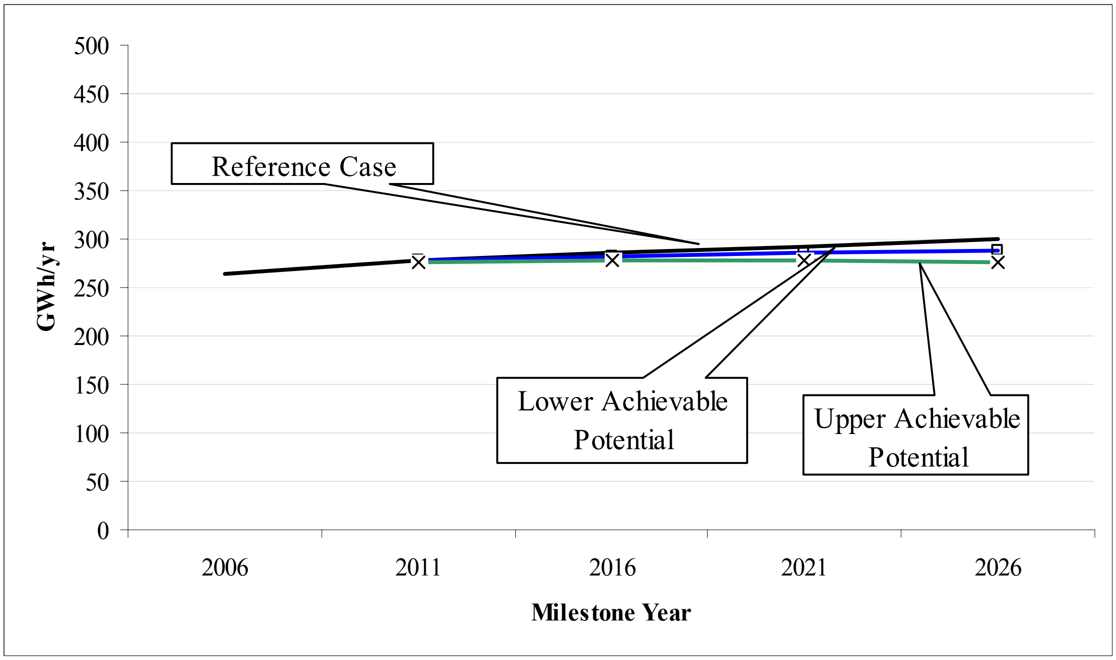


Exhibit 6.11 provides a summary of the achievable electricity savings under both the Lower and Upper scenarios for the Labrador Interconnected service region.

As illustrated, under the Reference Case residential electricity use would grow from the Base Year level of 264 GWh/yr. to approximately 300 GWh/yr. by 2026. This contrasts with the Upper Achievable scenario in which electricity use would increase to approximately 275 GWh/yr. for the same period, a difference of approximately 25 GWh/yr., or about 8% reduction. Under the Lower Achievable scenario, electricity use would increase to approximately 287 GWh/yr. for the same period, a difference of approximately 13 GWh/yr., or about 4% reduction.

Exhibit 6.11: Reference Case versus Upper and Lower Achievable Potential Electricity Consumption in Residential Sector for the Labrador Interconnected Service Region (GWh/yr.)



Further detail on the total potential electricity savings provided by the Achievable Potential forecasts is provided in the following exhibits:

- Exhibits 6.12 and 6.13 present, respectively, the Upper and Lower Achievable results by end use, dwelling type and milestone year for the Island and Isolated service region
- Exhibits 6.14 and 6.15 present, respectively, the Upper and Lower Achievable results by end use, dwelling type and milestone year for the Labrador Interconnected service region
- Exhibits 6.16 and 6.17 present, respectively, the Upper and Lower Achievable savings in 2026 by major end use and dwelling type for the Island and Isolated service region
- Exhibits 6.18 and 6.19 present, respectively, the Upper and Lower Achievable savings in 2026 by major end use and service region for the Labrador Interconnected service region
- Exhibit 6.20 presents the Upper and Lower Achievable savings by milestone year and service region.

Exhibit 6.12: Summary of Annual Electricity Savings for the Island and Isolated Service Region by End Use and Dwelling Type, Upper Achievable Potential (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	47.1	1.9	0.0	9.0		0.0	0.0		0.0	0.0	34.4	1.0	0.0	0.7	0.0	
	2016	121.6	15.0	0.1	14.9		0.6	0.3		0.3	2.4	70.2	8.0	1.3	8.2	0.2	
	2021	233.0	45.9	0.1	24.7		2.2	1.2		0.9	7.8	107.0	16.0	4.8	21.8	0.5	
	2026	362.0	116.0	0.2	38.6		4.4	2.6		2.1	17.5	144.6	26.3	9.7	0.0	0.0	
Attached	2011	5.6	0.0	0.0	1.1		0.0	0.0		0.0	0.0	4.2	0.1	0.0	0.1	0.0	
	2016	15.5	1.6	0.0	1.8		0.1	0.0		0.0	0.2	8.6	1.2	0.2	1.7	0.0	
	2021	29.6	4.6	0.0	3.0		0.4	0.0		0.1	0.8	13.3	2.4	0.6	4.3	0.1	
	2026	41.6	10.4	0.0	4.8		0.8	0.0		0.2	1.8	18.2	4.0	1.3	0.0	0.0	
Apartment	2011	3.5	0.3	0.1	0.7		0.0	0.0		0.0	0.0	2.2	0.1	0.0	0.1	0.0	
	2016	9.5	0.6	0.2	1.6		0.1	0.0		0.0	0.1	4.6	0.8	0.1	1.3	0.0	
	2021	18.0	1.2	0.4	3.2		0.3	0.0		0.0	0.3	7.1	1.6	0.4	3.4	0.0	
	2026	25.1	4.5	0.7	5.2		0.7	0.0		0.1	0.8	9.6	2.7	0.9	0.0	0.0	
Isolated	2011	1.0	0.0	0.0	0.2		0.0	0.0		0.0	0.0	0.8	0.0	0.0	0.0	0.0	
	2016	2.2	0.0	0.0	0.3		0.0	0.0		0.0	0.0	1.5	0.1	0.0	0.1	0.0	
	2021	3.7	0.1	0.0	0.5		0.0	0.0		0.0	0.2	2.3	0.2	0.1	0.3	0.0	
	2026	5.0	0.2	0.0	0.8		0.1	0.1		0.0	0.3	3.1	0.3	0.1	0.0	0.0	
Other	2011	0.4	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	0.6	0.0	0.0	0.0	0.0	
	2016	1.0	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	1.1	0.0	0.0	0.0	0.0	
	2021	1.6	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	1.7	0.0	0.0	0.0	0.0	
	2026	2.1	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	2.2	0.0	0.0	0.0	0.0	
Vacant and Partial	2011	0.6	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	0.8	0.0	0.0	0.0	0.0	
	2016	1.4	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	1.5	0.0	0.0	0.0	0.0	
	2021	2.1	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	2.2	0.0	0.0	0.0	0.0	
	2026	2.8	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	2.9	0.0	0.0	0.0	0.0	
TOTAL	2011	58.2	2.0	0.1	10.9		0.0	0.0		0.0	0.0	42.8	1.2	0.1	1.0	0.0	
	2016	151.1	17.0	0.3	18.6		0.8	0.4		0.3	2.8	87.6	10.0	1.6	11.3	0.3	
	2021	287.9	51.6	0.6	31.4		2.9	1.3		1.1	9.1	133.5	20.1	5.9	29.7	0.7	
	2026	438.7	130.9	0.9	49.5		5.9	2.7		2.5	20.5	180.7	33.2	12.1	0.0	0.0	

•

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) A value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures. 5) Savings for television peripherals and other electronics are from standby loss reduction measures. Workshop participants believed that by 2026 advances in the appliances themselves would eliminate the savings available from add-on devices such as timed power bars. Savings in the last milestone period therefore drop to zero.

Exhibit 6.13: Summary of Annual Electricity Savings for the Island and Isolated Service Region by End Use and Dwelling Type, Lower Achievable Potential (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	12.2	0.5	0.0	2.2		0.0	0.0		0.0	0.0	8.4	0.3	0.0	0.7	0.0	
	2016	54.8	3.3	0.0	6.0		0.1	0.1		0.1	0.5	33.1	2.5	0.7	8.2	0.2	
	2021	128.2	11.1	0.1	11.0		0.4	0.2		0.2	1.4	74.5	5.3	1.8	21.8	0.5	
	2026	190.8	30.8	0.1	15.3		0.8	0.5		0.4	3.3	132.9	5.0	1.8	0.0	0.0	
Attached	2011	1.5	0.0	0.0	0.3		0.0	0.0		0.0	0.0	1.0	0.0	0.0	0.1	0.0	
	2016	7.2	0.1	0.0	0.7		0.0	0.0		0.0	0.0	4.0	0.4	0.1	1.7	0.0	
	2021	16.6	0.4	0.0	1.3		0.1	0.0		0.0	0.1	9.2	0.8	0.2	4.3	0.1	
	2026	22.3	2.1	0.0	1.9		0.2	0.0		0.0	0.3	16.7	0.8	0.2	0.0	0.0	
Apartment	2011	1.3	0.2	0.0	0.3		0.0	0.0		0.0	0.0	0.6	0.0	0.0	0.1	0.0	
	2016	5.2	0.4	0.1	0.8		0.0	0.0		0.0	0.0	2.3	0.2	0.1	1.3	0.0	
	2021	11.6	0.7	0.2	1.5		0.1	0.0		0.0	0.1	5.0	0.5	0.2	3.4	0.0	
	2026	14.6	2.1	0.3	2.6		0.1	0.0		0.0	0.1	8.7	0.5	0.2	0.0	0.0	
Isolated	2011	0.2	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.2	0.0	0.0	0.0	0.0	
	2016	1.0	0.0	0.0	0.1		0.0	0.0		0.0	0.0	0.7	0.0	0.0	0.1	0.0	
	2021	2.3	0.0	0.0	0.2		0.0	0.0		0.0	0.0	1.6	0.1	0.0	0.3	0.0	
	2026	3.4	0.0	0.0	0.3		0.0	0.0		0.0	0.1	2.9	0.0	0.0	0.0	0.0	
Other	2011	0.1	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.1	0.0	0.0	0.0	0.0	
	2016	0.4	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	0.5	0.0	0.0	0.0	0.0	
	2021	1.1	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	1.2	0.0	0.0	0.0	0.0	
	2026	1.9	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	2.0	0.0	0.0	0.0	0.0	
Vacant and Partial	2011	0.1	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.2	0.0	0.0	0.0	0.0	
	2016	0.6	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	0.7	0.0	0.0	0.0	0.0	
	2021	1.4	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	1.5	0.0	0.0	0.0	0.0	
	2026	2.6	-0.1	0.0	0.0		0.0	0.0		0.0	0.0	2.7	0.0	0.0	0.0	0.0	
TOTAL	2011	15.5	0.7	0.0	2.8		0.0	0.0		0.0	0.0	10.6	0.3	0.1	1.0	0.0	
	2016	69.2	3.7	0.1	7.6		0.2	0.1		0.1	0.6	41.4	3.1	0.8	11.3	0.3	
	2021	161.3	12.0	0.3	14.1		0.5	0.2		0.2	1.7	93.0	6.6	2.3	29.7	0.7	
	2026	235.7	34.8	0.4	20.1		1.1	0.5		0.5	3.8	166.0	6.3	2.2	0.0	0.0	

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) A value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures. 5) Savings for television peripherals and other electronics are from standby loss reduction measures. Workshop participants believed that by 2026 advances in the appliances themselves would eliminate the savings available from add-on devices such as timed power bars. Savings in the last milestone period therefore drop to zero.

