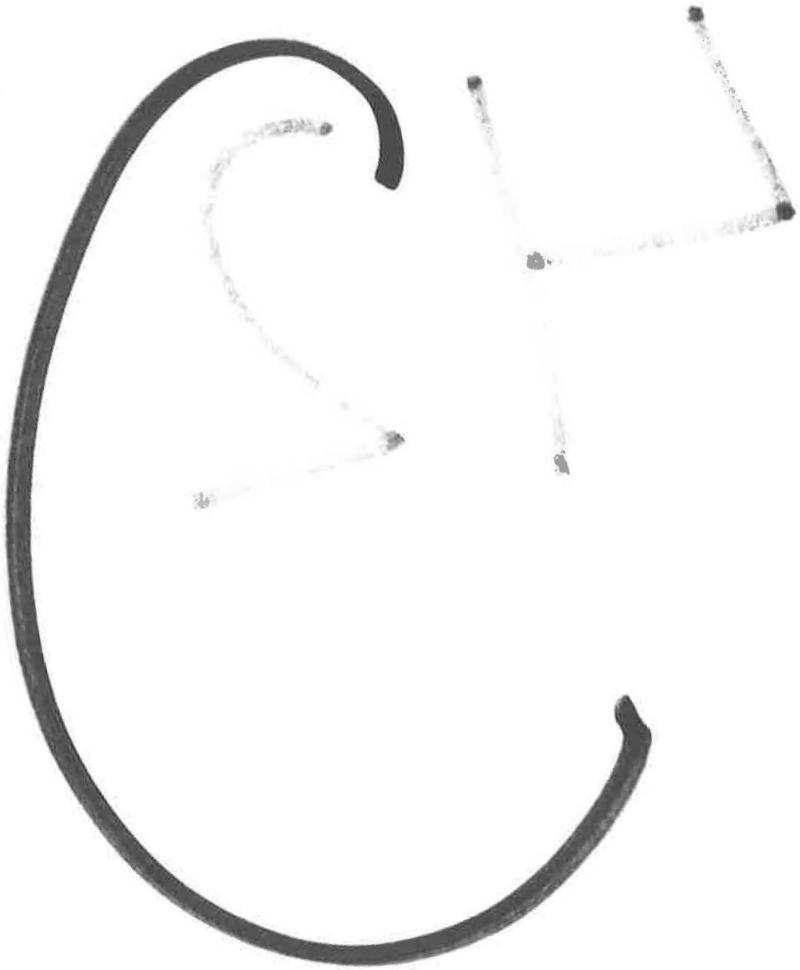


PREPARED FOR ACTION CANADA

Making Best Use of the Lower Churchill:

The Muskrat Falls Development

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This essay was prepared by David A Vardy for Action Canada. The essay examines the policy context in which the Lower Churchill can best be assessed from a national and provincial context, along with the options to be considered in achieving energy security

1.0 Introduction[1] and Terms of Reference

This essay was commissioned by Action Canada, who asked the author to deal with the Lower Churchill development, including the following issues:

- How much power is needed on the island?
- What are the potential sources of power for the island?
- Is the best alternative to transmit power from Muskrat Falls to the island?
- What are the other potential uses of Lower Churchill power (including Gull Island)?
- Is the current proposal the best use of the Lower Churchill potential?

A draft was forwarded on August 15, 2011 and this final version is submitted on August 31, 2011, incorporating revisions and expansions requested by Action Canada.

This essay will deal with the Lower Churchill hydroelectric developments in Labrador, downstream from the large Churchill Falls project which was completed in 1976 and most of the power of which is sold by Churchill Falls (Labrador) Corporation to Hydro Quebec under contractual obligations that end in 2041. There are two proposed generation facilities on the lower reaches of the Churchill River, one at Gull Island and the other at Muskrat Falls. The Government of Newfoundland and Labrador recently announced its plan to begin development of the smaller of these two facilities, located at Muskrat Falls, just 18 km upriver from Happy Valley-Goose Bay. The proposed Muskrat Falls facility is rated at 824 megawatts (MW) and 4.9 million megawatt hours (MWh) of energy per year. The combined capacity of Gull Island and Muskrat Falls is 3,074 MW[2] while the combined energy is 17 million MWh of electricity per year.

The Muskrat Falls project has been selected as the first of the two facilities because its smaller size is perceived to be a better fit for the Province's energy requirements. The Muskrat Falls facility, if constructed, will serve the energy requirements of the Island of Newfoundland, with surplus energy to be sold to Emera Energy of Nova Scotia and other power users in Eastern Canada or the Eastern United States. The Gull Island facility, according to the Province's energy plans, will be developed later, possibly for sale west, using transmission lines in Quebec or using an additional transmission line across the Strait of Belle Isle and the Cabot Strait, through the Maritime Provinces. The preferred sequencing of these two projects will be discussed below in the context of the recently released Joint Panel Report on the Lower Churchill Hydroelectric Project, in which Report the term "Project" embraces both the Muskrat Falls and Gull Island generation facilities.

2.0 Role of hydroelectric power in Canada

Canada depends heavily upon hydroelectric power, compared with other industrial nations. It is second in the world in hydroelectric power generation.[3] More than 60% of Canada's electricity production is from renewable hydro generation while 24.9% comes from thermal generation.[4] Today, 11.5% of the world's hydropower is generated in Canada. There remains an estimated 163,173 MW of

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[1] The author is grateful to Nalcor Energy, for providing information and agreeing to the use of their map and charts in this document, as well as to James Feehan (Professor of Economics at Memorial University), Ron Penney (former Deputy Minister of Justice with the Province of Newfoundland and Labrador), Victor L. Young (former Chair and CEO of Newfoundland and Labrador Hydro) and Fred Way (former Vice-Chair of the Canada Newfoundland and Labrador Offshore Petroleum Board, Secretary to Cabinet, Deputy Minister of Intergovernmental Affairs and Deputy Minister of Natural Resources), for helpful comments on previous drafts of this essay. Any errors or omissions are the responsibility of the author alone.

[2] (16), slide 21 and (9).

[3] (12), p 19.

[4] (2), p. 15.

undeveloped hydro potential in Canada today, mostly in the North.[5] More than 10,000 MW of this undeveloped hydro potential is in Newfoundland and Labrador.[6] Quebec and British Columbia together have 80,000 MW undeveloped.

Canada is a major exporter of electric power to the United States. Gross exports in 2008 were 55.7 million MWh while gross imports were 23.5 million MWh, resulting in net exports of 32.2 million MWh.[7] This number corresponds roughly to the energy that is sold to Hydro Quebec by the Churchill Falls (Labrador) Corporation (CF(L)Co). The high level of Canadian electric power export calls for a highly reliable continental transmission system, with open access.

