Newfoundland and Labrador
Board of Commissioners of Public Utilities

Muskrat Falls Review

Public Presentation

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Efficiency is the ratio of useful work performed to the total energy expended. Aiming for high efficiency is a wise use of resources. It reduces waste, allows higher productivity and businesses to be more competitive and more profitable. But there is a cost to high efficiency. In the market place it is desirable that it be cost effective.

Perhaps no groups of professionals use the efficiency word more than engineers. It is indispensible for their analysis for projects and products design and application. The word shows up in the Manitoba Hydro International (MHI) Report in the section on "forecasts". It is the intent of this presentation to challenge the low weight and low value placed by our power companies on the efficiency component. Efficiency is part of a factor called "technology change". This is one of the components, an input, into the formulas being used by our power companies to predict future electrical energy needs, that is forecasts. It's effect would be good in that it would help drive down the energy and peak demand needs, and it is beneficial to help offset the contributions by other factors that tend to increase energy needs, like more new houses, more conversions from oil to electric heat etc.

The MHI Report gives some comparison of the methods used for forecasting by our power companies, as compared to the provinces of Ontario, Manitoba, and British Columbia. It says the "key finding" is that Ontario, Manitoba and British Columbia all use End-Use Models to predict the domestic (residential) forecast. Our power companies, both Newfoundland Power and Newfoundland and Labrador Hydro DO NOT.

The MHI report makes recommendations in this regard:

1. That Nalcor should develop an end-use forecasting model for the domestic sector, and that the best utility practice for preparing a domestic energy forecast is to use a combination of regression and end-use modeling techniques.
2. Newfoundland and Labrador hydro should partner with Newfoundland Power to develop and implement an end-use methodology to predict future domestic energy consumption.

3. Additional details of end-use forecasting methods may likely improve, but not guarantee an improvement, as it depends on the accuracy of the assumptions on which it is based.
4. The current process produces reasonable results, but it does not possess the explanatory power of an end-use methodology, and that end-use methods improve the capability to:
   a) Quantify the load growth by end-use
   b) Quantify energy -efficiency by end-use.
   c) Incorporate new end-uses (e.g. electric cars)
   d) Improve the design of CDM (conservation demand management) programs.
   e) Improve the defensibility of the load forecasting methods.
5. That Newfoundland and Labrador Hydro should partner with Newfoundland Power to develop a coordinated load research program using information by sector and end-use. To incorporate all sectors: domestic, general service, and industrial. This would also include end-use (e.g. space heating) load research information so as to integrate the energy and peak forecasting processes.

The MHI report says Newfoundland and Labrador Hydro's ability to conduct detailed end-use analysis is limited since they do not have access to the majority of customer's billing information. Newfoundland Power, a privately owned utility distributes power to 90 percent of the island's domestic and general service customers. Yet, it is Newfoundland and Labrador Hydro, which has the responsibility for developing the long term forecast to assess future generation requirements on the island.

Again the MHI report says the current models do not have the explanatory power of end-use analysis.

> "That end-use models are based on detailed customer billings and survey analysis. That end-use models are calculated using a bottom up approach, meaning- that the forecast is calculated by summing up the energy associated with each of the major domestic end-uses such as; electric space heat, electric water heating, fridges, washers, dryers, dishwashers, televisions, personal computers and lighting, plus a miscellaneous component to represent all other electrical uses."

The MHI report says:

> "The domestic sector represents about 50 percent of all electricity sales on the island," and "Electric heat growth is the dominant domestic end-use and a significant factor in the overall island load growth."

The domestic load for electric heat is 783 Megawatts of peak demand and consumes 1506 Gwh of energy. Newfoundland and Labrador Hydro has 1637 Mw of installed capacity. So our peak-heating load comprises 52 percent of the capacity and 21 percent of energy sales. This contributes to a low load factor overall, because heating is mostly for the winter months of December to March.

For the Newfoundland Power domestic sector, the reduction in energy due to the technological change variable in the forecast formula is 178 Gwh total over 20 years This is 8.9 GWH per year (9.6 when allowing for reduced line losses). Since our average domestic sales is 3600 GWH per year, our forecast gives just 0.002 reduction, just two tenths of one percent, almost zero savings. That's a value of $3.67 per year to the average customer. And yet energy efficiency improvements are a key factor that should be driving savings.