Exhibit 6.14: Summary of Annual Electricity Savings for the Labrador Interconnected Service Region by End Use and Dwelling Type, Upper Achievable Potential (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	1.8	0.2	0.0	0.4							1.1	0.0		0.0	0.0	
	2016	5.3	2.0	0.0	0.5							2.3	0.2		0.2	0.0	
	2021	11.1	6.1	0.0	0.6							3.5	0.4		0.5	0.0	
	2026	19.2	13.3	0.0	0.5							4.7	0.7		0.0	0.0	
Attached	2011	0.5	0.0	0.0	0.1							0.4	0.0		0.0	0.0	
	2016	1.4	0.3	0.0	0.2							0.7	0.1		0.1	0.0	
	2021	2.8	1.1	0.0	0.2							1.1	0.1		0.2	0.0	
	2026	4.5	2.7	0.0	0.2							1.5	0.2		0.0	0.0	
Apartment	2011	0.1	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.2	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
	2021	0.3	0.0	0.0	0.0							0.2	0.0		0.1	0.0	
	2026	0.4	0.1	0.0	0.0							0.2	0.0		0.0	0.0	
Isolated	2011	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2021	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2026	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
Other	2011	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2021	0.1	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
	2026	0.1	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
TOTAL	2011	2.5	0.2	0.0	0.6							1.6	0.0		0.0	0.0	
	2016	6.9	2.4	0.0	0.7							3.2	0.3		0.3	0.0	
	2021	14.3	7.2	0.0	0.8							4.8	0.5		0.8	0.0	
	2026	24.2	16.1	0.0	0.7							6.5	0.9		0.0	0.0	

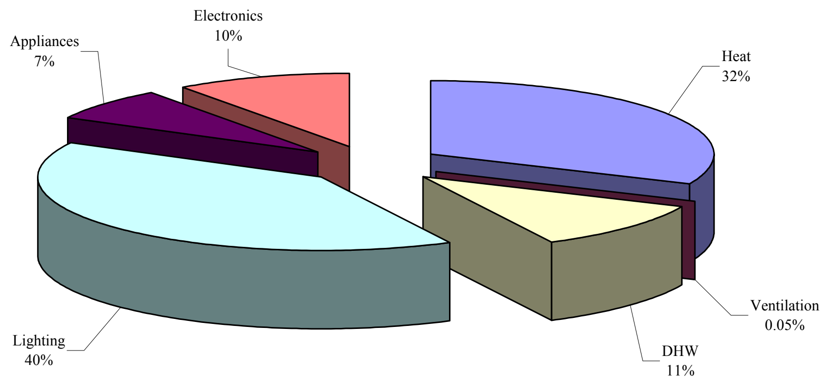
Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) A value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures. 5) Savings for television peripherals and other electronics are from standby loss reduction measures. Workshop participants believed that by 2026 advances in the appliances themselves would eliminate the savings available from add-on devices such as timed power bars. Savings in the last milestone period therefore drop to zero.

Exhibit 6.15: Summary of Annual Electricity Savings for the Labrador Interconnected Service Region by End Use and Dwelling Type, Lower Achievable Potential (GWh/yr.)

Dwelling Type	Milestone Year	Residential															
		Total	Space Heating	Ventilation	DHW	Cooking	Refrigerator	Freezer	Dishwasher	Clothes Washer	Clothes Dryer	Lighting	Computer and peripherals	Television	Television Peripherals	Other Electronics	Small Appliances & Other
Detached	2011	0.6	0.1	0.0	0.1							0.3	0.0		0.0	0.0	
	2016	2.2	0.6	0.0	0.3							1.1	0.1		0.2	0.0	
	2021	5.3	1.7	0.0	0.4							2.4	0.1		0.5	0.0	
	2026	9.5	4.5	0.0	0.5							4.3	0.1		0.0	0.0	
Attached	2011	0.2	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
	2016	0.6	0.1	0.0	0.1							0.3	0.0		0.1	0.0	
	2021	1.4	0.3	0.0	0.1							0.8	0.0		0.2	0.0	
	2026	2.4	0.9	0.0	0.1							1.3	0.0		0.0	0.0	
Apartment	2011	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.1	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2021	0.2	0.0	0.0	0.0							0.1	0.0		0.1	0.0	
	2026	0.3	0.1	0.0	0.0							0.2	0.0		0.0	0.0	
Isolated	2011	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2021	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2026	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
Other	2011	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2016	0.0	0.0	0.0	0.0							0.0	0.0		0.0	0.0	
	2021	0.1	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
	2026	0.1	0.0	0.0	0.0							0.1	0.0		0.0	0.0	
TOTAL	2011	0.7	0.2	0.0	0.1							0.4	0.0		0.0	0.0	
	2016	2.9	0.7	0.0	0.3							1.5	0.1		0.3	0.0	
	2021	7.0	2.0	0.0	0.6							3.3	0.2		0.8	0.0	
	2026	12.3	5.5	0.0	0.7							6.0	0.2		0.0	0.0	

Notes: 1) Results are measured at the customer's point-of-use and do not include line losses. 2) Any differences in totals are due to rounding. 3) A value displays as 0 if it is between 0 and 0.5. Totals are calculated using the actual numerical value. 4) Negative values in the space heating end use are a result of the reduction in internal heat gains due to lighting and appliance measures being greater than any savings from space heating measures. 5) Savings for television peripherals and other electronics are from standby loss reduction measures. Workshop participants believed that by 2026 advances in the appliances themselves would eliminate the savings available from add-on devices such as timed power bars. Savings in the last milestone period therefore drop to zero.

**Exhibit 6.16: Savings by Major End Use,
Upper Achievable – Island and Isolated Service Region 2026 (%)**



Totals for Exhibits 6.16 and 6.17 may not add to 100% due to rounding.

**Exhibit 6.17: Savings by Major End Use,
Lower Achievable – Island and Isolated Service Region 2026 (%)**

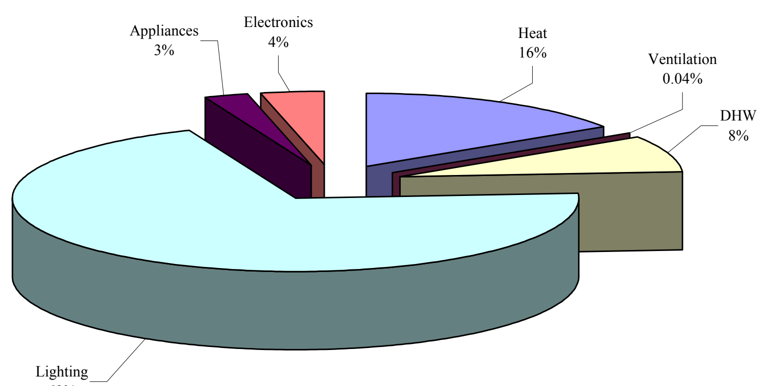
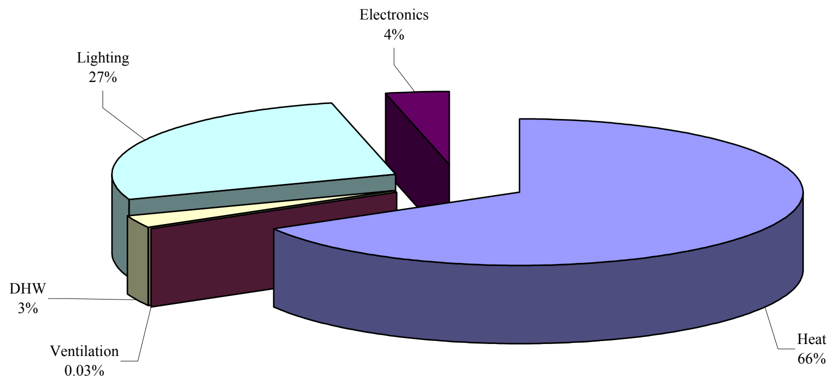


**Exhibit 6.18: Savings by Major End Use,
Upper Achievable – Labrador Interconnected Service Region 2026 (%)**



Totals for Exhibits 6.18 and 6.19 may not add to 100% due to rounding.

**Exhibit 6.19: Savings by Major End Use and Dwelling Type,
Lower Achievable – Labrador Interconnected Service Region 2026 (GWh/yr.)**

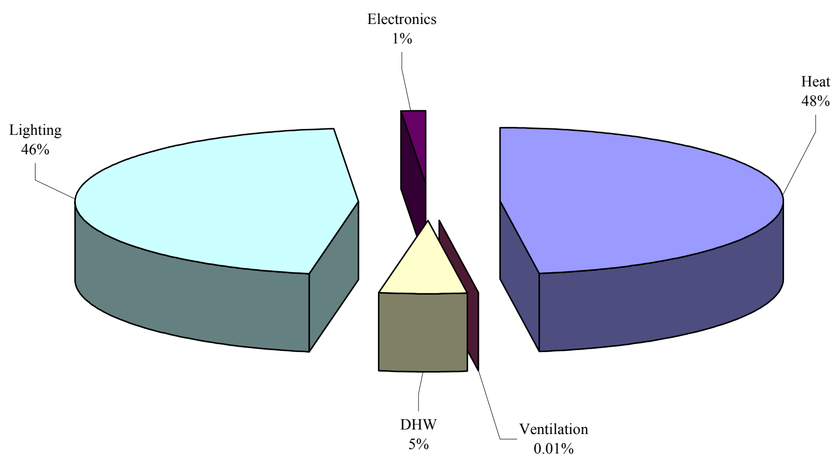
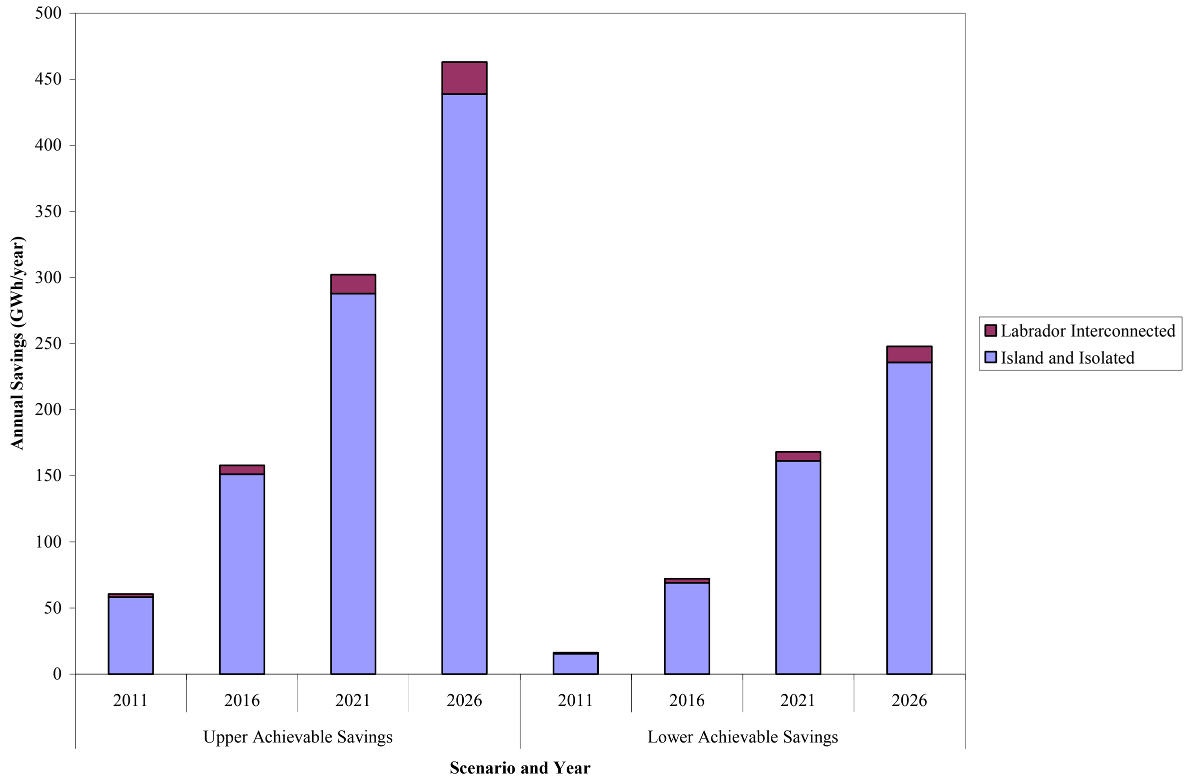


Exhibit 6.20: Savings by Scenario, Milestone Year and Service Region (GWh/yr.)



6.6 PEAK LOAD IMPACTS

The electricity (electric energy) savings (GWh) contained in the preceding scenarios also result in a reduction in electric demand (MW).[125]

The conversion of electricity savings to hourly demand requires the following steps:

- Annual electricity savings for each combination of sub sector and end use are disaggregated *by month*
- Monthly electricity savings are then further disaggregated *by day type* (weekday, weekend day and peak day)
- Finally, each day type is disaggregated *by hour*.

The above steps that convert electricity to electric demand require the development and application of the following four factors (sets of ratios).

[125] Peak load savings were modelled using Applied Energy Group's Cross-Sector Load Shape Library Model (LOADLIB).

- **Monthly Usage Factor**

This factor represents the percentage of annual electricity use that occurs in each month of the year. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, process or end use, and is dictated by weather or other seasonal factors. This allocation factor can be obtained from either (in decreasing order of priority): (a) monthly consumption statistics from end-use load studies; (b) monthly seasonal sales (preferably weather normalized) obtained by subtracting a "base" month from winter and summer heating and cooling months; or (c) heating or cooling degree days on an appropriate base.