Decisions regarding investment in new capacity must recognize the impact of generation upon global warming. In Canada, there has been a federal commitment to reduce national greenhouse gas emissions by 20 percent below 2005 levels by 2020, and 90 percent non-emitting electricity generation by 2020.[8] Such a commitment favours hydroelectric investment along with investment in other renewable sources.

Investment in the electricity sector is required in order to meet future demand and to replace aging infrastructure as well as to reduce greenhouse gas emissions. Such investment will lead to rising prices as undeveloped generation projects are normally more costly than those already developed. Planners normally select those projects where energy costs are lower, unless there are other compensating factors, such as inappropriate scale, in relationship to the load to be served.

The supply mix has to recognize the needs for both baseload power and for peaking. Some energy sources are better suited to meeting base demand while others are suited to supply peak demand. Some energy sources, such as solar and wind power, are intermittent and require energy storage, posing greater challenges than those presented by hydroelectric, nuclear and thermal power sources. However, water reservoirs can often be used to store potential energy. Variations in hydroelectric production from such reservoirs can be used to compensate for variations in energy supply from other renewable sources, such as wind and solar energy, thereby turning these reservoirs into multi-purpose energy storage.

The electric power system should be designed with an optimum mix of energy sources which will minimize cost and achieve environmental and sustainability goals. Planning for future growth must also deal with energy conservation and with the design of a pricing system that will provide information to the consumer as to the full cost of his/her decisions to consume energy. Canada enjoys relatively low cost power and Canadian utility pricing to domestic and industrial consumers reflects these lower costs. However, an efficient allocation of resources should reflect the incremental or marginal cost of energy as well as the competitive advantage which gives us relatively low cost hydroelectric power in Canada.

2.1 Hydroelectric resources of Labrador, including Churchill Falls

The infamous Churchill Falls contract is a prominent feature in the social and economic landscape of Newfoundland and Labrador and is a major influence in the Province's energy policy. The loss of economic rent from this undertaking is perceived to be egregious. The Churchill Falls power contract reaches the end of its 65 year term in 2041. This contract has been the source of much controversy in light of the fact that the energy is sold by the Churchill Falls (Labrador) Corporation to Hydro Quebec, at the border. The option of dealing with customers outside Quebec was not available, and Hydro Quebec was placed in a monopsony position. The general view in Newfoundland and Labrador is that the power contract is one-sided, providing large benefits to Quebec and few benefits to Newfoundlanders and Labradorians. The price paid by Hydro Quebec is very low over its 65 year term and declines for the last 25 years, which compounds the intrinsic inequity of the contract during a time of

[5] (2), p.22.
[6] (14), pp.35-40.
[7] (3), p. 18.
[8] (3). p. 57

escalating energy prices. The power contract will have run its course in 2041 and all of the options will then be back on the table, including the use of Churchill Falls power for meeting domestic requirements, as well as for revenue generation by export from the Province of power surplus to the its requirements. The Province's Energy Plan of 2007 fixed its sights on the post-2041 time horizon in examining the options for oil and gas and electric power development.[9]

The Government of Newfoundland and Labrador attempted to utilize the courts to overturn the power contract and to recall additional power through two different initiatives. The first case involved an attempt to recall additional power under the provision of the lease of water rights which stated that power could be recalled where it was economically feasible to do so. This case took 16 years to resolve. The Supreme Court of Canada ultimately upheld the decision of the Newfoundland Court of Appeal that it wasn't economically feasible in 1988, so that attempt failed.

Because of the length of time it was taking to get a final determination of this case, the Government decided to pursue another approach, which would have had the effect of taking back the lease of the water rights through The Water Rights Reversion Act. The Government referred the constitutionality of this Act to the Newfoundland Court of Appeal. It was ultimately heard by the Supreme Court of Canada, which decided in 1984 that it was unconstitutional because it attempted to interfere with the power contract, which gave the right to deliver power at a place outside the territory of the Province and the Province had no authority to legislate outside of its boundaries.

The Churchill Falls Power Corporation, CF(L)Co, which operates the power plant at Churchill Falls is owned by Nalcor and Hydro Quebec, with majority ownership held by Nalcor. The Upper Churchill is the largest generation facility in the Province, producing 5,428 MW of power and 34.0 million MWh of energy. With the exception of 1) the 300 MW which has been reserved for use in the Province, depending upon provincial requirements, 2) the block of 225 MW which was diverted from Twinco to the Churchill Falls project for use by the iron ore industry in Labrador and 3) 682 MW which is being sold to Hydro Quebec on a seasonal basis[10], the full output is sold to Hydro Quebec under a long term contract for a price declining from 1976 to 2016 and which is currently $2.50 per MWh. It will decline to $2.00 per MWh for the remaining 25 years, from 2016 to the conclusion of the power contract in 2041.[11] To put this in context, the rate charged for domestic power users in St. John's is $104.07 per MWh.[12]

When the Province's hydroelectric production is compared to population size, the 80,000 MWh per year per 1,000 people in Newfoundland and Labrador is higher than in many resource-abundant jurisdictions, higher than Iceland (30,000 MWh) and Norway (25,000 MWh) and higher than Manitoba (30,000 MWh) and Quebec (25,000 MWh).[13]

The Energy Plan calls for the transfer of funds from non-renewable energy sources to renewable sources through the development of Gull Island and Muskrat Falls as well as other hydroelectric and wind energy projects. For the Province as a whole 85% of total energy output is from hydroelectric sources. However, this number is heavily influenced by Churchill Falls and very little of the Churchill Falls energy is used within the Province. For the Island, which is not yet electrically connected with Labrador, the percentage of total energy capacity that was hydroelectric in 2007 was 65%, when the Energy Plan was published; 35% came from thermal power. Since then, two small wind powered projects have been developed but thermal power continues to play a major role, particularly the 490 MW oil fired plant at Holyrood, which is on the Avalon Peninsula, close to St. John's

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[9] See (9)
[10] See (15), p. 20.
[11] Ibid, p. 9.
[12] From the Newfoundland Power bill of David Vardy dated August 11, 2011.
[13] (9), p. 16.