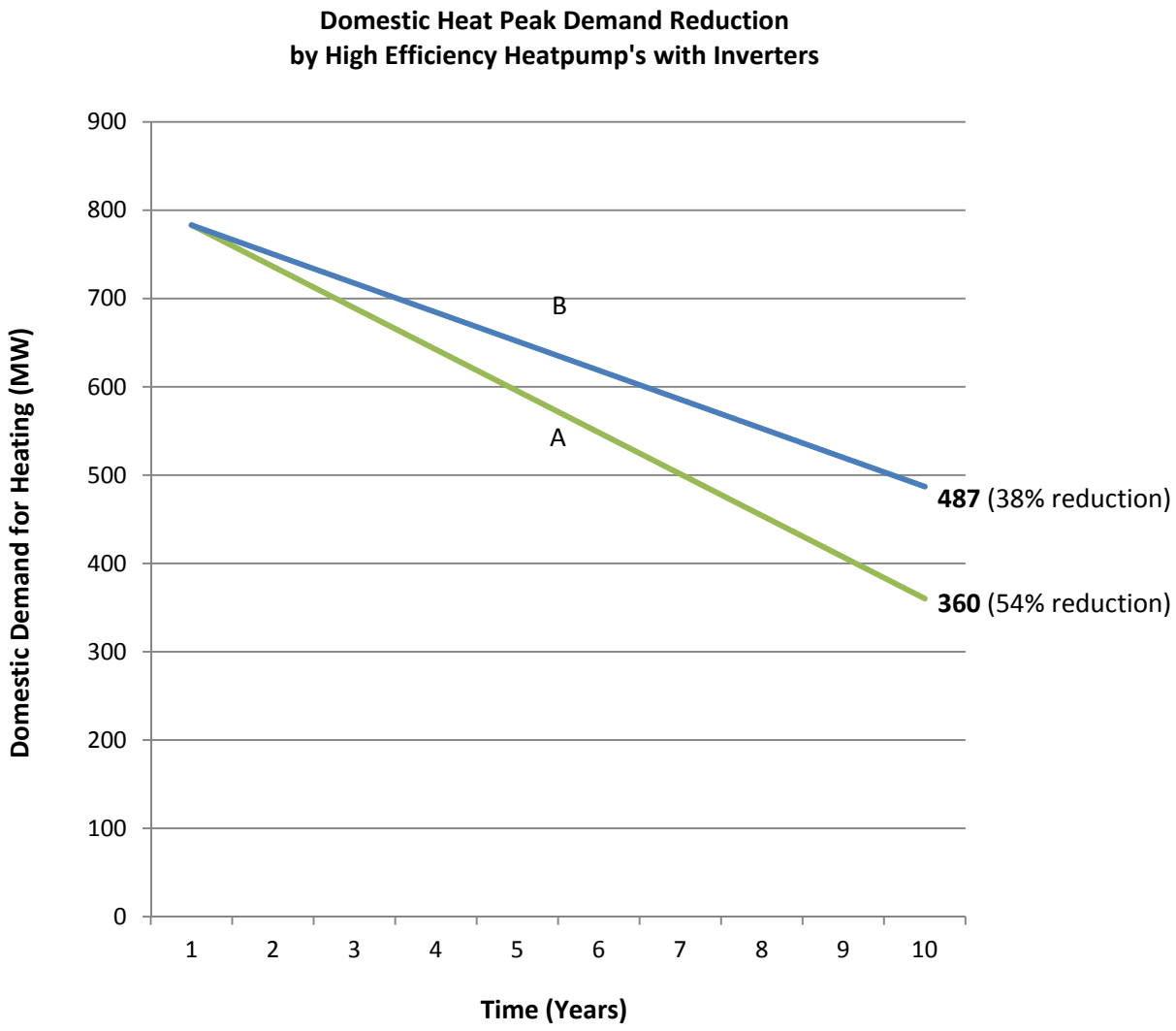
So why are our power companies forecasting no significant savings?

The MHI Report also says that the present forecast uses an assumption that peak efficiency improvements will be 30 percent more difficult to achieve in the future because the most cost effective improvements have already been done.