- **Weekend to Weekday Factor**

This factor is a ratio that describes the distribution of electricity use between weekends and weekdays

- **Peak Day Factor**

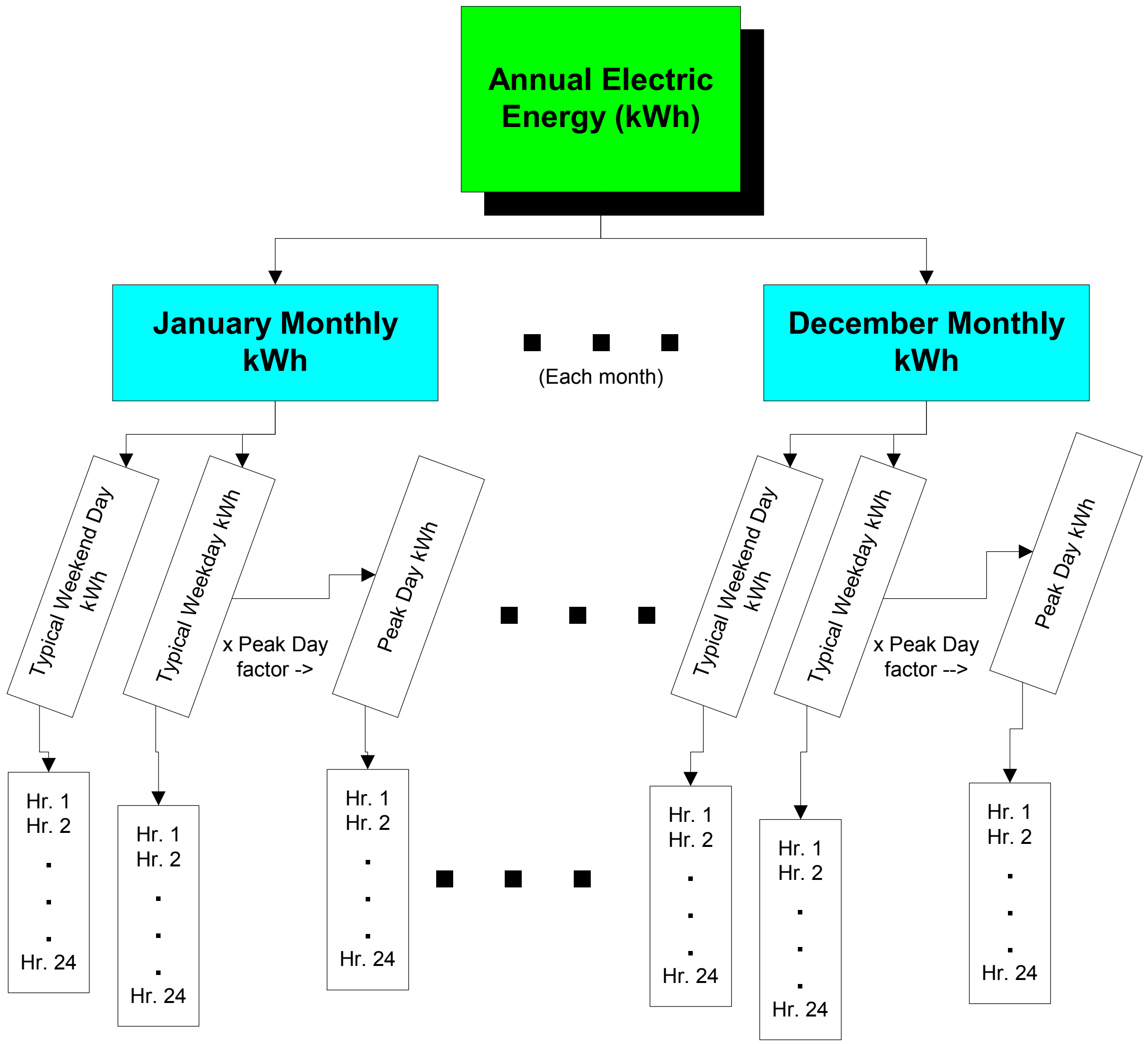
This factor defines the degree of daily weather sensitivity associated with the load shape, particularly heating or cooling; it compares a peak (e.g., hottest or coldest) day to a typical weekday in that month.

- **Hourly Factor**

This factor describes the typical distribution of daily electricity use for each day type (weekday, weekend day, peak day) and for each month. It reflects the operating hours of the electric equipment or end use by sub sector. For example, for lighting, this would be affected by time of day and season (affected by daylight).

Exhibit 6.21 provides an illustration of the sequential application of the above factors to convert annual electricity to hourly demand. Further description is provided in Appendix C.

Exhibit 6.21: Illustration of Electricity to Peak load Calculation



The study defined the Newfoundland Labrador system peak as:

> *The morning period from 7 am to noon and the evening period from 4 pm to 8 pm on the four coldest days in the December to March period; this is a total of 36 hours per year.*

Exhibit 6.22 presents a summary of the peak load reductions that would occur during the peak period noted above as a result of the electricity savings contained in Upper and Lower Achievable scenarios. In each case, the reductions are an average value over the peak period and are defined relative to the Reference Case.

Exhibit 6.22: Peak load Reductions (MW) Relative to Reference Case by Milestone Year, Service Region and Achievable Scenario

Service Region	Milestone Year	Peak Demand Reduction MW	
		Upper Achievable	Lower Achievable
Island and Isolated	2011	10.8	2.9
	2016	29.1	13.3
	2021	57.8	32.4
	2026	91.1	48.9
Labrador Interconnected	2011	0.6	0.2
	2016	1.8	0.8
	2021	3.8	1.9
	2026	6.5	3.3
TOTAL	2011	11.4	3.1
	2016	30.9	14.1
	2021	61.6	34.3
	2026	97.6	52.2

7. CONCLUSIONS AND NEXT STEPS

This study has confirmed the existence of significant cost-effective CDM potential within Newfoundland and Labrador's Residential sector. The study results provide:

- Specific estimates of the potential CDM savings opportunities, defined by sector, sub sector, end use and, in several cases, specific technology(s)
- A baseline set of energy technology penetrations and energy use practices that can assist in the design of specific programs.

The next step[126] in this process involves the selection of a cost-effective portfolio of CDM programs and the setting of specific CDM targets and spending levels. To provide a preliminary reference point for this next step in the program development process, the study team conducted a brief literature search in an attempt to identify typical CDM spending levels in other jurisdictions. The literature search identified two (relatively) recent studies that had addressed similar issues on behalf of other Canadian utilities. The two studies are:

- *Demand-Side Management: Determining Appropriate Spending Levels and Cost-Effectiveness Testing,* which was prepared by Summit Blue Consulting and the Regulatory Assistance Project for the Canadian Association of Members of Public Utility Tribunals (CAMPUT). The study was completed in January 2006.
- *Planning and Budgeting for Energy Efficiency/Demand-Side Management Programs,* which was prepared by Navigant Consulting for Union Gas (Ontario) Limited. The study was completed in July 2005.

The CAMPUT study, which included a review of U.S. and Canadian jurisdictions, concluded that an annual CDM expenditure equal to about 1.5% of annual electricity revenues might be appropriate for a utility (or jurisdiction) that is in the early stages of CDM[127] programming. This level of funding recognizes that it takes time to properly introduce programs into the market place.

The same study found that once program delivery experience is gained, a ramping up to a level of about 3% of annual electricity revenues is appropriate. The study also notes that higher percentages may be warranted if rapid growth in electricity demand is expected, or if there is an increasing gap between demand and supply due to such things as plant retirements or siting limitations. The current emphasis on climate change mitigation measures would presumably also fall into a similar category of potential CDM drivers.

The CAMPUT study also notes that even those states with 3% of annual revenues as their CDM target have found that there are more cost-effective CDM opportunities than could be met by the 3% funding. The finding is consistent with the situation in British Columbia. In the case of BC Hydro, CDM expenditures over the past few years have been about 3.3% of electricity

[126] Full treatment of these next steps is beyond the scope of the current project.
[127] The CAMPUT study uses the term DSM (demand-side management); DSM is used interchangeably with CDM in this section.

revenues.[128] However, the results of BC Hydro's recently completed study (Conservation Potential Review (CPR) 2007) identified over 20,000 GWh of remaining cost-effective CDM opportunities by 2026. The magnitude of remaining cost-effective CDM opportunities combined with the aggressive targets set out in British Columbia's provincial Energy Plan suggest that BC Hydro's future CDM expenditures are likely to increase significantly if the new targets are to be met.

Additional notes:

- Neither of the studies noted above found any one single, simple model for setting CDM spending levels and targets. Rather, the more general conclusion is that utilities use a number of different approaches that are reasonable for their context. In fact, the CAMPUT report identified seven approaches to setting CDM spending levels:

  - Based on cost-effective CDM potential estimates
  - Based on percentages of utility revenues
  - Based on Mills/kWh of utility electric sales
  - Levels set through resource planning process
  - Levels set through the restructuring process
  - Tied to projected load growth
  - Case-by-case approach.

- The CAMPUT study also notes that, although not always explicit, a key issue in most jurisdictions is resolving the trade off between wanting to procure all cost-effective energy-efficiency measures and concerns about the resulting short-term effect on rates. The study concluded that CDM budgets based on findings from an Integrated Resource Plan or a benefit-cost assessment tend to accept whatever rate effects are necessary to secure the overall resource plan, inclusive of the cost-effective energy-efficiency measures.

[128] CAMPUT, 2006. p. 14.

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MARBEK
Resource Consultants Ltd.

NEWFOUNDLAND & LABRADOR

CONSERVATION AND DEMAND MANAGEMENT (CDM) POTENTIAL STUDY

–Appendices–

Residential Sector

Submitted to:
Newfoundland Labrador Hydro &
Newfoundland Power

Prepared by:
Marbek Resource Consultants Ltd.

In association with:
Sustainable Housing and Education Consultants
and
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MARBEK
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APPENDIX A

CDM Measure Profiles

Energy Efficiency Upgrades
Cost and Performance Data
- High and Super High Performance Windows, Existing

Type	Technology	Annual Consumption kWh/yr	Energy Svngs kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline 1	**Detached Island**	12,554	N/A						25						
Upgrade 1	Energy Star Windows	11,675	879	$333	$0	$333	$333	$0	25		2.4		3.0		3.6
Upgrade 2	Super Windows	11,298	1,255	$666	$0	$666	$666	$0	25		3.4		4.2		5.0
Baseline 2	**Detached Lab**	29,379	N/A						25						
Upgrade 1	Energy Star Windows	28,380	999	$264	$0	$264	$264	$0	25		1.7		2.1		2.5
Upgrade 2	Super Windows	28,027	1,351	$527	$0	$527	$527	$0	25		2.5		3.1		3.7
Baseline 2	**Row Island**	11,377	N/A						25						
Upgrade 1	Energy Star Windows	10,694	683	$310	$0	$310	$310	$0	25		2.9		3.6		4.3
Upgrade 2	Super Windows	10,353	1,024	$620	$0	$620	$620	$0	25		3.9		4.7		5.7
Baseline 4	**Row Lab**	27,294	N/A						25						
Upgrade 1	Energy Star Windows	26,230	1,064	$310	$0	$310	$310	$0	25		1.9		2.3		2.7
Upgrade 2	Super Windows	25,656	1,638	$620	$0	$620	$620	$0	25		2.4		3.0		3.5

Energy Efficiency Upgrades
Cost and Performance Data
- High and Super High Performance Windows, New

Type	Technology	Annual Consumption kWh/yr	Energy Svngs kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline 1	**Detached Island**	12,554	N/A						25						
Upgrade 1	Energy Star Windows	11,725	829	$207	$0	-	$207	$0	25		1.6		2.0		2.3
Upgrade 2	Super Windows	11,298	1,255	$827	$0	-	$827	$0	25		4.2		5.2		6.2
Baseline 2	**Detached Lab**	29,966	N/A						25						
Upgrade 1	Energy Star Windows	28,618	1,348	$207	$0	-	$207	$0	25		1.0		1.2		1.4
Upgrade 2	Super Windows	27,928	2,038	$827	$0	-	$827	$0	25		2.6		3.2		3.8
Baseline 1	**Row Island**	11,377	N/A						25						
Upgrade 1	Energy Star Windows	10,558	819	$186	$0	-	$186	$0	25		1.5		1.8		2.1
Upgrade 2	Super Windows	10,091	1,286	$744	$0	-	$744	$0	25		3.7		4.5		5.4
Baseline 2	**Row Lab**	27,840	N/A						25						
Upgrade 1	Energy Star Windows	26,559	1,281	$186	$0	-	$186	$0	25		0.9		1.1		1.4
Upgrade 2	Super Windows	25,836	2,004	$744	$0	-	$744	$0	25		2.4		2.9		3.5

Energy Efficiency Upgrades
Cost and Performance Data
-Envelope Measures, Existing