In addition to the two sites on the Lower Churchill there are a number of other potential developments in Labrador. Millan (1974)[14] estimated a potential of over 9,000 MW, not including five interprovincial rivers whose headwaters are in Labrador but which run through Quebec's North Shore on their way to the St. Lawrence River. These are the St. Paul, St. Augustine, Little Mecatina, Natashquan and Romaine Rivers, which have a combined potential of approximately 3,430 MW.[15]

In order to develop the full potential of these projects both the Provinces of Quebec and Newfoundland and Labrador must come to an agreement on water management, dealing with headwaters and river flooding. However, this has not stopped Quebec from embarking on a major new project which will be almost twice the size of Muskrat Falls. Hydro Quebec has commenced work on a $6.5 billion facility on the Romaine River which will produce 8 million MWh of energy. This facility, with four dams, will be built on Quebec's Lower North Shore by 2020.

Nalcor Energy (Nalcor) is a provincially owned energy company, a crown corporation, which in turn owns the Newfoundland and Labrador Hydroelectric Corporation (Hydro) as well as CF(L)Co. Hydro operates most of the generation capacity on the Island along with the high voltage transmission lines. On the Island, Hydro is the wholesaler which sells to the retailer, Newfoundland Power (NP), fully owned by Fortis Inc. NP operates the distribution lines and deals with household consumers and general service commercial and industrial users, charging rates approved by the regulator.

In Labrador, Hydro is responsible for both the generation and transmission of power and sells power without the intermediation of Newfoundland Power or any other distributor. Hydro serves customers on the interconnected Labrador system and also operates a series of generating systems in isolated communities in Labrador and on the Island, fueled primarily by diesel generators. Rates charged by Hydro to interconnected Labrador customers are lower than those charged to interconnected Island customers, recognizing the lower cost of service in Labrador, where the power is supplied from Churchill Falls, drawing from the recall block of up to 300 MW. On the other hand, the rates charged to customers in isolated communities on the Labrador Coast, and on the Island, are higher, due to reliance on diesel fuel, given that the cost of connection to the grid is prohibitively expensive.

The development of the Upper Churchill was undertaken by a private company, Brinco, not by the Province, and the shares not owned by Hydro Quebec were acquired by the Province in 1974, along with the water rights for downstream development, so as to facilitate the development of the Lower Churchill.

In 1978 the Province signed an agreement with the Federal Government to create the Lower Churchill Development Corporation (LCDC), which is 51% owned by the Province, 49% by the Federal Government, to develop the power sites on the lower Churchill River at Gull Island and Muskrat Falls. The LCDC is currently inactive. However, the Province has approached the Federal Government for a loan guarantee for the Muskrat Falls facility, which was the subject of a recently signed MOU. Negotiations have commenced to work out the details of the guarantee. It would not be surprising if the Federal Government were to seek some form of management control to protect and limit their financial exposure. It is not known whether reactivation of a structure similar to LCDC might be an option for them.

Both Hydro and NP are regulated by the Board of Commissioners of Public Utilities of Newfoundland and Labrador (the PUB), which approves energy rates through the use of an allowed rate of return on rate base. Capital budgets for both utilities are also subject to review by the Board. The Lower Churchill projects (at Gull and Muskrat Falls) have been exempted by Order-in-Council from the jurisdiction of the PUB. However, the Provincial Government has made a reference to the PUB pursuant

[14] (14) pp. 35-40.
[15] (4).

to Section 5 of the Electrical Power Control Act (EPCA). The reference question is whether Muskrat Falls represents "the least cost option for the supply of power to Island Interconnected Customers over the period 2011-2067 as compared to the Isolated Island Option." We will return later to this reference and the limited mandate it gives to the PUB.

4.0 Proposal for Muskrat Falls Development

The proposed Muskrat Falls development calls for a dam at Muskrat Falls, with four turbines generating 4.9 million MWh of energy per year from a capacity rated at 824 MW. This project was announced jointly by Premier Danny Williams of Newfoundland and Labrador and Premier Darrell Dexter of Nova Scotia on November 18, 2010.[16] The project has five components, the Muskrat Falls generating plant, the transmission line to Churchill Falls and the Strait of Belle Isle, the Strait of Belle Isle crossing, the Island transmission system to Soldier's Pond (outside of St. John's) and the Cabot Strait crossing, estimated to cost a total of $6.2 billion (see map in Figure 1). The generating plant will cost $2.9 billion, the Labrador-Island link will cost $2.1 billion, and the Maritime Transmission Link is expected to cost $1.2 billion. Completion will take approximately six years. The subsea line across the Strait of Belle Isle will be 30 km in length while that from the Island to Nova Scotia across the Cabot Strait will be 180 km.

Emera Inc. (Emera), which is an energy and services company serving Nova Scotia, will contribute 20 per cent of construction costs and provide transmission to Nalcor Energy (Nalcor) across the Maritime Link and through Nova Scotia. Nalcor will provide Emera with approximately one million MWh per year (Nova Scotia Block) or 20% of the energy from Muskrat, for a term of 35 years.[17]

The rationale given for the project at the press conference was the closure of the 490 MW Holyrood thermal plant and the elimination of its GHG, along with stabilization of power costs by avoiding continued exposure to the price volatility of oil-fired thermal generation. The development of Muskrat Falls would avoid approximately 96 million tonnes of emissions by 2065.

The project will generate large scale employment benefits for the Province, the Atlantic region and the country as a whole. First consideration for jobs in Labrador will go to the Labrador Innu as outlined in the New Dawn Agreement, then to Labrador residents, and then to residents of the province generally.

Initially, displacement of Holyrood energy will absorb 40% of the energy from Muskrat Falls. In addition to the commitment of 20% to Nova Scotia the remaining 40% will be available for sale into New England or the Maritimes or else held in reserve for the industrial requirements of Labrador.

> *Nalcor will be provided use of Emera's transmission rights to transmit power through New Brunswick with Nalcor paying the associated transmission tariff when used by Nalcor. If these rights cannot be acquired or extended, Emera will purchase the power Nalcor would have sold through New Brunswick. Alternatively, at Nalcor's option, Emera will provide Nalcor with the opportunity to acquire or use 300 MW of firm transmission if proposed Nova Scotia-New Brunswick transmission line is constructed.*[18]

The Government of Newfoundland and Labrador has reached an agreement with the Innu Nation with respect to land claims along with impact and benefits. The agreement covers resource royalty sharing and management of lands. An Upper Churchill redress agreement has also been reached with the Innu Nation.

The reference review being undertaken by the PUB will not consider the potential revenues from the agreement with Emera nor will it consider the costs incurred as part of the Term Sheet to supply

[16] (21).
[17] (10)
[18] (10)

power to Nova Scotia. Instead the PUB will examine Muskrat Falls solely on the basis of its ability to supply Interconnected Island customers at a lower cost than the Isolated Island alternative. The Gull Island project, as an alternative to Muskrat Falls, is not covered in the reference. The deadline for the PUB reference is December 30, 2011.