THIS PRESENTATION CHALLENGES THAT ASSUMPTION. WE SUBMIT:

1. THAT PEAK EFFICIENCY IMPROVEMENTS IN THE FUTURE WILL BE EASIER TO ACHEIVE BECAUSE HIGHLY EFFICIENT, RELIABLE, COST EFFECTIVE TECHNOLOGY IS AVAILABLE FOR ELECTRC SPACE HEATING SYSTEMS TO ACHEIVE THIS.
2. THAT THESE HEATING SYSTEMS CURRENTLY HAVE A VERY LOW PENETRATION RATE IN THE NEWFOUNDLAND MARKET, SO THERE IS SIGNIFICANT POTENTIAL FOR USE
3. THAT IT CAN PROVIDE A LARGE REDUCTION IN WHAT IS THE LARGEST DRIVER OF OUR PEAK LOAD - DOMESTIC SPACE HEATING
4. THAT THE HEATING EFFECIENCY IS SO HIGH THAT ON A INDIVIDUAL HOUSE IT MIGHT REASONABLY BE DESCRIBED AS A QUANTUM LEAP IN ENERGY SAVING AND DEMAND REDUCTION: 60 PERCENT AVERAGE REDUCTION FOR SPACE HEAT, AND AT LEAST 50 PERCENT REDUCTION IN PEAK DEMAND
5. AN ENHANCED INSTALLATION METHOD PROVIDES ADVANTAGES IN OUR SEVERE WINTER CLIMATE: IMPROVED OPERATION RELIABILITY IN EXTREME COLD, AND HIGH WIND AND SNOW CONDITION (without backup resistance heaters); 10 PERCENT AVERAGE ADDITIONAL IMPROVEMENT IN ENERGY REDUCTION (AN ADDED VALUE OF 6.2 MILLION DOLLARS FOR THE ELECTRIC HEAT USERS); AND PROTECTION AGAINST SALT CORROSION

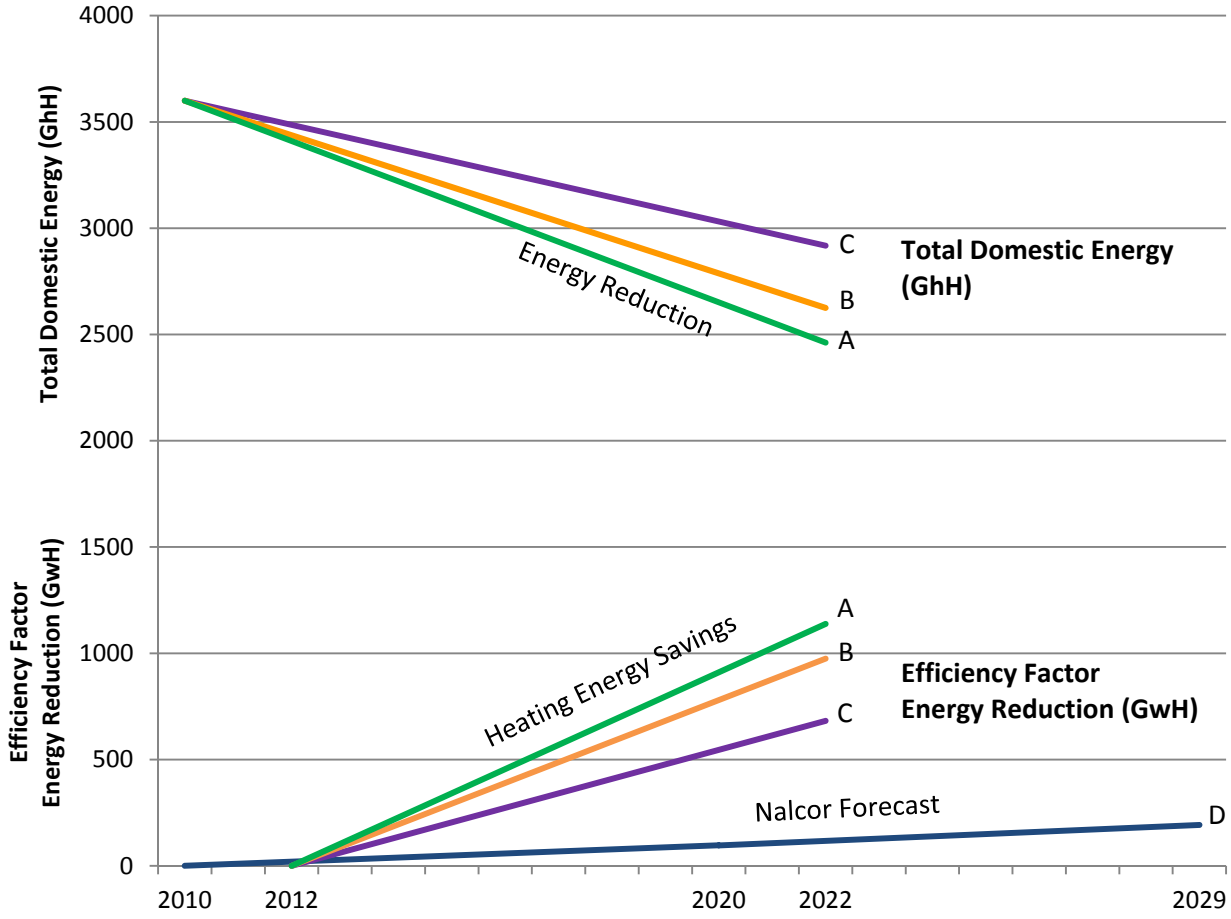
6. ON THE ISLAND SYSTEM, FROM THE DOMESTIC SECTOR, IT HAS THE POTENTIAL TO REDUCE PEAK DEMAND BY 423MW, WITH 296MW ACHEIVEABLE IF HOUSES USE 70% COVERAGE.