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
				Capital	Installation	Full	Incremental			D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	$	$	$	$			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	**Detached Island**	12,554	N/A						25						
Upgrade 1	Wall Insulation	11,236	1,318	$2,400	$0	$2,400	$2,400	$0	25	11.7	11.7	14.2	14.2	17.1	17.1
Upgrade 2	Attic Insulation	11,876	678	$600	$0	$600	$600	$0	25	5.7	5.7	6.9	6.9	8.3	8.3
Upgrade 3	Foundation Insulation	9,214	3,339	$3,600	$0	$3,600	$3,600	$0	25	6.9	6.9	8.4	8.4	10.1	10.1
Upgrade 4	Crawlspace Insulation	10,328	2,226	$1,000	$0	$1,000	$1,000	$0	25	2.9	2.9	3.5	3.5	4.2	4.2
Upgrade 5	Vacuum Panel insulation	10,420	2,134	$9,000	$0	$9,000	$9,000	$0	25	27.0	27.0	33.0	33.0	39.5	39.5
Upgrade 6	Air Sealing	11,374	1,180	$900	$0	$900	$900	$50	25	9.1	9.1	10.2	10.2	11.4	11.4
Baseline 2	**Detached Lab**	29,379	N/A						25						
Upgrade 1	Wall Insulation	26,441	2,938	$2,000	$0	$2,000	$2,000	$0	25	4.4	4.4	5.3	5.3	6.4	6.4
Upgrade 2	Attic Insulation	27,616	1,763	$700	$0	$700	$700	$0	25	2.5	2.5	3.1	3.1	3.7	3.7
Upgrade 3	Foundation Insulation	18,920	10,459	$3,200	$0	$3,200	$3,200	$0	25	2.0	2.0	2.4	2.4	2.9	2.9
Upgrade 4	Crawlspace Insulation	22,406	6,973	$1,000	$0	$1,000	$1,000	$0	25	0.9	0.9	1.1	1.1	1.3	1.3
Upgrade 5	Vacuum Panel insulation	24,384	4,994	$9,000	$0	$9,000	$9,000	$0	25	11.5	11.5	14.1	14.1	16.9	16.9
Upgrade 6	Air Sealing	26,441	2,938	$900	$0	$900	$900	$50	25	3.7	3.7	4.1	4.1	4.6	4.6
Baseline 3	**Row Island**	11,377	N/A						25						
Upgrade 1	Wall Insulation	10,376	1,001	$2,400	$0	$2,400	$2,400	$0	25	15.3	15.3	18.8	18.8	22.5	22.5
Upgrade 2	Attic Insulation	10,956	421	$500	$0	$500	$500	$0	25	7.6	7.6	9.3	9.3	11.1	11.1
Upgrade 3	Foundation Insulation	9,363	2,014	$1,464	$0	$1,464	$1,464	$0	25	4.7	4.7	5.7	5.7	6.8	6.8
Upgrade 4	Crawlspace Insulation	10,034	1,342	$1,000	$0	$1,000	$1,000	$0	25	4.8	4.8	5.8	5.8	7.0	7.0
Upgrade 5	Vacuum Panel insulation	9,283	2,093	$9,000	$0	$9,000	$9,000	$0	25	27.5	27.5	33.6	33.6	40.3	40.3
Upgrade 6	Air Sealing	10,307	1,069	$900	$0	$900	$900	$50	25	10.1	10.1	11.3	11.3	12.6	12.6
Baseline 4	**Row Lab**	27,294	N/A						25						
Upgrade 1	Wall Insulation	24,974	2,320	$2,000	$0	$2,000	$2,000	$0	25	5.5	5.5	6.7	6.7	8.1	8.1
Upgrade 2	Attic Insulation	26,066	1,228	$600	$0	$600	$600	$0	25	3.1	3.1	3.8	3.8	4.6	4.6
Upgrade 3	Foundation Insulation	21,153	6,141	$1,464	$0	$1,464	$1,464	$0	25	1.5	1.5	1.9	1.9	2.2	2.2
Upgrade 4	Crawlspace Insulation	23,200	4,094	$1,000	$0	$1,000	$1,000	$0	25	1.6	1.6	1.9	1.9	2.3	2.3
Upgrade 5	Vacuum Panel insulation	23,255	4,040	$9,000	$0	$9,000	$9,000	$0	25	14.3	14.3	17.4	17.4	20.9	20.9
Upgrade 6	Air Sealing	24,565	2,729	$900	$0	$900	$900	$50	25	3.9	3.9	4.4	4.4	4.9	4.9

Energy Efficiency Upgrades
Cost and Performance Data
- Envelope Measures, New

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	Capital $	Installation $	Full $	Incremental $			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	**Detached Island**	12,554	N/A						25						
Upgrade 1	Wall Insulation	11,901	653	$1,500	$0	$1,500	$1,500	$0	25	14.7	14.7	18.0	18.0	21.5	21.5
Upgrade 2	Attic Insulation	12,177	377	$600	$0	$600	$600	$0	25	10.2	10.2	12.5	12.5	14.9	14.9
Upgrade 3	Foundation Insulation	8,637	3,917	$3,600	$0	$3,600	$3,600	$0	25	5.9	5.9	7.2	7.2	8.6	8.6
Upgrade 4	Crawlspace Insulation	9,943	2,611	$1,000	$0	$1,000	$1,000	$0	25	2.5	2.5	3.0	3.0	3.6	3.6
Upgrade 5	Vacuum Panel insulation	10,545	2,009	$9,000	$0	$9,000	$9,000	$0	25	28.7	28.7	35.1	35.1	42.0	42.0
Upgrade 6	Air Sealing	11,562	992	$600	$0	$600	$600	$50	25	8.9	8.9	9.8	9.8	10.7	10.7
Baseline 2	**Detached Lab**	29,966	N/A						25						
Upgrade 1	Wall Insulation	29,217	749	$1,500	$0	$1,500	$1,500	$0	25	12.8	12.8	15.7	15.7	18.8	18.8
Upgrade 2	Attic Insulation	29,307	659	$700	$0	$700	$700	$0	25	6.8	6.8	8.3	8.3	9.9	9.9
Upgrade 3	Foundation Insulation	17,171	12,796	$3,200	$0	$3,200	$3,200	$0	25	1.6	1.6	2.0	2.0	2.3	2.3
Upgrade 4	Crawlspace Insulation	21,436	8,530	$1,000	$0	$1,000	$1,000	$0	25	0.8	0.8	0.9	0.9	1.1	1.1
Upgrade 5	Vacuum Panel insulation	26,910	3,057	$9,000	$0	$9,000	$9,000	$0	25	18.8	18.8	23.0	23.0	27.6	27.6
Upgrade 6	Air Sealing	26,969	2,997	$600	$0	$600	$600	$50	25	3.0	3.0	3.2	3.2	3.5	3.5
Baseline 1	**Row Island**	11,377	N/A						25						
Upgrade 1	Wall Insulation	10,979	398	$1,000	$0	$1,000	$1,000	$0	25	16.1	16.1	19.6	19.6	23.5	23.5
Upgrade 2	Attic Insulation	11,104	273	$500	$0	$500	$500	$0	25	11.7	11.7	14.3	14.3	17.2	17.2
Upgrade 3	Foundation Insulation	8,828	2,548	$1,464	$0	$1,464	$1,464	$0	25	3.7	3.7	4.5	4.5	5.4	5.4
Upgrade 4	Crawlspace Insulation	9,678	1,699	$1,000	$0	$1,000	$1,000	$0	25	3.8	3.8	4.6	4.6	5.5	5.5
Upgrade 5	Vacuum Panel insulation	9,795	1,581	$9,000	$0	$9,000	$9,000	$0	25	36.4	36.4	44.5	44.5	53.3	53.3
Upgrade 6	Air Sealing	10,478	899	$600	$0	$600	$600	$50	25	9.8	9.8	10.8	10.8	11.8	11.8
Baseline 2	**Row Lab**	27,840	N/A						25						
Upgrade 1	Wall Insulation	27,144	696	$1,000	$0	$1,000	$1,000	$0	25	9.2	9.2	11.2	11.2	13.5	13.5
Upgrade 2	Attic Insulation	27,200	640	$600	$0	$600	$600	$0	25	6.0	6.0	7.3	7.3	8.8	8.8
Upgrade 3	Foundation Insulation	18,096	9,744	$1,464	$0	$1,464	$1,464	$0	25	1.0	1.0	1.2	1.2	1.4	1.4
Upgrade 4	Crawlspace Insulation	21,344	6,496	$1,000	$0	$1,000	$1,000	$0	25	1.0	1.0	1.2	1.2	1.4	1.4
Upgrade 5	Vacuum Panel insulation	25,000	2,840	$9,000	$0	$9,000	$9,000	$0	25	20.3	20.3	24.8	24.8	29.7	29.7
Upgrade 6	Air Sealing	25,056	2,784	$600	$0	$600	$600	$50	25	3.2	3.2	3.5	3.5	3.8	3.8

Energy Efficiency Upgrades
Cost and Performance Data
- Space Heating Fuel Switching, New

Type	Technology	Annual Consumption kWh/yr	Energy Svngs kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Incr. Fuel Cost	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline 1	**New Detached Island, Baseboard Electric**	12,554	N/A	$2,695	$0	$2,695	$0			15						
Upgrade 1	Oil Furnace	420	12,134	$7,000	$0	$7,000	$4,305	$150	$1,118	15	15.6	13.6	16.4	14.1	17.2	14.6
Baseline 2	**New Detached Lab, Baseboard Electric**	29,966	N/A	$2,695	$0	$2,695	$0			15						
Upgrade 1	Oil Furnace	420	29,546	$7,000	$0	$7,000	$4,305	$150	$2,668	15	11.7	10.8	12.0	11.0	12.3	11.2
Baseline 1	**New Row Island, Baseboard Electric**	11,377	N/A	$2,695	$0	$2,695	$0			15						
Upgrade 1	Oil Furnace	420	12,134	$7,000	$0	$7,000	$4,305	$150	$1,013	15	14.8	12.8	15.5	13.2	16.3	13.7
Baseline 2	**New Row Lab, Baseboard Electric**	27,840	N/A	$2,695	$0	$2,695	$0			15						
Upgrade 1	Oil Furnace	420	29,546	$7,000	$0	$7,000	$4,305	$150	$2,478	15	11.0	10.2	11.3	10.4	11.7	10.6

Energy Efficiency Upgrades
Cost and Performance Data
- Advanced Building Measures

Technology	Annual Consumption kWh/yr	Energy Svngs kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Standard Home Construction- High Consumption	12,554	N/A	$200,000	$0	$200,000		$0	30						
Upgrade 1: Built Green Bronze- EGH rating 72	10,985	1,569	$201,202	$0	$201,202	$1,202	$0	30	741.5	4.4	931.5	5.6	1,138.9	6.8
Upgrade 2: Built Green Silver- EGH rating 75	9,808	2,746	$202,104	$0	$202,104	$2,104	$0	30	425.6	4.4	534.7	5.6	653.7	6.8
Upgrade 3: Built Green Gold- EGH rating 77	9,023	3,531	$202,705	$0	$202,705	$2,705	$0	30	332.0	4.4	417.1	5.6	510.0	6.8
EGNH 80	7,846	4,708	$203,000	$0	$203,000	$3,000	$0	30	249.4	3.7	313.3	4.6	383.0	5.7
R2000	7,846	4,708	$205,500	$0	$205,500	$5,500	$0	30	252.4	6.8	317.1	8.5	387.8	10.4

Technology	Annual Consumption kWh/yr	Energy Svngs 2 kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Apartment- High Consumption	200,000	N/A	$20,000,000		$20,000,000		$0	50						
LEED Rated Apartment	120,000	80,000	$20,500,000	$0	$20,500,000	$500,000	$0	50	1,192.8	29.1	1,625.8	39.7	2,094.7	51.1

Energy Efficiency Upgrades
Cost and Performance Data
Programable Thermostat, New and Existing

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
				Capital	Installation	Full	Incremental			D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	$	$	$	$			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	Standard Home Construction- High Consumption	25,000	N/A						12						
Upgrade 1	Setback Programable Thermostat	23,500	1,500	$70	$0	$70	$70	$0	12	0.5		0.6		0.6	
Baseline 2	Standard Home Construction - mid consumption	12,000	N/A												
Upgrade 1	Setback Programable Thermostat	11,280	720	$70	$0	$70	$70	$0	12	1.0		1.2		1.3	
Baseline 3	Standard Home Construction - low consumption	8,000	N/A												
Upgrade 1	Setback Programable Thermostat	7,520	480	$70	$0	$70	$70	$0	12	1.6		1.7		1.9	

Energy Efficiency Upgrades
Cost and Performance Data
Programable Thermostat, New and Existing

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
				Capital	Installation	Full	Incremental			D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	$	$	$	$			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	Standard Home Construction- High Consumption	25,000	N/A						12						
Upgrade 1	Efficient (More Accurate) Thermostat	24,250	750	$30	$0	$30	$30	$0	12	0.4		0.5		0.5	
Baseline 2	Standard Home Construction - mid consumption	12,000	N/A												
Upgrade 1	Efficient (More Accurate) Thermostat	11,640	360	$30	$0	$30	$30	$0	12	0.9		1.0		1.1	
Baseline 3	Standard Home Construction - low consumption	8,000	N/A												
Upgrade 1	Efficient (More Accurate) Thermostat	7,760	240	$30	$0	$30	$30	$0	12	1.3		1.5		1.7	