4.1 Environmental Assessments

A joint federal-provincial environmental assessment panel has completed hearings on the Lower Churchill generation project. Their report, released August 25, 2011, is a comprehensive review of the Lower Churchill Project, defined as comprising both the Gull Island and Muskrat Falls facilities. This packaging of the two facilities did not preclude individual assessments of each. Transmission lines were not included in the Project. The provincial and federal governments will make the final decisions regarding the Project approval. The Terms of Reference issued by the Ministers required the Panel to assess the environmental effects of the Project, including:

- consideration of the need for and purpose of the Project;
- alternatives to the Project and alternative means of carrying out the Project;
- the environmental effects of the Project, including accidents and malfunctions:
- cumulative effects, and the significance of these effects;
- measures to reduce adverse effects and enhance beneficial effects; and
- monitoring and follow-up.

The Panel decided that it would assess Muskrat Falls and Gull Island separately with respect to alternatives, energy requirements and economic considerations, even though their mandate combines the two as a single Project. This separate assessment is based on the fact that each component is subject to separate sanction decisions.

The panel approached the energy security issue with the understanding that the Province's long term energy security is assured and that energy requirements beyond 2041 will be addressed through access to Churchill Falls power, once the power contract has expired. The main benefit to future generations will accrue to the rest of North America. The Province's ability to capitalize on these benefits, through revenues from power sales, will depend on the future of electricity market demand and supply as well as on achieving access to these markets.

> *Long-term energy security would be among the key benefits to future generations. The Panel observes that because of the existing Churchill Falls project, the long-term energy security for the province is already secure after 2041, so the main benefit to future generations in this regard would accrue to the rest of North America. Another potential benefit to future generations would be the predicted large-scale provincial revenues. Whether and at what scale these would be realized would depend on a number of factors, including whether the whole Project proceeds, whether economic access to markets can be realized, and the future of electricity demand and supply.*[19]

The panel has considered Muskrat Falls and Gull Island together as a single project, possibly with overlapping schedules or else with a hiatus in between. This provides the opportunity for sales outside the province to cross-subsidize the price of power to domestic consumers, if such sales are available. Lack of market access, or its high cost, may make such external sales infeasible or unattractive.

> *If the Muskrat Falls facility were to proceed by itself because market access could not be resolved in a manner that makes Gull Island economically attractive, there is a risk that the Project would not generate sufficient revenues to cover the various mitigation and compensation commitments*

[19] (13) p. 308.

and needs associated with the Project, or the revenues for the Province necessary to ensure long-term economic benefits, and that it would result in higher power rates for the Island of Newfoundland than would be the case without it. The Panel has therefore recommended a formal financial review and an independent alternatives assessment to resolve these uncertainties and allow for a more accurate assessment of the economic risks. ...

If the whole Project proceeds, the Panel has reasonable confidence that the adverse economic effects and risks would be outweighed by the potential for large-scale economic benefits. Economic benefits during construction would be centered on jobs and business opportunities, while the dominant economic benefit during operation would arise from the potential revenues the Project would generate for the Province. The financial review recommended by the Panel (Recommendation 4.1) should give government decision makers a better understanding of whether these net economic benefits would materialize.

The results of the alternatives assessment recommended by the Panel (Recommendation 4.2)may affect whether a government decision to permit the Muskrat Falls facility to proceed should be made on the basis of a separate sanction decision by Nalcor, or whether other options, which might include commitments by Nalcor to a Gull Island (project) only or a joint sanction decision for Muskrat Falls and Gull Island, should be considered.

The Panel believes that only after the financial review and alternatives assessment have been completed would government decision makers be in a position to carefully consider whether the Project, under the various scenarios contemplated by Nalcor, would have a net economic benefit, and at what scale."[20]

In its Recommendation 4.2 the panel describes the terms of reference which should be covered by an independent analysis of alternatives to meeting domestic demand. They ask

why Nalcor's least cost alternative to meet domestic demand to 2067 does not include Churchill Falls power which would be available in large quantities from 2041 or any recall power in excess of Labrador's needs prior to that date, especially since both would be available at near zero generation cost (recognizing that there would be transmission costs involved);[21]

The Joint Panel recommends this question should be included in the terms of reference of the independent analysis, along with the following questions and issues:

- Whether Gull Island power should first be developed, given that it has a lower per unit generation cost than Muskrat Falls?
- Whether Nalcor considered developing technology, as compared simply with current technology?
- Whether Nalcor's assumptions regarding the price of oil till 2067 are robust and realistic?
- Whether Nalcor's estimates of domestic demand growth are realistic?
- Whether Nalcor has placed sufficient emphasis upon demand management programs in light of information about targets set and expenditures incurred in other jurisdictions?
- Whether Nalcor should consider introducing disincentives to the inefficient use of electric space heating?
- Whether Nalcor has placed sufficient priority on wind power, in light of the suggestion by the Helios Corporation that an 800 MW wind farm on the Island should be considered as an alternative to Muskrat Falls?

[20] Ibid. p. 305.
[21] Ibid. p. 34.

- Whether conversion of the Holyrood thermal plant to natural gas as an alternative to Bunker C should be considered?
- Whether further exploration of the potential for renewable energy sources on the Island (wind, small scale hydro, tidal) would be a viable option?

The panel also believes that the planning approach of defining demand requirements and seeking the lowest cost generation solution should be replaced by what is known in the public utility fraternity as integrated resource planning (IRP). IRP looks at both demand and supply options and places more weight on demand management than least cost supply planning.

The panel returns to wind power and demand side management in their recommendation 17.4 where they say as follows:

> *From a greenhouse gas emissions perspective, the Project would offer significant advantages over fossil fuel-based energy sources, and be generally comparable to wind, other hydro and nuclear power. Conservation and efficiency measures would rate better than the Project. From a general biophysical perspective, large-scale hydro again tends to rate better than fossil fuel based energy, but does not rate as well as wind or conservation and efficiency measures.*[22]

Both Nalcor and the Panel are of the view that the two projects are likely to be beneficial if they are sequenced, with an overlap in construction. The Panel supported this approach largely because lessons learned and capacity built from construction of Muskrat Falls can be applied to Gull Island. If Muskrat Falls proceeds on its own, in order to meet the Island's energy needs, it is less clear to the Panel that the Project will result in net benefits to the Province as a whole or to Labrador, as a region of the Province.