Line A Assumes High Efficiency Heatpumps having full coverage gives 423MW reduction
Line B Assumes High Efficiency heatpumps with 70% coverage gives 296MW reduction

Note 1 150,000 electric heated homes at 5.2 KW each.
Note 2 Heatpumps at 50% reduction in KW input at -18C.
Note 3 Allowance made for transmission line loss of 8 percent.
Note 4 Assume no new additional domestic energy uses.
Note 5 Assume conversion of 150,000 houses over 10 years

7. ON THE ISLAND BASIS, FROM THE DOMESTIC SECTOR, IT HAS THE POTENTIAL TO REDUCE ENERGY CONSUMPTION BY 1138 GWH, WITH 622 GWH REDUCTION ACHEIVEABLE IF HOUSES USES 70% COVERAGE. CHART 2 COMPARES THE PROJECTED SAVINGS OVER 20 YEARS AS FORECAST BY NALCOR, AND THE POTENTIAL SAVINGS FROM EFFICIENT HEATING SYSTEMS, AND SAVINGS EXPECTED AT A 70 PERCENT OF POTENTIAL.



Line A allows for 150,000 electric heated homes converted over 10 years getting 70% reduction for heat (enhanced)
Line B allows for 150,000 electric heated homes converted over 10 years getting 60% reduction for heat (normal)
Line C allows for 150,000 electric heated homes converted over 10 years getting 60% reduction for heat but only 70% coverage.
Line D is Nalcor forecast reduction

Line A gives 7 times Nalcor's reduction in half the time
Line B gives 10 times Nalcor's reduction in half the time
Line C gives 12 times Nalcor's reduction in half the time

Line A gives 31.6% total domestic reduction
Line B gives 27% total domestic reduction
Line C gives 19% total domestic reduction
Line D gives about 2 tenth of one percent per year reduction (2.6% over 10 years)

8. ADDITIONAL SUBSTANCIAL SAVINGS IS POSSIBLE IN THE DOMESTIC SECTOR WITH EFFICIENT WATER HEATING, AND ALSO WITH SPACE HEATING IN THE SMALL COMMERICAL SECTOR