**Energy Efficiency Upgrades
Cost and Performance Data
- Furnace Fan Motor - Existing Dwellings**

Type	Technology	Annual Consumption	Energy Svngs 2	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Base line 1	PSC - High Consumption	700		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM	420	280	$225	$0	$225	$140	$0.00	20		3.7		4.4		5.1
Base line 2	PSC - Low Consumption	350		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM	210	140	$225	$0	$225	$140	$0.00	20		7.4		8.7		10.2
Base line 3	PSC, continuous vent	2,780		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM continuous vent	1,668	1,112	$225	$0	$225	$140	$0.00	20		0.9		1.1		1.3

**Energy Efficiency Upgrades
Cost and Performance Data
- Furnace Fan Motor - New Dwellings**

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Base line 1	PSC - High Consumption	700		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM	420	280	$225	$0	$225	$140	$0.00	20		3.7		4.4		5.1
Base line 2	PSC - Low Consumption	350		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM	210	140	$225	$0	$225	$140	$0.00	20		7.4		8.7		10.2
Base line 3	PSC, continuous vent	2,780		$85	$0	$85		$0.00	20						
Upgrade 1	ECPM continuous vent	1,668	1,112	$225	$0	$225	$140	$0.00	20		0.9		1.1		1.3

Energy Efficiency Upgrades
Cost and Performance Data
High Efficiency Heat Recovery Ventilator

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
				Capital	Installation	Full	Incremental			D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	$	$	$	$			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	New home with Standard HRV	26,679	N/A	$2,500		$2,500			15						
Upgrade 1	High Efficiency HRV	24,812	1,868	$3,150	$0	$3,150	$650	$0	15	15.2	3.1	17.4	3.6	19.7	4.1
Baseline 2	New home with Standard HRV	11,531	N/A	$2,500		$2,500			15						
Upgrade 1	High Efficiency HRV	10,724	807	$3,150	$0	$3,150	$650	$0	15	35.1	7.2	40.2	8.3	45.6	9.4
Baseline 3	New home with Standard HRV	10,202	N/A	$2,500		$2,500			15						
Upgrade 1	High Efficiency HRV	9,488	714	$3,150	$0	$3,150	$650	$0	15	39.7	8.2	45.4	9.4	51.5	10.6

Energy Efficiency Upgrades
Cost and Performance Data
- Heat pumps - New Dwellings

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	Capital	Installation	Full	Incremental	O&M		Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	**Detached Island**	12,554		$900	$900	$1,800		$0.00	20						
Upgrade 1	Air Source Heat Pump - moderate winter, no cooling	6,277	6,277	$4,500	$1,000	$10,000	$8,200	$0.00	20	11.7	9.6	13.9	11.4	16.2	13.3
Upgrade 2	Ground Source Heat Pump- moderate winter, no cooling	4,394	8,160	$15,000	$5,000	$20,000	$18,200	$0.00	20	18.0	16.4	21.4	19.4	25.0	22.7
Baseline 2	**most severe winter heating load - Lab**	31,094		$900	$900	$1,800		$0.00	20						
Upgrade 1	Air Source Heat Pump - Harsh winter, no cooling	15,547	15,547	$4,500	$1,000	$10,000	$8,200	$0.00	20	4.7	3.9	5.6	4.6	6.6	5.4
Upgrade 2	Ground Source Heat Pump- Harsh winter, no cooling	10,883	20,211	$15,000	$5,000	$20,000	$18,200	$0.00	20	7.3	6.6	8.6	7.9	10.1	9.2
Baseline 3	**Electric Baseboard- Island, with DHW**	15,855		$900	$900	$1,800		$0.00	20						
Upgrade 1	Ground Source Heat Pump W desuperheater- moderate winter	6,025	9,830	$16,000	$5,000	$21,000	$11,000	$0.00	20	15.7	14.4	18.6	17.0	21.8	19.9
Baseline 4	**Electric Baseboard- Labrador, with DHW**	35,055		$900	$900	$1,800		$0.00	20						
Upgrade 1	Ground Source Heat Pump W desuperheater- harsh winter	13,321	21,734	$16,000	$5,000	$21,000	$11,000	$0.00	20	7.1	6.5	8.4	7.7	9.8	9.0

Energy Efficiency Upgrades
Cost and Performance Data
- DHW Low Flow Shower Head/Faucet Aerator -

Type	Technology	Annual Cons	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/yr	Capital $/appl	Installation $/appl	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline	DHW use	3,301													
Upgrade 1	Low Flow Shower Heads/Faucet Aerators	2,954	347	$25.0	$0.0	$25.0	$0	$0.00	10	0.9		1.0		1.1	

Energy Efficiency Upgrades
Cost and Performance Data
- DHW Tank Insulation

Type	Technology	Annual Cons	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	No Insulation	3,301							10						
Upgrade 1	Tank Insulation	3,103	198	$30.0	$0.0	$30.0	$30	$0.00	10	1.9	1.9	2.1	2.1	2.3	2.3

Energy Efficiency Upgrades
Cost and Performance Data
- DHW Pipe Insulation

Type	Technology	Annual Cons	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Base	**No pipe insulation**	3,301							15						
Upgrade 1	Pipe Wrap	3,202	99	$4.0	$0.0	$4.0	$4	$0.00	15	0.4	0.4	0.4	0.4	0.5	0.5

Energy Efficiency Upgrades
Cost and Performance Data
- Microwave/Convection Oven

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Conventional Stove and microwave oven	815		$0	$0	$0		$0.00	20						
upgrade 1	Microwave-Convection Oven	611	204	$1,400	$0	$1,400	$1,400	$0.00	20		50.6		59.9		70.0

Energy Efficiency Upgrades
Cost and Performance Data
- Cooking Fuel Switching

Type	Technology	Annual Consumption kWh/yr	Energy Svngs kWh/year	Technology Costs Capital $	Technology Costs Installation $	Installed Costs Full $	Installed Costs Incremental $	Incr. Ann. O&M	Incr. Fuel Cost	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Existing Baseline	**Conventional Electric Range**	633	N/A	$0	$0	$0	$0			18						
Upgrade 1	Propane Range, with Tank and Installation	0	633	$645	$0	$645	$645	$105	$154	18	49.0	49.0	50.3	50.3	51.8	51.8

Energy Efficiency Upgrades
Cost and Performance Data
- Refrigerator

Type	Technology	Annual Consumption kWh/fixture	Energy Svngs kWh/year	Technology Costs Capital	Technology Costs Installation	Installed Costs Full	Installed Costs Incremental	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline 1	**Baseline 18 Cu ft New**	588		$850	$0	$850		$0.00	18						
Upgrade 1	Energy Star 18 Cu Ft New	500	88	$900	$0	$900	$50	$0.00	18		4.5		5.2		6.1
Compact															
Baseline 2	**Baseline compact new**	455		$250	$0	$250		$0.00	18						
Upgrade 1	Energy Star compact	364.1	91	$300	$0	$300	$50	$0.00	18		4.3		5.1		5.9

Energy Efficiency Upgrades
Cost and Performance Data
- Freezer -

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/yr	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Baseline new freezer, upright, 17 Cu ft, Auto defrost	519		$850		$850		$0.00	18						
Upgrade 1	Energy Efficient Freezer	467	52	$900	$0	$900	$50	$0.00	18		7.6		8.9		10.3
Upgrade 2	Manual Defrost	363	155.640341	$900	$0	$900	$50	$0.00	18		2.5		3.0		3.4
Existing Baseline	Baseline new freezer, chest, 15 cu ft.	316		$500	$0	$500		$0.00	18						
Upgrade 1	Energy Efficient Freezer	285	32	$550	$0	$550	$50	$0.00	18		12.5		14.6		16.9

Energy Efficiency Upgrades
Cost and Performance Data
- Dishwasher, Elect DHW

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
										D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	new conventional	70		$500	$0	$500		$0.00	13						
Upgrade 1	New Energy Star dishwasher	41	29	$550	$0	$550	$50	$0.00	13		17.4		19.6		21.9
Existine Baseline	New Conventional Plus DHW	829		$500	$0	$500		$0.00	13						
upgrade 2	New Energy Star dishwasher plus DHW	489	340	$550	$0	$550	$50	$0.00	13		1.5		1.7		1.9

Energy Efficiency Upgrades
Cost and Performance Data
- ClothesWasher, Elect DHW

Type	Technology	Annual Consumption kWh/year	Energy Svngs kWh/year	Technology Costs Capital	Technology Costs Installation	Installed Costs Full	Installed Costs Incremental	Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Existing Baseline	**New Top Load Washing-Machine-mechanical energy only**	60		$650	$0	$650		$0.00	15						
Upgrade 1	Energy Star top-loading clothes washer	30	30	$900	$0	$900	$250	$0.00	15		75.0		85.9		97.5
upgrade 2	Horizontal axis clothes washer	30	30	$1,200	$0	$1,200	$550	$0.00	15		165.1		189.0		214.4
Existing Baseline	**New Top Load Washing-Machine + Dryer energy**	828		$650	$0	$650		$0.00	15						
Upgrade 1	Energy Star top-loading clothes washer + Dryer energy	529	299	$900	$0	$900	$250	$0.00	15		7.5		8.6		9.8
upgrade 2	Horizontal axis clothes washer + Dryer Energy	529	299	$1,200	$0	$1,200	$550	$0.00	15		16.6		19.0		21.5
Existing Baseline	**New Top Load Washing-Machine plus Dryer plus DHW**	1,719		$650	$0	$650		$0.00	15						
Upgrade 1	Energy Star top-loading clothes washer plus DHW	886	833	$900	$0	$900	$250	$0.00	15		2.7		3.1		3.5
upgrade 2	Horizontal axis clothes washer plus DHW	796	923	$1,200	$0	$1,200	$550	$0.00	15		5.4		6.1		7.0

Energy Efficiency Upgrades
Cost and Performance Data
- Consumer Electronics - Reduced Standby Losses

Type	Technology	Annual Consumption kWh/year	Energy Svngs kWh/year	Technology Costs Capital	Technology Costs Installation	Installed Costs Full	Installed Costs Incremental	Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00% Full	D.R = 4.00% Incr.	D.R = 6.00% Full	D.R = 6.00% Incr.	D.R = 8.00% Full	D.R = 8.00% Incr.
Baseline 1	**Average Annnual electricity Use - Computer**	394		$0	$0	$0		$0.00	15						
Upgrade 1	Power bar with built-in timer	331	63	$10	$0	$10	$0	$0.00	15	1.4	1.4	1.6	1.6	1.9	1.9
Baseline 2	**Average Annnual electricity Use - TV**	178		$0	$0	$0		$0.00	15						
Upgrade 1	Power bar with built-in timer	164	14	$10	$0	$10	$0	$0.00	15	6.3	6.3	7.2	7.2	8.2	8.2
Baseline 3	**Average Annnual electricity Use - TV Peripherals**	226		$0	$0	$0		$0.00	15						
Upgrade 1	Power bar with built-in timer	61	165	$10	$0	$10	$0	$0.00	15	0.5	0.5	0.6	0.6	0.7	0.7
Baseline 4	**Average Annnual electricity Use - Other Electronics**	159		$0	$0	$0		$0.00	15						
Upgrade 1	Power bar with built-in timer	146	13	$10	$0	$10	$0	$0.00	15	7.1	7.1	8.1	8.1	9.2	9.2

Energy Efficiency Upgrades
Cost and Performance Data
- Energy Star Compliant Computer

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/comp	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	baseline	394		$1,200	$0	$1,200		$0.00	8						
Upgrade 1	Energy Star Power Mgt Operating	157	236	$1,200	$0	$1,200	$0	$0.00	8		0.0		0.0		0.0

Energy Efficiency Upgrades
Cost and Performance Data
Television

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	32 inch LCD TV	250		$700	$0	$700		$0.00	20						
upgrade 1	Energy Star Compliant 32 inch LCD TV	175	75	$750	$0	$750	$50	$0.00	20		4.9		5.8		6.8

Energy Efficiency Upgrades
Cost and Performance Data
LCD Television

Type	Technology	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	27 inch CRT TV	352		$300	$0	$300		$0.00	20						
upgrade 1	32 inch LCD TV	250	102	$700	$0	$700	$400	$0.00	20		29.0		34.3		40.1

Energy Efficiency Upgrades
Cost and Performance Data
- Compact Fluorescents - New and Existing Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs 1	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Baseline: Incandescent	60	4000	240			$1	$0	$1		$0.00	0.6						
Upgrade 1	Replace incandescent with CFL	13	4000	52	188	188	$3	$0	$3	$2	$0.00	9.0	0.2	-0.7	0.2	-0.7	0.3	-0.7
Upgrade 2	Replace incandescent with white LED	40	4000	160	80	80	$46	$0	$46	$45	$0.00	10	5.0	4.9	5.7	5.6	6.5	6.4