The Panel recommends a wide range of measures to mitigate the adverse environmental, social and economic impacts. The Panel concludes that the social effects in Labrador could likely be fully mitigated and could be expected to diminish when construction is finished, but the reduced environmental effects would still be negative for Labrador. The regional distribution of benefits is a big concern for the Panel, particularly the impact upon Labrador. The full Project (Muskrat Falls and Gull Island, with overlapping construction) would likely deliver net benefits to the Province as a whole but net benefits to Labrador will depend upon the policy decision to reinvest revenues in the Labrador component of the Province.

An environmental assessment of the transmission line has not yet started. The Labrador-Island Transmission Link project is currently undergoing public and government review of 14 topic-specific Component Studies (prior to submission of Nalcor Energy's Environmental Impact Statement (EIS)).

The environmental assessment for this project does not include the Maritime Transmission Link, for which no EIS has yet been filed.

5.0 Interprovincial transmission through Quebec

Hydro (and Nalcor) has had difficulty in gaining access to wheeling rights for Churchill Falls power through the high voltage transmission lines of Hydro Quebec and remains in dispute with Quebec about the terms under which Lower Churchill power can pass through Quebec. This has led the Government of Newfoundland and Labrador to pursue the "Anglo-Saxon route", bypassing Quebec, to connect with the national transmission grid through Nova Scotia. This route imposes the cost penalty of two sub-sea underwater crossings, one of 30 km and the other of 180 km, thereby placing both Lower Churchill projects at a cost disadvantage. The cost per unit of Gull Island energy is lower by virtue of economies of scale. From this perspective it makes more sense to develop Gull Island with its power

[22] Ibid. p. 307.

capacity of 2,250 MW, rather than Muskrat. This is in keeping with both the theory and practice of public utility economics.

Nalcor has attempted to use the leverage of the US Federal Energy Regulatory Commission (the FERC). The FERC's Order 2000 provides that "all transmission users should receive access under rates, terms and conditions comparable to those the transmitting utility applies to itself to serve its own customers." This open access provision is intended to open up wheeling of power through long distance transmission lines by imposing FERC rules upon Canadian companies, including Hydro Quebec, selling into American markets. As a major exporter of energy into the United States wheeling power through power lines owned by American utilities, Hydro Quebec has to comply with the wheeling rules established by the national American energy regulator, which demands that reciprocal open access rules be observed. The Province has attempted to deal with Quebec through a series of negotiations and legal maneuvers but, as noted earlier, none of these has been successful.[23]

6.0 How much power is needed on the Island?

Nalcor has selected a 50 year time horizon for planning purposes and has performed a cumulative present value analysis for the period 2011-67, which includes the 50 years after the 2017 in service target date for the Muskrat Falls project and is reflective of its capital life. It has forecasted a growth in demand of 0.8% a year for this period. .

The actual compound annual growth rate in energy consumption that occurred for the period 1970-2010 was 2.3% [24](see Figure 2). This rate is in fact driven by growth in the first 20 year period, since there was virtually no growth from 1990 to 2010. The Province's population is virtually static and growth projections are modest. In recent years, the loss of two pulp and paper mills at Stephenville and Grand Falls plus the expropriation of the Abitibi hydroelectric facilities and the elimination of a paper machine at Corner Brook have created negative growth. These factors resulted in a decline in energy use from 2004 to 2010, when it declined to 1990 levels. As a forecasting tool the 40 year growth rate of 2.3%, used by Nalcor to estimate future trends, is suspect, given the lack of growth in the period 1990-2010, notwithstanding that electric heating is being used in 85% of new homes. It can credibly be argued that the historical period from 1990 to 2010, during which growth was flat, might be a more relevant reference period for future planning. From 2010 to 2067, Nalcor's forecast of compound annual growth is 0.8%. Nalcor maintains sufficient reserve capacity to ensure that the loss of load probability (LOLP) is no greater than 2.8 hours per year. By this standard, capacity deficits begin in 2015 and energy deficits in 2019.

This means that the Holyrood thermal plant would not be able to meet peak winter demand and still meet the LOLP reserve capacity by the year 2015. If the peak could somehow be spread out the system would be able to supply energy requirements up until 2019. The inexorable winter weather does not permit elimination of the peak, in a Province where electricity is widely used for home heating. However, more aggressive demand side management might be a good way to shave the peak and delay the need for new capacity.

This suggests that it is not the forecast of robust growth in demand that is driving the Muskrat Falls project. Rather it is more closely linked with the goal of removing the Holyrood Thermal Plant from the system. The power capacity of the Island system at present is about 2,000 MW, with energy capability of 9 million MWh. Slightly more than 600 MW of the 2,000MW of power capacity is thermal power, mostly generated at the Holyrood plant, of which 490 MW is fully operational during winter months and

[23] For a history of the power corridor issue see: (4), (5), (6), (8) and (24).

[24] See (19) slide 10.

could produce 3 million MWh, if operated year round. Because of the high cost of bunker C fuel[25] this capacity is only drawn upon when hydroelectric generators are running close to their maximum output. As the load grows the dependence upon Holyrood thermal capacity increases. It is this growth in the use of expensive bunker C fuel that is driving the Muskrat Falls project, combined with the projected increase in fuel prices and the high cost of refurbishing an old plant.[26]

> *Holyrood's historical consumption and historical oil prices are not a basis to forecast the thermal plant's production output and oil costs for the next 20 years. Twenty years from now, if the Holyrood plant remains in operation, Hydro estimates the plant will be burning an average of about 3.5 million barrels of heavy fuel oil a year, at a projected cost of about $150/BBL CDN which is approximately $500 million annually. For comparison, in 2010, 1.36 million barrels was burned at Holyrood at an average cost of $74 /BBl CDN.*

The Long Harbour hydromet plant which has been constructed to smelt nickel from the Voisey's Bay mine will impose a major demand upon the Holyrood plant.[27]

> *By 2015, electricity demand on the island is expected to reach the same level as 2004 when we hit an historical peak in electricity use, and it will continue to grow from residential, commercial and industrial electricity usage.*
>
> *Almost all extra load growth on the island from today, including the addition of Vale Inco's large industrial load at Long Harbour commencing late in 2011, will cause Holyrood output to once again increase. The Long Harbour hydromet plant at full load in 2016 will require the burning of an additional 1.1 million barrels of heavy fuel oil at the Holyrood thermal plant every year under normal hydroelectric production conditions.*

The additional 1.1 million barrels of heavy fuel oil in 2016 is almost a doubling of the 2010 usage at Holyrood, all driven by one industrial plant.