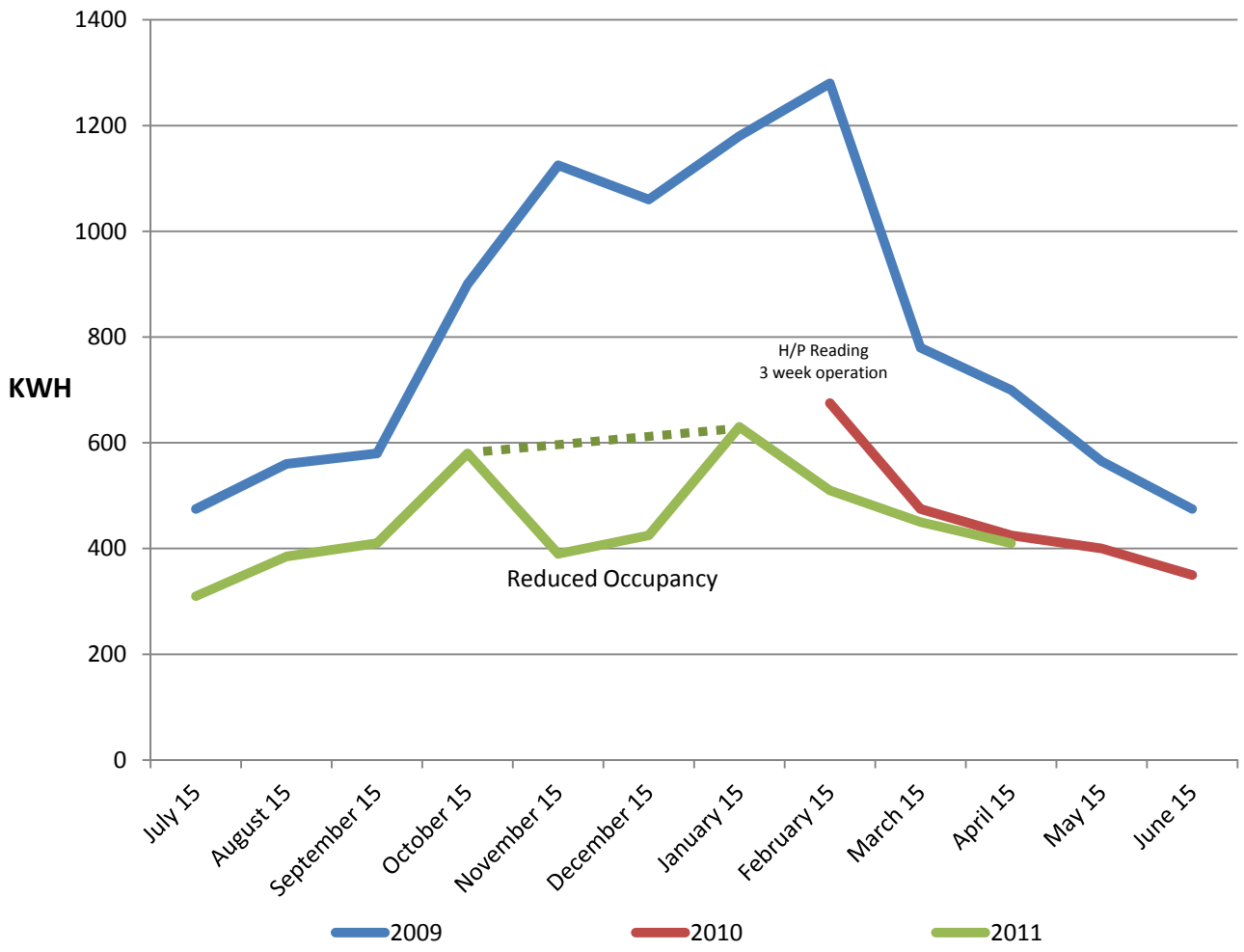
AN AGGRESSIVE PLAN TO CONVERT TO EFFICIENT SYSTEMS WOULD FREE UP SUBSTANTIAL EXISTING HYDRO ELECTRICAL GENERATING CAPACITY TO FACILITATE MORE CONVERSIONS FROM OIL TO ELECTRIC AND TO SUBSTANCIALLY REDUCE IF NOT ELIMINATE THE BURNING OF FOSIL FUELS AT THE HOLYROOD PLANT.

Whether we are wasting energy depends on how cost effective conversions are. A type 3 system can be contractor installed for about $1800.00 per kilowatt of heat produced at 0 degree F (minus 18 C). This would include installation for enhanced performance and reliability. So reduction in costs for energy efficiency appears to be much less, at one-fifth the cost of new generation via the in feed system. And would appear to offer even more savings from the cost of new generation for the island isolated option.

To determine the actual energy and demand reductions, and to assure reliability in our severe climate, we undertook research to obtain end-use data (as the Manitoba Report says would permit more accurate forecasting) at a residential installation, being 23 years old and needing 5watts per sq. ft. of electric baseboard heaters. The conversion was put in operation in January 2010. It is currently in it's third winter of operation. We selected a type 3 electromechanical heating system. Its installation was such to expect enhanced performance from it's already high certified factory ratings. Modest shell improvements were also made.

The research data shows the following:

1. Reduced overall yearly energy consumption by 42 percent.
2. Reduced peak demand from the space heating equipment by 73 percent
3. No malfunctions up to present, midway through the third heating season
4. Benefit from air conditioning and humidity control in the summer season
5. Other: A positive contribution to increase the summer system load, and so improves the system load factor
6. That the new heating system maintains heat at 0 degree C for about o.65 watts per sq. ft. and would appear not to exceed 1 watt per sq. ft. at about minus 12 C. This compares with about 1.4 watts per sq. ft. required for a R2000 construction.