Notes:
CCEs — CCEs are based on Energy Savings 2, which include line losses.
Line Losses — Value used: ***0%***
Line losses used in this analysis are: Area transmission (3%) and distribution (4%). Consistent with the approach applied to other electricity options, bulk transmission losses are omitted. Further detail is provided in Section 4 of the main report.
Baseline — Consumption of 60W/fixture for standard incandescent lighting system is based on typical installation. Expect life of bulb estimated at 800 hrs (range is 600 to 1000)
Upgrade 1 — Replace incandescent bulbs with 15 W/fixture CFL . Assume life of CFL at 6000 hr.
Replace incandescent bulbs with 40W LED luminous strip based on an efficacy of 20 Lumens/Watt.
Assume life of LED at 10,000 hr (ref ACEEE).

hours per day 11.0
life of incandescent (hours) 800

Energy Efficiency Upgrades
Cost and Performance Data
- Compact Fluorescents - New and Existing Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs 1	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh) D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Baseline: Incandescent	60	1200	72			$1	$0	$1		$0.00	0.6						
Upgrade 1	Replace incandescent with CFL	13	1200	16	56	56	$3	$0	$3	$2	$0.00	9.0	0.7	-2.3	0.8	-2.3	0.9	-2.3
Upgrade 2	Replace incandescent with white LED	40	1200	48	24	24	$46	$0	$46	$45	$0.00	10	16.6	16.5	19.0	18.8	21.5	21.2

Notes:
CCEs — CCEs are based on Energy Savings 2, which include line losses.
Line Losses — Value used: ***0%***
Line losses used in this analysis are: Area transmission (3%) and distribution (4%). Consistent with the approach applied to other electricity options, bulk transmission losses are omitted. Further detail is provided in Section 4 of the main report.
Baseline — Consumption of 60W/fixture for standard incandescent lighting system is based on typical installation. Expect life of bulb estimated at 800 hrs (range is 600 to 1000)
Upgrade 1 — Replace incandescent bulbs with 15 W/fixture CFL . Assume life of CFL at 6000 hr.
Replace incandescent bulbs with 40W LED luminous strip based on an efficacy of 20 Lumens/Watt.
Assume life of LED at 10,000 hr (ref ACEEE).

hours per day 1.0
life of incandescent (hours) 800

Energy Efficiency Upgrades
Cost and Performance Data
- Compact Fluorescents - New and Existing Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/fixture	hrs/year	kWh/fixture	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Baseline: Incandescent	60	365	22		$1	$0	$1		$0.00	0.6						
Upgrade 1	Replace incandescent with CFL	13	365	5	17	$8	$0	$8	$7	$0.00	9.0	6.3	-3.8	6.9	-3.3	7.5	-2.9

Energy Efficiency Upgrades
Cost and Performance Data
- Flourescent Lighting - Existing Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W	hrs/year	kWh/yr	kWh/year	Capital $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	**T12 lamp , magnetic ballast 80 W/fixture and operation of 1200 hrs/year)**	80	1200	96		$0	$0	$0		$0.00	15						
Upgrade 1	Relamp and reballast with Standard T8 lamp and electronic ballast (58 W/fixture)	58	1200	70	26	$15.00	$0.00	$15.00	$0.00	$0.00	15	5.1		5.9		6.6	
Upgrade 2	Relamp and reballast with High Performance T8 lamp and electronic ballast (48 W/fixture)	48	1200	58	38	$18.00	$0.00	$18.00	$0.00	$0.00	15	4.2		4.8		5.5	
Apartment																	
Baseline 2	**T12 lamp, magnetic ballast 80 W/fixture and operation of 8760 hrs/year)**	80	8760	701		$0	$0	$0		$0.00	15						
Upgrade 1	Relamp and reballast with Standard T8 lamp and electronic ballast (58 W/fixture)	58	8760	508	193	$15.00	$0.00	$15.00	$0.00	$0.00	15	0.7		0.8		0.9	
Upgrade 2	Relamp and reballast with High Performance T8 lamp and electronic ballast (48 W/fixture)	48	8760	420	280	$18.00	$0.00	$18.00	$0.00	$0.00	15	0.6		0.7		0.8	

Energy Efficiency Upgrades
Cost and Performance Data
- Flourescent Lighting - New Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W	hrs/year	kWh/yr	kWh/year	Capital $/fixture	Installation $/fixture	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Baseline 1	Standard T8 lamp and electronic ballast (58 W/fixture)	58	8760	508		$15	$0	$15		$0.00	15						
Upgrade 1	High Performance T8 lamp and electronic ballast (48 W/fixture)	48	8760	378	130	$18.00	$0.00	$18.00	$3.00	$0.00	15	0.7		0.9		1.2	

Energy Efficiency Upgrades
Cost and Performance Data
Holiday Lights - New and Existing Buildings

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/string	hrs/year	kWh/string	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	incandescent	150	155	23		$8	$0	$8		$0.00	3						
Upgrade 1	LED	14.0	155.0	2.2	21	$16	$0	$16	$9	$0.00	20	5.6	-9.7	6.6	-9.1	7.7	-8.5

Energy Efficiency Upgrades
Cost and Performance Data
Motion Sensors and Timers

Type	Technology	Connected Load	Hours of Operation	Annual Consumption	Energy Svngs	Technology Costs		Installed Costs		Incr. Ann. O&M	Life (yrs)	CCEs (¢/kWh)					
												D.R = 4.00%		D.R = 6.00%		D.R = 8.00%	
		W/light	hrs/year	kWh/string	kWh/year	Capital	Installation	Full	Incremental			Full	Incr.	Full	Incr.	Full	Incr.
Existing Baseline	Dusk to Dawn Operation	60	3650	219						$0.00	20						
Upgrade 1	Timer to switch off at Midnight	60.0	1460	87.6	131	$20	$0	$20	$20	$0.00	10	1.9		2.1		2.3	
Upgrade 2	Motion sensor	60.0	182.5	11.0	208	$50	$0	$50	$50	$0.00	10	3.0		3.3		3.6	

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APPENDIX B

Achievable Potential Workshop Materials

Opportunity Profile

R1: PROGRAMMABLE THERMOSTAT

Overview:

Digital programmable thermostats provide improved temperature setting accuracy and are capable of multiple time settings. When combined with an assumed 4ºC temperature setback during night and unoccupied periods, typical space heat savings are in the range of 10% to 15% relative to the baseline, depending on the dwelling's vintage and type of dwelling.

Other utility studies have indicated that a lower savings percentage should be used, to reflect the fact that the thermostat's setback capabilities do not completely reflect how they are used, e.g., some home occupants reliably set back manual thermostats, and some home occupants do not use the setback features on their electronic thermostats. Accordingly a value of 6% savings has been used in this study.

Target Technologies and Dwelling Types:

- The programmable setback thermostat is a mature technology
- This technology is applicable to all dwelling types, but is most easily applied where a limited number of thermostats can be used to control all the heating devices in the dwelling.

Opportunity Costs and Savings Profile:

- This technology is assumed to cost an average of $70 per dwelling.
- In single family dwellings with baseboard electric heating, in most cases it is possible to combine more than one baseboard per thermostat, so that three to four thermostats can be used. In dwellings with forced air systems, one thermostat will usually control the whole dwelling.
- Customer payback is approximately one year, somewhat longer in Labrador.
- The CCE for this measure in detached dwellings ranges from 0.6 in Labrador to 1.2 in the Island, or somewhat higher for attached dwellings and apartments.

Potential energy performance or technology price trends affecting this Opportunity include:

- Pricing and performance are relatively stable for this technology.
- For homes with a need for more thermostats because of multiple baseboards, another option is the high efficiency (more accurate) thermostat, which is lower cost but is still expected to save approximately 3%.
- There is added uncertainty in the savings estimates for this technology because of the behavioural aspect.

Target Audience(s) & Potential Delivery Allies:

- Homeowners and renters
- HVAC contractors and retailers

Constraints & Challenges:

- Some consumers still think a thermostat behaves like a gas pedal (the higher you set it, the faster the house warms up!)
- Tendency for some users to override the setback
- Installation is simple for central thermostats on 24-V loops, but not for in-line thermostats controlling a powerful baseboard

Opportunities & Synergies:

- Could build on/expand previous Nfld thermostat rebate programs
- Could be offered in conjunction with other programs, through trade allies, or even used as a premium to entice consumers to participate in other programs
- Amenable to use of point-of-sale rebates or other in-store promotions

Experience Related to Possible Participation Rates:

*R1: Space heating, Programmable Thermostats: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	31	27	79	79												
Attached	5	5	10	10												
Apartment	3	2	10	10												
Other	1	1	11	11												
Total	40	35	110	109												

New

Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	2	5	3	12												
Attached	0	1	1	2												
Apartment	0	1	1	2												
Other	0	0	0	0												
Total	3	7	5	16												
Grand Total	42	41	114	125												

NOTES:
* Includes savings of heating and ventilation.

Opportunity Profile

R2: CONVERT INCANDESCENT LAMPS TO STANDARD CFLS

Overview:

This Opportunity will encourage consumers to convert their household lighting from incandescent bulbs to Compact Fluorescent bulbs (CFLs). Standard CFL refers to relatively low-cost lamps in relatively high-use fixtures. There is additional cost effective potential from higher cost, specialty CFLs for dimmable and odd-shaped applications however the greatest potential results from the standard type.

Standard CFLs can save up to 80% of electricity use per fixture and are considered capable of achieving a very high market penetration.

Target Technologies and Dwelling Types:

- Coil or regular bulb shaped non-dimmable CFLs for high-use fixtures
- The focus dwelling type for this discussion is single family dwellings in the Island and Isolated region

Opportunity Costs and Savings Profile:

- Typical cost per application is in the range of $3
- Annual electricity savings per fixture are estimated to be in the range of 56 kWh/yr
- Customer payback is approximately 0.5 years in the Island and Isolated region, 1.5 years in the Labrador Interconnected region.
- The CCE for this opportunity is 0.008 $/kWh

Potential energy performance or technology price trends affecting this Opportunity include:

- The price of CFLs has been decreasing and this trend is expected to continue
- It is still not possible to find CFLs to fit all applications. Increased versatility of design will affect this opportunity.

Target Audience(s) & Potential Delivery Allies:

- Homeowners and renters
- Builders/developers
- Lighting consultants / retailers
- Federal/provincial home energy audit programs (e.g. EcoEnergy)
- Nfld Dept of Natural Resources

Constraints & Challenges:

- Low awareness and education of upgraded CFL technology re: colour rendition (warm white), converting lumen output
- Technology for some applications such as dimmable not fully developed (poor turndown, interference with home audio)
- Awareness and education of appropriate applications and conditions (e.g. Cold weather requires specialty bulb, high frequency of switching on and off is not appropriate etc.)
- Non Energy Star, poor quality, CFL's with poor operating performance and service life, stark colour rendition.

Opportunities & Synergies:

- Opportunity to build on earlier EE workshops and co-operative efforts with Dept. of Natural Resources
- Well suited to mass market campaigns with point-of-sale promotion involving major retailers
- Pending provincial/ regional/ municipal legislation or bylaws (e.g., Province of Ontario) may add profile

Experience Related to Possible Participation Rates:

In BC, between March 2002 and December 2005, the Power Smart (PS) CFL Program encouraged residential customers to adopt CFLs and torchieres through monetary incentives and giveaways.

- Nfld residential lighting load is approximately 10 to 15% of BC load
- BC Net Cumulative Energy Savings = 340 GWh
- BC Participants = 703,042 (95.2% CFLs)
- 55% of households in 2006 had at least 1 CFL

*R2: Lighting, CFLs - Standard: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thous. Eq Dwellings Affected **		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	113	109	119	118												
Attached	13	13	15	15												
Apartment	6	6	14	14												
Other	5	5	17	17												
Total	137	132	165	164												

New

Building Type	Economic Potential Annual Savings (GWh)		Cumulative Thous. Eq Dwellings Affected **		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	5	16	5	17												
Attached	1	3	1	3												
Apartment	0	1	1	3												
Other	0	0	0	0												
Total	6	20	7	24												
Grand Total	143	152	172	188												

NOTES:
* The Standard CFL refers to relatively low-cost lamps in relatively high-use fixtures. There is additional cost effective potential from higher cost, specialty CFLs for dimmable and odd-shaped applications.
** In this case, numbers of Eq Dwellings refer to equivalent complete dwellings converted over to CFL. Thus, if 80% of the lighting hours in 100 houses are converted to CFL, that is the same as 100% of the lighting hours in 80 houses.

Opportunity Profile

R3: FOUNDATION INSULATION IN EXISTING HOUSING

Overview:

Foundation insulation would be added to an existing house in the context of a basement renovation project that would involve adding or replacing the interior frame walls of the basement. While the frame walls are being constructed, insulation would be upgraded to a level of RSI-4. Many houses in Newfoundland and Labrador have heated basements with little or no insulation. Savings can range from 18% to over 40% of space heating consumption, depending on the location and type of house. If the heating system uses forced air, savings from furnace fans would be approximately the same percentage.