7.0 Alternative sources of power for provincial load

Nalcor's preferred choice, Option A, is the construction of Muskrat Falls and transmission lines to the Island (and another to Nova Scotia). As Option B, Nalcor has identified an alternative generation expansion path with no interconnection between the Island and Labrador. This expansion path draws upon a combination of small hydro sites on the Island, along with wind power, refurbishment of the Holyrood thermal plant, other small thermal sources, along with energy conservation measures to reduce dependence upon thermal power. Option B is estimated to be more costly than Muskrat Falls, Option A. The cumulative present worth (CPW in 2010$)) of the Isolated Island alternative over the period 2011-67 is $12.3 billion, compared with $10.1 billion for the Muskrat interconnected option. Muskrat Falls is preferred by over $2.2 billion dollars (see Figure 3).

The load forecast is based upon forecasts provided by the Department of Finance, which is projecting minimal growth in population over the forecast period. Nalcor has assumed that the two mills at Stephenville and Grand Falls will remain closed, that the Corner Brook paper mill and the Come by Chance Refinery will continue with their present level of energy use and the nickel smelter will begin to take power in 2011, rising to its full load in 2016. The provincial load forecast must also include new industrial requirements, including those emerging in Labrador from an expanding mining industry. Real

[25] Bunker C is a high viscosity residual fuel which is what remains from the processing of crude oil after the more valuable products, such as gasoline, have been removed. The residue may include undesirable impurities which add to the negative environmental impact of operating the Holyrood thermal plant.

[26] (20).

[27] (17)

disposable income is projected to rise by 0.9% a year from now to 2029. Average housing starts are projected to drop from 2575 (by 2014) to 2135 (by 2029). The preference for electric heating is assumed to continue.[28]

The three small hydro sites scheduled for development under Option B are Island Pond (36MW and 172,000 MWh), which will require 42 months to develop, Portland Creek (23MW and 99,000 MWh) which will take 32 months to bring onstream, and the smaller Round Pond (18 MW and 108,000 MWh) which will take 33 months to develop. These three hydro power sites will contribute 77 MW of capacity.

The Province has two existing 27 MW wind farms (at Fermeuse and St. Lawrence) which are connected to the Island transmission system. The next potential wind farm will have a capacity of 25 MW (using eight wind turbines) with firm energy capability of 70,000 MWh. It will take 30 months to bring such a system on stream. If the Island were interconnected the potential for additional wind turbines would be enhanced by enabling energy exchanges, depending on where the wind is blowing.

Nalcor's Isolated Island alternative continues to rely heavily on thermal fired plants. Combined-cycle combustion turbine (CCCT) plants can be fired by light fuel oil or by natural gas. The proposed 170 MW CCCT plant would generate 1,340,000 MWh of firm energy. The overall project schedule is estimated to be at least 36 months from the project release date to the in-service date.

Option B provides for two 50 MW (net), simple-cycle combustion turbines (CT) to be located either adjacent to similar existing units at Hydro's Hardwoods and Stephenville Terminal Stations, at the Holyrood site or at greenfield locations. They are fired on light oil and due to their modest efficiency relative to a CCCT plant they are primarily deployed for peaking and voltage support functions. If required, they can be utilized to provide an annual firm energy capability of 394,000 MWh each.

The small hydro and wind units will add 102 MW, while the CCCT and CT units will add 270 MW, for a total of 372 MW by 2030. This incremental capacity of 372 MW compares with the 824 MW capacity of Muskrat Falls. The cost of these capital assets plus the cost of fuel are estimated at more than $12.2 billion, $2.0 billion more than the cost of the Muskrat Falls project. Nalcor is, strangely, not forecasting an increase in generating capacity beyond 2030, in the Isolated Island alternative.

Option B will include addressing environmental concerns with sulphur dioxide (SO2) and particulate emissions at Holyrood in the 2015-20 period via the addition of scrubbers and electrostatic precipitators, at a cost of $582 million. This will be followed after 2030 by the replacement of the thermal units ($1,504 million). It appears, based on the evidence filed by Nalcor with the PUB, that the additional 372 MW in place by 2030 will be sufficient to meet demand up to 2067.

8.0 Alternatives to Development of Muskrat Falls

Other alternatives to the development of Muskrat Falls have been proposed. Fisher et al[29] have undertaken a desk study for the Harris Centre of Memorial University which examined the potential for very small hydroelectric developments, along with additional wind power. They claim that such developments are sufficiently economic to avoid further dependence on thermal power in the absence of a Lower Churchill megaproject. The conclusions of the report require additional study but the authors have made a case for investing in further exploration of the options before the Province commits itself to a large and expensive project such as Muskrat Falls.

[28] The data on load and generation options in this and the following paragraphs are taken from (16) and (19).
[29] (7).

The Joint Panel received presentations dealing with wind power, specifically the notion of a large wind farm on the Island with a capacity of 800 MW and with energy output comparable to Muskrat Falls. The levelized cost of energy cited was 7.5 cents per KWh.[30]

All of the possible alternatives cannot be explored in this essay. Four other options will be explored briefly in addition to Option A (Muskrat Falls) and Option B (Isolated Island Alternative). One, which we will call Option C, is pursuit of the larger Gull Island project, the cost per kilowatt hour of which is lower than the cost of Muskrat Falls[31]. This 2,250 MW project can produce close to 12 million MWh of energy, more than twice the output of Muskrat Falls. In the absence of wheeling rights through Quebec and access to Hydro Quebec's high voltage transmission system, the necessity to build expensive new transmission lines and underwater power cables across two Straits (the Strait of Belle Isle and Cabot Strait) makes it extremely difficult to deliver energy at competitive prices. If surplus Gull power could be sold through Quebec it is likely that Gull energy could be delivered more economically than energy from Muskrat Falls.

The provincial reference to the Public Utilities Board does not include consideration of this option, which is unfortunate. The reference limits the enquiry to consideration of Muskrat Falls, in comparison with Nalcor's Option B, the Isolated Island alternative. However, development of Gull Island is an attractive option if wheeling arrangements can be negotiated with Quebec, possibly with Federal help, and if markets can be found for firm energy commitments.

Option D is to negotiate with Quebec to access power, possibly supplied from the Churchill Falls power plant. It is unlikely that Hydro Quebec would sell the power at the same price stipulated in the power contract between CF(L)Co and Hydro Quebec. However, the price might be more advantageous than the cost incurred to develop Muskrat Falls, with 40% of the energy remaining unsold. Transmission lines would still need to be built to connect Labrador with the Island but the cost of building the new generation site at Muskrat Falls would be avoided, as would the cost of the link with the Maritimes.