It would appear that there are VERY SERIOUS ERRORS in the power company's methods or formulas. There should be very positive contributions from energy efficiency upgrades. And forecasts should show significant gains. It is likely the error is due to not having actual end-use data.

Present Electric Space Heating Systems

Electric space heating systems used in Newfoundland are of a variety of styles, but most all are of the resistance type heater. The method being that if you apply a sufficient voltage to a conductor of high resistance, it will heat up. This was the used with Edison's light, whereby it gave mostly heat but also light. For heating purposes, we have the baseboard heater, the electric furnace, the duct heater, the electric boiler, the in-floor electric heater, all being resistance heaters. Sir William Coaker used electric resistance heaters in his house in Port union in 1917,being state of the art at that time. They are reliable and cheap, but very inefficient by today's standards.

Modern Electromechanical Space Heating System

A modern electromechanical space heating system is a hybrid type of electrical, mechanical, and electronic components. They offer energy reduction due to their exceptional high efficiency. This is generally measured in COP (coefficient of performance). Their performance is climate dependent. Our climate in Newfoundland is very good to attain high performance. COP of 2 or better can be expected for a type 3 system in worst winter conditions (A COP of 2 means for one dollar worth of energy in you get two out). COP of 3 or better for yearly average. COP of 4 or better in spring and fall when operating at part load. Part load is accomplished by INVERTER technology. This also is very beneficial to the power company to eliminate high current inrush that commonly would dim the lights momentarily. When used extensively it allows lower utility cost for smaller capacity distribution lines and power transformers.

Compact Fluorescent Light Energy Saving: Fact Or Fiction

MHI points out the importance of end-use research to confirm claimed energy efficiencies. Many products are climate dependent, that is, it may work fine for one application but not for another. These style lights produce much less heat but equivalent light, so they are much more energy efficient. The old style 60 watt light bulb can be replaced by the newer one of 13 watts, about 78 percent reduction. Most all of this is due to less heat generation. For southern climates where little heat is needed, and where excessive heat requires air conditioning, these lights save substantial energy year round. In our climate, the old style light contributes to the heat needed, for about 11 months out of 12. So when the light is on, the electric baseboard heater (and other resistance type space heaters) uses less energy. When replaced with the newer style, because it puts out less heat, the regular electric heaters must stay on longer to compensate. The result is that there is essentially no energy saving except in the warm period of summer, about one month. So the suggested saving is about 10 times more than actual. End-use data would show that. The same principle applies to the more efficient appliances like fridges or TVs, or insulating hot water pipes that are within the building occupied envelope. However, for the new type lights that are used outdoors, these will save the energy suggested. Again end-use research would show that. Also, when the energy efficient lights are used indoors in conjunction with the highly efficient heating system, the lights save on energy year round. That's because their lost heat output is then supplied by the highly efficient heating system at about one third the cost - so they work together effectively.

The Manitoba Hydro report says Newfoundland Power and Newfoundland and Labrador Hydro designed the energy efficient guidelines (promoted as the Take Charge Program). It appears that since no end use research was done, that many of their recommendations for energy savings are ineffective. That many highly efficient products are not promoted. This likely contributes to a forecast that shows no significant savings from energy reduction in technology change from efficiency.

Conclusion

That energy efficiency can give tremendous saving to the power companies that can pass on to the customers, in particular the domestic customers. As well these offer environmental benefits. That this approach can offer alternate options to meet efficiency gains. Forecasting methods that use end-use data and research to obtain the data is essential. And programs that partner with domestic customers on costs to convert to the modern highly efficient heating systems would result in substantial savings and benefits from the efficiency factor. A 10 percent efficiency surcharge on electricity sales with a 60 percent rebate on customer's costs would allow an aggressive conversion rate. This would allow no net increases for electricity to the domestic consumer, since the energy reduction savings offsets the surcharge. It can be seen that the issue of efficiency for our power systems, in generation and use, is substantial. Areas like Vermont, Nova Scotia and New Brunswick realize that it is often less costly to advance efficiency improvements as compared to new generation. They have set up corporations with sole responsibility for efficiency issues - EFFICIENCY NOVA SCOTIA, EFFICIENCY VERMONT ETC. Perhaps such a corporation - EFFICIENCY NEWFOUNDLAND AND LABRADOR would be useful.

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