Target Technologies and Dwelling Types:

- Insulation can be fibreglass batt or a variety of other types
- The focus dwelling type for this discussion is single family dwellings in the Island and Isolated region

Opportunity Costs and Savings Profile:

- Typical cost per application is in the range of $40 per square metre of basement wall area
- Annual electricity savings per household are estimated to be around 3300 kWh/yr in a single family detached dwelling in the Island and Isolated region.
- Customer payback is approximately 11 years for a single family detached dwelling in the Island and Isolated region.
- The CCE for this opportunity is between 0.02 $/kWh and 0.08 $/kWh

Potential energy performance or technology price trends affecting this Opportunity include:

- This technology is mature

Target Audience(s) & Potential Delivery Allies:

- Homeowners
- Building supply outlets
- Renovation contractors
- Insulation contractors
- Home Energy Auditors

Constraints & Challenges:

- Contractor training and experience, requires labour intensive and careful application
- Competes with other insulation business, typically only performed in down periods when other work not available

Opportunities & Synergies:

- Build on Wrap up for Savings program
- Impact could be expanded by combining with EGH service and/or ecoENERGY where homeowners can receive $500 to $1000 depending on R-value
- Good opportunity for point-of-sale promotion
- Add-on to basement renovation projects where basement walls are exposed.

Experience Related to Possible Participation Rates:

- Participation rates in NL Wrap up for Savings have averaged about 350 participants per year over the past 3 years and the related electricity savings have averaged about 1.25.GWh/year in the same period.

*R3: Space heating, Foundation Insulation: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh) 2011	Economic Potential Annual Savings (GWh) 2026	Cumulative Thousands of Eq Dwellings Affected 2011	Cumulative Thousands of Eq Dwellings Affected 2026	Lower Achievable Scenario: Achievable Participation 2011	Lower: Achievable Participation 2026	Lower: Achievable Potential Annual Savings (GWh) 2011	Lower: Achievable Potential Annual Savings (GWh) 2026	Lower: Achievable Eq Thous. Dwellings Affected 2011	Lower: Achievable Eq Thous. Dwellings Affected 2026	Upper Achievable Scenario: Achievable Participation 2011	Upper: Achievable Participation 2026	Upper: Achievable Potential Annual Savings (GWh) 2011	Upper: Achievable Potential Annual Savings (GWh) 2026	Upper: Achievable Eq Thous. Dwellings Affected 2011	Upper: Achievable Eq Thous. Dwellings Affected 2026
Detached	10.78	$ 0.084	32	152	20	92												
Attached	7.27	$ 0.057	4	17	3	12												
Total			36	168	22	104												

New

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh) 2011	Economic Potential Annual Savings (GWh) 2026	Cumulative Thousands of Eq Dwellings Affected 2011	Cumulative Thousands of Eq Dwellings Affected 2026	Lower Achievable Scenario: Achievable Participation 2011	Lower: Achievable Participation 2026	Lower: Achievable Potential Annual Savings (GWh) 2011	Lower: Achievable Potential Annual Savings (GWh) 2026	Lower: Achievable Eq Thous. Dwellings Affected 2011	Lower: Achievable Eq Thous. Dwellings Affected 2026	Upper Achievable Scenario: Achievable Participation 2011	Upper: Achievable Participation 2026	Upper: Achievable Potential Annual Savings (GWh) 2011	Upper: Achievable Potential Annual Savings (GWh) 2026	Upper: Achievable Eq Thous. Dwellings Affected 2011	Upper: Achievable Eq Thous. Dwellings Affected 2026
Detached	9.19	$ 0.072	3	57	1	17												
Attached	5.74	$ 0.045	0	7	0	3												
Total			4	64	1	20												
Grand Total			40	232	23	124												

NOTES:
* Includes savings of heating and ventilation.

Opportunity Profile

R4: AIR LEAKAGE SEALING

Overview:
Air sealing of building envelopes includes completion of a blower door test to quantify leakage levels and to identify the location of air leaks. Generally, major leakage occurs at window-to-wall interfaces, around doors, through electrical and plumbing penetrations, at the top of foundation walls, and around chimneys and fireplaces. Savings can range from 8% to over 20% of space heating consumption, depending on the location and type of house. If the heating system uses forced air, savings from furnace fans would be approximately the same percentage.

Target Technologies and Dwelling Types:
- Installation of sealant and gaskets are generally accepted methods for reducing air leakage in buildings.
- The focus dwelling type for this discussion is single family dwellings in the Island and Isolated region

Opportunity Costs and Savings Profile:
- Typical cost per application is in the range of $900 depending on the type of house
- Annual electricity savings per household are estimated to be around 1200 kWh/yr in a single family detached dwelling in the Island and Isolated region .
- Customer payback is approximately 8 years.
- The CCE for this opportunity is between 0.02 $/kWh and 0.10 $/kWh

Potential energy performance or technology price trends affecting this Opportunity include:
- This technology is mature, but there may be a shortage of trained contractors

Target Audience(s) & Potential Delivery Allies:
- Homeowners
- Renovation contractors
- Insulation contractors
- Home Energy Auditors

Constraints & Challenges:
- Best approach is to use air test to identify opportunities
- Currently, few companies in Nfld with capability
- Low industry awareness and support of air sealing – most don’t understand benefits or method
- Contractor training and experience, requires labour intensive and careful application
- Competes with other insulation business, typically only performed in down periods when other work not available

Opportunities & Synergies:
- Most air sealing work in Nfld is done by homeowners; they need better info but could be encouraged with improved information, such as checklists, product lists and procedures etc.
- Add-on to larger home renovation projects where adjacent walls are exposed, insulation, drywall and siding installers on-site

Experience Related to Possible Participation Rates:
- Participation rates in NL Wrap up for Savings have averaged about 350 participants per year over the past 3 years and the related electricity savings have averaged about 1.25.GWh/year in the same period.

*R4: Space heating, Air Leakage Sealing: Economic Scenario, Residential Sector, Island and Isolated Region **

New

Building Type	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower Achievable Scenario: Achievable Potential Annual Savings (GWh)		Lower Achievable Scenario: Achievable Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper Achievable Scenario: Achievable Potential Annual Savings (GWh)		Upper Achievable Scenario: Achievable Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	6.05	$ 0.098	5	19	6	21												
Total			5	19	6	21												
Grand Total			5	19	6	21												

NOTES:
* Includes savings of heating and ventilation.

Opportunity Profile

R5: EFFICIENT WINDOWS

Overview:

High-performance windows are double glazed with a ½"-inch air space; they incorporate a number of additional energy-saving features including low E (soft coating), insulating spacers, argon fill and low conductivity frames (a mix of sliders, hinged and picture). The more efficient windows reduce heat loss through the window by 20% or more, compared to the average low- or mid-efficiency replacement window depending on dwelling type and region. High-performance windows have an RSI value of 0.5 (R-2.8) or higher. The efficient window is assumed to be equivalent in performance to and Energy Star rated window, whether or not the window has been tested and received that label.

Target Technologies and Dwelling Types:

- Windows being purchased for retrofit or for installation in new homes. These are two quite different markets.
- This technology is applicable to all dwelling types. The focus for this discussion is single family dwellings in the Island and Isolated region.

Opportunity Costs and Savings Profile:

- This analysis employs an incremental cost of $4 per square foot to renovate an existing dwelling to high-performance windows as opposed to standard windows. If the upgrade is chosen as part of a new construction, the incremental cost is $2 per square foot, because typically windows for new construction are purchased wholesale, where the incremental cost is smaller.
- Annual electricity savings per computer are estimated to be in the range of 3-7% of space heating energy, depending on housing type and region. Absolute potential savings are higher in new dwellings, because they tend to have more and larger windows, but they are especially larger as a percentage of space heat loss, because they other components of the envelope are so much better in new homes.
- Customer payback is between 2.5 and 9 years for existing homes, depending on dwelling type and region, shorter for new homes.
- The CCE for this measure is between 0.02 $/kWh and 0.04 $/kWh for existing dwellings, depending on type and region, approximately half that for new dwellings.

Potential energy performance or technology price trends affecting this Opportunity include:

- The standard energy performance for a window will evolve over the course of the study period, as will the energy performance that will qualify for the Energy Star label.
- The Energy Star standard is generally targeted to allow 25% of the products in the market to pass. It is assumed in the reference case that 25% of the windows purchased in NL will qualify, throughout the study period.
- Studies in other markets have shown that the mark-up on the increment between standard and efficient windows tends to be dramatic as the window moves from the wholesale to the retail marketplace.

Target Audience(s) & Potential Delivery Allies:

- Homeowners
- Retailers and contractors
- Tract builders

Constraints & Challenges:

- Nfld EGH experience indicates that many window replacements are still not EE models
- Need for more education to both retailers and consumers
- Replacement of windows is slow; the measure is financially practical only as an increment over an already planned window replacement
- Tract builders tend not to offer premium windows as an option, despite potentially attractive mark-ups.
- In new homes, any increases in window efficiency are assumed to be more than cancelled out by increases in the number and size of windows.

Opportunities & Synergies:

- Opportunity to combine with residing renovations and with ecoEnergy exterior wall grants ($900 for R3.8 addition) and $30 per EStar window
- High-performance windows provide occupant co-benefits, such as reduced interior noise, reduced air leakage, greater thermal comfort and fewer condensation problems
- The study includes an even higher level of performance for windows. These "super" windows also pass the economic screen for some dwelling types, and could be incorporated as an additional element in a window program.

Experience Related to Possible Participation Rates:

*R5: Space heating, Energy Star Windows : Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	3.79	$ 0.030	2	19	4	41												
Attached	4.54	$ 0.036	0	3	1	5												
Apartment	7.41	$ 0.065	1	6	1	3												
Total			3	27	5	49												

New

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	2.49	$ 0.020		2		2												
Attached	2.27	$ 0.018		0		0												
Total				2		3												
Grand Total			3	29	5	52												

NOTES:
* Includes savings of heating and ventilation.

Opportunity Profile

R6: ENERGUIDE 80

Overview:

An EnerGuide for Houses rating is a standard measure of a home's energy performance, calculated by a professional EnerGuide for Houses advisor. The rating is based on information from the construction plans of the home and the results of a blower door test performed once the house has been built. A blower door test measures air leakage when the air pressure within the house is lowered a specified amount below the air pressure outside. EnerGuide ratings for new houses fall within the following ranges:

- Typical new detached houses: 69 to 74 (a house built to code would typically receive a rating of 68), townhouse 73-76
- Energy-efficient new houses: 77 to 82
- R-2000 houses: 80 minimum (includes environmental features add-on requirement)
- Highly energy-efficient new houses: 84 to 90
- Advanced houses using little or no purchased energy: 91 to 100.

This analysis estimates that annual space heating savings are 38% relative to standard new houses.

Target Technologies and Dwelling Types:

- The focus dwelling type for this discussion is single family dwellings (detached & townhouses) in the Island and Isolated region
- A variety of energy efficient technologies can be incorporated into the design of a new home to ensure it receives an EnerGuide rating of 80 or above

Opportunity Costs and Savings Profile:

- Typical cost per application is in the range of $3000 incremental cost
- Annual electricity savings per household are estimated to be in the range of 4,700 kWh/yr
- Customer payback is approximately 6 years.
- The CCE for this opportunity is about 0.046 $/kWh

Target Audience(s) & Potential Delivery Allies:

- Prospective Homebuyers
- Builders and Developers
- Home Builder's Associations
- Complementary programs (e.g. Built Green, municipal housing authorities, planning depts)

Constraints & Challenges:

- Remote locations of Nfld provide challenge re: delivery capability
- Existing infrastructure of Certified Energy Evaluators insufficient to meet large volume demand
- Inflationary house prices restrict exploration of incremental first costs

Opportunities & Synergies:

- In some examples, monthly payment for principal, interest, taxes and energy are less for EGH 80 than conventional; may provide useful promotion message
- Provincial /municipal regulatory influences regarding EG80 as baseline
- Townhouse units typically score higher EG73 -76, interior units higher again, large townhouse/row house growth
- Legislation on equipment technologies indirectly raises baseline scores, results in only incremental improvements required

Experience Related to Possible Participation Rates:

- Former EGH had low uptake in NL

*R6: Space heating, New House Designed to an EGNH 80 Rating: Economic Scenario, Residential Sector, Island and Isolated Region **

New

Building Type	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower Achievable Scenario: Achievable Potential Annual Savings (GWh)		Lower Achievable Scenario: Achievable Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper Achievable Scenario: Achievable Potential Annual Savings (GWh)		Upper Achievable Scenario: Achievable Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	6.37	$ 0.046	2	26	1	10												
Attached	6.37	$ 0.046	0	5														
Total			2	31	1	10												
Grand Total			2	31	1	10												

NOTES:
* Includes savings of heating and ventilation.

Opportunity Profile

R7: POWER BAR WITH INTEGRATED TIMER TO REDUCE STANDBY LOSSES IN HOUSEHOLD ELECTRONICS

Overview:

This Opportunity will encourage consumers to plug their TVs and TV peripherals (e.g., set top boxes, audio systems etc.) into a "Smart" power bar that has an integrated timer rather than directly into the wall socket. This will enable users to completely turn off the electricity to these appliances when not in use. Technologies for doing this vary in sophistication, but the target technology for this discussion is a power bar with a built-in timer, such as those eligible for rebate under OPA's current program. The timer will automatically turn the power bar "on" and "off" daily at preset times.