Option E is to set our sights on the year 2041, when the 65 year Churchill Falls power contract will have expired, and more aggressively to moderate demand on the Island until that time, through demand side management and conservation. The Joint Panel reports that the Province is budgeting $3.1 million for conservation and demand management or about 0.75% of utility revenues. Hydro's consultant proposed that this should be substantially increased. Demand management can be accomplished by using better pricing signals, where prices are more finely tuned to reflect marginal cost[32], thereby signaling to the energy user the cost consequences of his decisions. This might be a good way to discourage electric space heating in favour of more efficient alternatives.

In addition to introducing disincentives to the use of energy, government could open up competition on the supply side by offering to purchase power from small producers, particularly small hydro, wind and solar producers and other renewable energy sources. This would open up private sector solutions to the supply of energy and perhaps, ultimately, transform Hydro into a system manager, reducing its role in the direct provision of energy. Hydro could then focus its energy on the transmission of power, including building an interconnection with Quebec.

Option F is a variant of the Isolated Island alternative. It includes a thermal plant at Holyrood but one which is converted to use natural gas, a cleaner and cheaper alternative, rather than Bunker C, with its high emissions. Abundant natural gas is available on the Grand Banks in association with producing oilfields. It has been suggested that a system of pipelines be established to collect gas and that the

[30] (13) p. 32.
[31] The levelized unit energy cost for Gull Island and Muskrat Falls were estimate at 3.92 cents and 4.47 cents per kilowatt hour (KWH) (2000 dollars) respectively. Ibid. p. 19.
[32] (23).

pipelines come ashore on the Avalon Peninsula, possibly in Holyrood.[33] Nalcor has advised[34] that there are two problems. One is that the gas is currently being used to optimize oil production through reinjection of natural gas and that production of gas would detract from the economics of oilfield operations. The second is that natural gas prices have fallen largely as a result of new discoveries of gas found in association with shale, known as "shale gas". This decline in prices has a "good news, bad news" effect. The good news is that natural gas is cheaper, thereby enhancing the viability of the proposed conversion at Holyrood. The bad news is that the low prices may not justify a large investment in underwater pipelines on the Grand Banks. Another important factor is that the requirements of a converted thermal plant would be extremely small in relationship to the large amount of natural gas which would be piped and may not justify bringing a pipeline landfall on the Island.

Two other sources of natural gas should be considered. One is liquefied natural gas (LNG) which is transported by gas tankers from suppliers around the world. This supply of natural gas should be explored as an alternative to Bunker C. Market prices are relatively low and large volumes are available. Liquefaction of natural gas on the site of floating oil producing platforms is not considered feasible by industry experts. Compressed natural gas (CNG) is another possibility and might be available by compressing gas on oil-producing sites as well as from international suppliers outside the Province. Both LNG and CNG should be explored to improve the economics of the isolated Island alternative.

9.0 Is Muskrat Falls the best option to supply the Island?

The Muskrat Falls project is probably a second or third best solution. Notwithstanding the power agreement whereby the overall investment is shared between Emera and Nalcor Energy, the project will cause a large increase in the already large debt burden of the Province. This raises the question as to whether a private sector solution can be found, or a private public partnership, which will avoid the added direct debt burden. Can such a partnership be found which will engage the private sector as well as other provinces, possibly Ontario? Could such a partnership build Gull Island rather than Muskrat Falls, and, in so doing, secure lower prices for Newfoundland and Labrador consumers while at the same time serving other North American consumers, by meeting their needs with firm and long term energy contracts?

The selection of Muskrat Falls as the first Lower Churchill project defers the preferred Gull Island project, with its larger capacity and lower cost per energy unit, which ideally should be the first project in the sequence of Labrador power developments. While the Churchill Falls project conferred few benefits upon the Province it did not impose large financial obligations upon the Provincial Government or its Crown Corporations to underwrite the financing costs, as does Muskrat Falls.

Option A, with Muskrat Falls, leaves 40% of the power without committed sales and the politically unpalatable potential of being sold in the Maritimes or New England at a price below the prices charged to local consumers. The challenge is to mobilize the resources of the Province so that the needs of local users will be given first priority while at the same time extracting maximum rent for the people of the Province. If neither of these projects can be expedited without inflicting huge financial risks upon ratepayers and taxpayers then perhaps other avenues should be found to bring demand into line with the supply of energy. Looming large over these decisions is the prospect of access to Churchill Falls power in 2041, both to meet the energy needs of the Province and to generate revenue through sale of power at current and rising energy prices. Do we have the foresight to make the tough choice of short term pain for long term gain?

10.0 Other potential uses of Lower Churchill Power

Much of the public debate over Muskrat Falls has focused on meeting the energy needs of the Island and shutting down the Holyrood power plant. In assessing local needs one has to look as well at the

[33] (1).

[34] This information on LNG is based on a discussion with Ed Martin, President and CEO of Nalcor Energy, and his senior officials, on April 14, 2011.

growth of industrial demand in Labrador. While the mining industry has been expanding in Labrador as well as in Quebec the energy available to fuel this growth has remained limited to the 225 MW generated at Churchill Falls to replace Twin Falls and made available to the iron ore industry. In addition there is a block of 300 MW of recall power that is being used by local domestic and industrial consumers.

We need to assess all potential uses for power in Labrador, including the further processing in Labrador of indigenous mineral resources, and also mineral resources extracted from nearby mines in Quebec. Electric power can be used as an instrument of economic development to encourage processing and smelting of local ores. It can also be used to encourage the smelting of imported raw material such as bauxite into aluminum. Our Province has in the past used cheap energy as an inducement to develop energy-intensive industry. Such incentives must be weighed against the benefit of extracting rents by sale of energy to growing central Canadian and American markets. Such sales will require resolution of the wheeling issues which have for so long delayed power development in Labrador.

11.0 Conclusion

The Lower Churchill Project (or projects) needs to be viewed from a national, provincial and regional (Labrador) perspective. It is in the national interest to develop clean, renewable energy projects which allow Canadians, wherever they live, to enjoy access to our comparative abundance of hydroelectric resources, without compromising the ability of resource owners to maximize their economic rent. National policy should facilitate free interprovincial and international trade in energy and reduce barriers to the free flow of energy in all its forms. Canada has not enjoyed the same freedom of trade in electric energy as does the United States, nor has the National Energy Board (NEB) played the same trade-liberating role as has the Federal Energy Regulatory Commission (FERC). Yet there is a Federal Government commitment to bilateral free trade between Canada and the United States.