This opportunity recognizes that TVs, and in particular TV peripherals, such as set top boxes, consume significant amounts of electricity even in the "off" mode. This end use will become more important as North America shifts to digital broadcasting over the next few years. Current digital receivers (cable and satellite) consume up to 80% of their load even in the "off" mode.

Target Technologies and Dwelling Types:

- Smart power bars with integrated timers
- Two main applications include: Televisions & peripherals; computers & peripherals
- The focus dwelling type for this discussion is single family dwellings in the Island and Isolated region

Opportunity Costs and Savings Profile:

- Typical cost per application is in the range of $40 per household
- Annual electricity savings per application are estimated to be in the range of 16 kWh/yr for TVs and 168 kWh/yr for TV Peripherals.
- Customer payback is approximately 1 year in the Island and Isolated region, 3 years in the Labrador Interconnected region.
- The CCE for this opportunity is as low as 0.006$/kWh, depending on the application.
- Additional savings are available from applying the same technology to computers and to other electronics.. The discussion will focus on TVs and peripherals, however.

Potential energy performance or technology price trends affecting this Opportunity include:

- The power bars with timers are emerging in the marketplace in response to programs like that in Ontario. More sophisticated devices will likely follow.

Target Audience(s) & Potential Delivery Allies:

- Homeowners and renters
- Home entertainment retail outlets
- Home theatre installers, electrical contractors

Constraints & Challenges:

- Lack of consumer awareness re: energy use in "off" mode
- Larger LCD and plasma sets require sequential "turn down' process to cool and dissipate internal heat from lamp, may void manufacturer warranty provisions
- May be some service disruption while set top box re-boots (set top boxes download info hourly, may upset internal timer and microprocessor function)
- Safety consideration of overloading (either of the smart bar or the circuit) and counterfeit products

Opportunities & Synergies:

- Well suited to mass market campaigns with point-of-sale promotion involving major retailers
- Incremental sales opportunity for retailers, installers (currently cable, speakers, integrated remotes)

Experience Related to Possible Participation Rates:

- Mass market campaign currently underway in Ontario; results not yet available

*R7: Television and Peripherals, Standby Losses: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Building Type	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thous. Eq Dwellings Affected **		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation				Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2016	2021	2026	2011	2026	2011	2026
Detached	0.61	$ 0.016	76	80	109	79														
Attached	0.61	$ 0.016	14	15	14	10														
Apartment	0.61	$ 0.016	10	11	13	10														
Total			100	106	136	98														

New

Building Type	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thous. Eq Dwellings Affected **		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation				Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2016	2021	2026	2011	2026	2011	2026
Detached	0.61	$ 0.016	3	13	4	12														
Attached	0.61	$ 0.016	1	3	1	2														
Apartment	0.61	$ 0.016	1	3	1	2														
Total			5	20	6	16														
Grand Total			105	125	142	114														

NOTES:
* This is the standby loss just for televisions and peripherals.

Opportunity Profile

R8: ENERGY STAR COMPUTER

Overview:
The Energy Star specification for computers was revised in October 2006 and went into effect in July 2007. The previous specification only addressed energy use during a computer's sleep mode and was not demanding even in this respect with approximately 98% of available computers carrying the Energy Star label. The energy savings were also dependent on the operating mode set by the user. The requirements have been seriously revised in an attempt to offer greater differentiation for innovative, truly energy-efficient models and now address all modes of operation in order to have automatic savings that are not dependent on user behaviour. It is estimated that the new specification will mean that Energy Star computers and computer peripherals use on average 65% less energy than conventional models.

Target Technologies and Dwelling Types:
- Computers being purchased new or due for replacement
- This technology is applicable to all dwelling types. The focus for this discussion is single family dwellings in the Island and Isolated region.

Opportunity Costs and Savings Profile:
- This technology has a negligible cost premium over standard computer models.
- Annual electricity savings per computer are estimated to be in the range of 240 kWh/year
- Customer payback is instantaneous
- The CCE for this measure is zero.

Potential energy performance or technology price trends affecting this Opportunity include:
- The standard energy performance for a computer will evolve over the course of the study period, as will the energy performance that will qualify for the Energy Star label.
- In the reference case, any increases in efficiency are assumed to be more than cancelled out by increases in the number of peripherals and the hours of use.
- Energy Star labelling requirements are typically targeted to allow approximately 25% of the products on the market to pass. It is therefore assumed that in the reference case, 25% of computers purchased in NL will be Energy Star qualified, throughout the study period.

Target Audience(s) & Potential Delivery Allies:
- Homeowners and renters
- Computer retail outlets

Constraints & Challenges:
- Lack of consumer awareness
- Tendency for some users to override energy saving features
- Increasing size of screens, number of peripherals, and hours of use

Opportunities & Synergies:
- Computer replacement is relatively rapid, with useful life typically in the range of 6 years in the residential sector (longer than the replacement cycle in the commercial sector)
- No-cost selling feature for retailers to use as an additional marketing hook

Experience Related to Possible Participation Rates:

R8: Computer and peripherals, Energy Star Computer: Economic Scenario, Residential Sector, Island and Isolated Region

Existing/Renovated

							Lower Achievable Scenario						Upper Achievable Scenario					
Segment	CCE ($/kWh)	Customer Payback (yrs)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Eq Thous. Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	$ -	0.00	16	60	59	118												
Attached	$ -	0.00	2	8	8	15												
Apartment	$ -	0.00	1	5	7	14												
Total			19	74	74	147												

New

Segment	CCE ($/kWh)	Customer Payback (yrs)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Eq Thous. Dwellings Affected		Achievable Participation		Achievable Potential Annual Savings (GWh)		Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026
Detached	$ -	0.00	1	9	2	17												
Attached	$ -	0.00	0	2	0	3												
Apartment	$ -	0.00	0	1	0	3												
Total			1	12	3	24												
Grand Total			20	86	77	171												

NOTES:

Opportunity Profile

R9: ENERGY STAR CLOTHES WASHER

Overview:
This Opportunity will encourage consumers to upgrade from a standard model top loading clothes washer to an energy star equivalent. Energy Star clothes washers use 50%-60% less hot water and 50% less mechanical energy per load than standard models. Because Energy Star clothes washers spin faster, there are additional savings in dryer energy of approximately 35%. In January 2007 the Energy Star standard for clothes washers was increased, however the base regulation was also increased and the savings above the baseline therefore remain the same.

Target Technologies and Dwelling Types:
- Washing machines purchased new or due for replacement
- The focus dwelling type for this discussion is single family dwellings in the Island and Isolated region

Opportunity Costs and Savings Profile:
- Typical cost per application is in the range of $250 incremental
- Annual electricity savings per fixture are estimated to be in the range of 840 kWh/yr (includes savings in DHW and the dryer)
- Customer payback is approximately 3 years, longer in Labrador (where it does not pass the screen).
- The CCE for this opportunity is 0.08.5 $/kWh for a top loader, assuming that both DHW and dryer savings occur

Potential energy performance or technology price trends affecting this Opportunity include:
- Energy Star top loading washing machines are disappearing from the market, replaced by front loading designs.
- Future changes to Energy Star standards may affect costing and efficiency for qualifying models
- Greater availability of stackable washer/dryer options coming into market.

Target Audience(s)& Potential Delivery Allies:
- Homeowners and renters
- Appliance retailers
- Builders and developers
- Municipal / regional water conservation programs
- Green building architects / consultants (e.g. LEED planners for multifamily residential)

Constraints & Challenges:
- Nfld water quality issues may shorten appliance life and constrain consumer willingness to pay the incremental cost
- Consumer awareness of cold water washing detergents,
- Increased maintenance required to avoid accumulation of stagnant water in door assemblies
- High revolution spin cycle can cause floor vibration in some applications.

Opportunities & Synergies:
- Incremental sales opportunity for dryer sale as matched set with washer (attractive to appliance retailers)
- Integrate with green building programs as incremental points
- Although it is the top-loader models that pass the economic screen, consumers wishing to spend the extra money for a front-loader model could still qualify for programs.

Experience Related to Possible Participation Rates:
In BC recent data show that:
- 30% to 40% of current clothes washer sales are Energy Star
- 14% of households report having a front-loading clothes washer, with an average age of 4.0 years

*R9: Clothes washer, Energy Star Top Loading Clothes Washer: Economic Scenario, Residential Sector, Island and Isolated Region **

Existing/Renovated

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026		
Detached	2.78	$ 0.086		86		118														
Attached	2.78	$ 0.086		9		15														
Apartment	2.78	$ 0.086		6		14														
Total				102		147														

New

Segment	Customer Payback (yrs)	CCE ($/kWh)	Economic Potential Annual Savings (GWh)		Cumulative Thousands of Eq Dwellings Affected		Lower Achievable Scenario: Achievable Participation		Lower: Achievable Potential Annual Savings (GWh)		Lower: Achievable Eq Thous. Dwellings Affected		Upper Achievable Scenario: Achievable Participation		Upper: Achievable Potential Annual Savings (GWh)		Upper: Achievable Eq Thous. Dwellings Affected	
			2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026	2011	2026		
Detached	2.78	$ 0.086		13		17														
Attached	2.78	$ 0.086		2		3														
Apartment	2.78	$ 0.086		1		3														
Total				17		24														
Grand Total				119		171														

NOTES:
* This is the savings from DHW, the washer, and the dryer.

MARBEK
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APPENDIX C

LOADLIB Model Description

Electric Demand Modelling, AEG Model Description

The modeling of electric demand employs Applied Energy Group's (AEG) Cross-Sector Load Shape Library Model (LOADLIB). The load shape library, as implemented through the AEG LOADLIB Model, provides a means for organizing, documenting and reporting statistics on load shapes for use in various applications, including load research, load forecasting, load aggregation, and demand-side management impact analysis.

LOADLIB uses a per-unit structure data format that facilitates calibration of load data to take advantage of known statistics and best sources, and scaling of load data to match target consumption levels. The format was developed by AEG to provide a means of more easily describing load profiles in a way that is both flexible and detailed. This format has supported many projects for numerous AEG clients since its first use in 1982. The <u>36-day format</u> developed and used for the LOADLIB System consists of three hourly load profiles per month -- peak day, average weekday and average weekend day, and one set of ratios for each of twelve months. The format consists of four profile parameters, as follows:

- ***Monthly Usage Allocation:*** This allocation factor represents the percent of annual usage allocated to each month. This set of monthly fractions (percentages) reflects the seasonality of the load shape, whether a facility, residence, end use or appliance, and is dictated by weather or other factors. An equal allocation (1/12 each month, or 8.33%) would indicate no seasonality. This parameter can be calibrated to actual values using statistics such as monthly kWh from utility bills and weather (degree days).

- ***Peak Day Adjustment Factor***: This ratio reflects the degree of daily weather-sensitivity associated with the load shape, particularly heating or cooling, comparing a peak (e.g. hottest or coldest day) day to a typical day in that month. For overall facilities, this is typically dependent on the amount of air-conditioned or electrically-heated space in the facility and the weather conditions of the area in which it is located. A highly air-conditioned office space in a warm climate may have a peak day adjustment factor of as much as 1.5 - 1.6, while an unconditioned space with no difference between peak days and typical days might have a factor of 1.0.

- ***Weekend to Weekday Ratio***: This ratio describes the relationship between weekends and weekdays, reflecting the degree of weekend activity inherent in the facility or end use. For example, residential customers will have weekend to weekday ratios close to 1.0 or even slightly greater than 1.0, because residential consumption levels on weekend days and weekdays are generally about the same, although they may occur at different times of the day. For offices, weekend to weekday ratios will vary between 60-80% of weekdays, depending on the degree of weekend operations, i.e., whether it is a 5-day only operation, vs. six or seven days.

- ***Per-Unit Hourly Profiles***: The relationship of load among different hours of the day for each day type (weekday, weekend day, peak day) and for each month reflects the operating hours of the electric equipment, facility or residence. In the case of businesses, the hourly energy profile reflects when the business operates, as well as what equipment (such as lighting and air conditioning) operates during off-hours. For example, a large office building open from 9-5 on weekdays will have close to full energy consumption levels (80-100%) during the day, then drop to 50-60% of peak levels during the evening and 30-40% of peak levels overnight. The overnight consumption typically includes security lighting, 24-hour computer operations, and other 24-hour equipment (refrigerators, clocks).

The resulting complete load shape description can be easily calibrated to match known statistics such as monthly billing or weather, and produce any relevant statistic that may be required to convert annual energy to monthly energy, daily energy, and peak demands for any hour and for any month. An offshoot of the LOADLIB analysis is a set of standard statistics that can be used as inputs to many other energy models, including load factors, coincidence factors, average and peak demands, hours-use, and calculation of bills for various rate structures.