The Federal Government has been invited to participate in the financing of the Muskrat Falls proposal by providing a loan guarantee. It is highly unlikely that they will participate in this project unless the questions identified by the Joint Panel are addressed to their satisfaction and unless they have some management authority in decisions relating to the commissioning of the project. They will want to ensure that a Lower Churchill development strategy that places Muskrat first in the sequence is in the national interest. They will also reflect upon the Panel's caveats about the wisdom of the Province undertaking Muskrat Falls on its own without further analysis of the alternatives. The Lower Churchill, embracing both components, Gull Island as well as Muskrat Falls, has the potential not only to satisfy the energy needs of Newfoundland and Labrador but also of electrical consumers across Canada. For this reason Canada should the Lower Churchill within a broad policy context and will explore how national policy instruments can be used to facilitate interprovincial wheeling of power. The LCDC may be the appropriate instrument both to support financing of the project and to allow the Parliament of Canada to declare the project to be a national undertaking for the general advantage of Canada under Section 92 (10) (c) of the Constitution Act.

The Panel has recommended that the two components overlap in order to maximize net benefits. In light of this recommendation we would expect that the Federal Government will want to assure that markets in Canada are clearly identified to achieve cost recovery for the full energy output and that if markets are not available in Canada they should be found south of the border in the United States.

At this point in time it is difficult to undertake effective marketing, when the most cost effective transportation route (through Quebec) is precluded. The Province of Newfoundland and Labrador should be free to choose between the Quebec versus the so-called Anglo-Saxon routes on the basis of cost. If the Quebec route were an available option and if the cost were substantially less than the cost of the Anglo-Saxon route, with two submarine crossings, then Newfoundland and Labrador might elect to maximize its economic rent by selling all Lower Churchill power west, meeting the energy requirements of the Island from facilities entirely located on the Island. When this choice is unavailable the Province is left with only

one possible wheeling option to market energy surplus to its needs. Clearly there is a case for the exercise of national policy to ensure that efficient choices are made, within a free trade environment.

The Province's energy policy concerns itself with meeting the energy needs of the Province, as well as optimizing economic benefits and economic rent from energy developments. The Joint Panel has questioned Nalcor's analysis which showed that Muskrat Falls is the best and least cost way to meet domestic energy requirements. It recommended that an independent analysis of economic, energy and environmental considerations be undertaken before governments make their final decision. In light of the prominence given to the 2041 expiration date for the Upper Churchill contract in the Province's 2007 Energy Plan the Joint Panel recommended that Nalcor include Churchill Falls power in its planning for 2011-2067, which includes the period 2041-2067.

The Province has to be cognizant of the impact of the Muskrat Falls project upon Labrador. The Joint Panel heard a large volume of evidence from aboriginal and other groups in Labrador. Labrador can potentially benefit from the availability of power for use within the region. They concluded that a large-scale mitigation and adaptive management effort will be required to offset adverse social and biophysical effects. Social effects can be fully mitigated with enough resources and the passage of time. They also concluded that the residual environmental effect, though much reduced, would still be negative for Labrador. Unless the Province establishes a policy framework to redistribute benefits to Labrador the region may suffer negative net benefits.

In summary, there are a number of issues that must be addressed in weighing the options for supplying the energy needs of the Province of Newfoundland and Labrador. There are inherent advantages to be achieved through interconnection with the Mainland, in terms of reliability and the ability to export (and import) energy from renewable energy sources, such as wind. With respect to Muskrat Falls (Option A) versus the Isolated Island Alternative (Option B) the former will provide greater long term stability of prices to consumers by avoiding dependence upon unpredictable oil prices. On the other hand, without a firm market for surplus energy, Muskrat Falls involves building overcapacity and requires a large investment up front, with the potential for cost escalation and for adding to the provincial debt. The Isolated Island alternative allows for capacity to be built as needed depending on changes in the trend of load growth over time.

There is merit in the recommendation of the Joint Panel for an independent assessment. Such an independent assessment might be undertaken by broadening the terms of the reference made by the Province to the Public Utilities Board, or, preferably, by rescinding the exemption of Muskrat Falls and Gull Island from the jurisdiction of the Public Utilities Board. The Muskrat Falls decision should not be rushed. Due diligence requires further consideration of all of the issues raised by the Joint Panel, particularly the following:

- The lack of firm purchase agreements for surplus power and a clearer understanding of marketing possibilities;
- The use of other thermal alternatives, such as natural gas;
- The inefficient use of electric space heating; and
- Opportunities for conservation and demand management.

For convenience, the options are shown as follows, along with their advantages and disadvantages.

Table 1: Comparison of Options for Supplying Energy to Newfoundland and Labrador		
Five Options	Pros	Cons
Option A: Muskrat Falls Project with Link to Island and Maritime Transmission Link	• Price stability, upon completion. • Lower overall cost (CPW). • Connection of Island to continental grid. • Availability of additional power for industrial load growth in Labrador. • Sale of power surplus to needs of Province.	• Overcapacity for Island along with high initial cost. • Potential for cost escalation. • Increase in public debt. • Reliance upon long transmission lines with two sub-sea crossings. • No market for 40% of the energy. • Loss of Avalon Peninsula based emergency power by removal of Holyrood thermal plant.
Option B: Isolated Island Alternative	• Increased flexibility by building new capacity only as needed. • Can use demand side management.	• More costly than Muskrat ($2.2B). • Vulnerability to escalating oil prices
Option C: Gull Island Project	• Lower per unit cost. • Potential to accommodate unforeseen load growth. • Connection of Island to continental grid. • Revenue from sale of surplus power on firm basis.	• Overcapacity • Reliance upon Quebec for transmission. • Requirement for firm energy markets.
Option D: Negotiate with Quebec to purchase power, with Link to Island	• Reduced capital cost. • Lower energy cost. • Connection of Island with continental grid.	• Nalcor indicates that Quebec is not receptive. However this may change as the political scene unfolds.
Option E: The 2041 alternative, drawing upon Island sources as needed, along with aggressive demand side management, until Churchill Falls power is available in 2041, at the end of the power contract with Quebec.	• Reduced capital cost. • Increased flexibility by building new capacity only as required.	• Higher prices before 2041. • Loss of economic opportunities from development of the Lower Churchill.
Option F: The Conversion of the Holyrood thermal plant from Bunker C to natural gas.	• Improved viability of Isolated Island alternative. • Lower fuel cost. • Lower emissions.	• Possible high capital cost.

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Figure 1: Map of Muskrat Falls Development

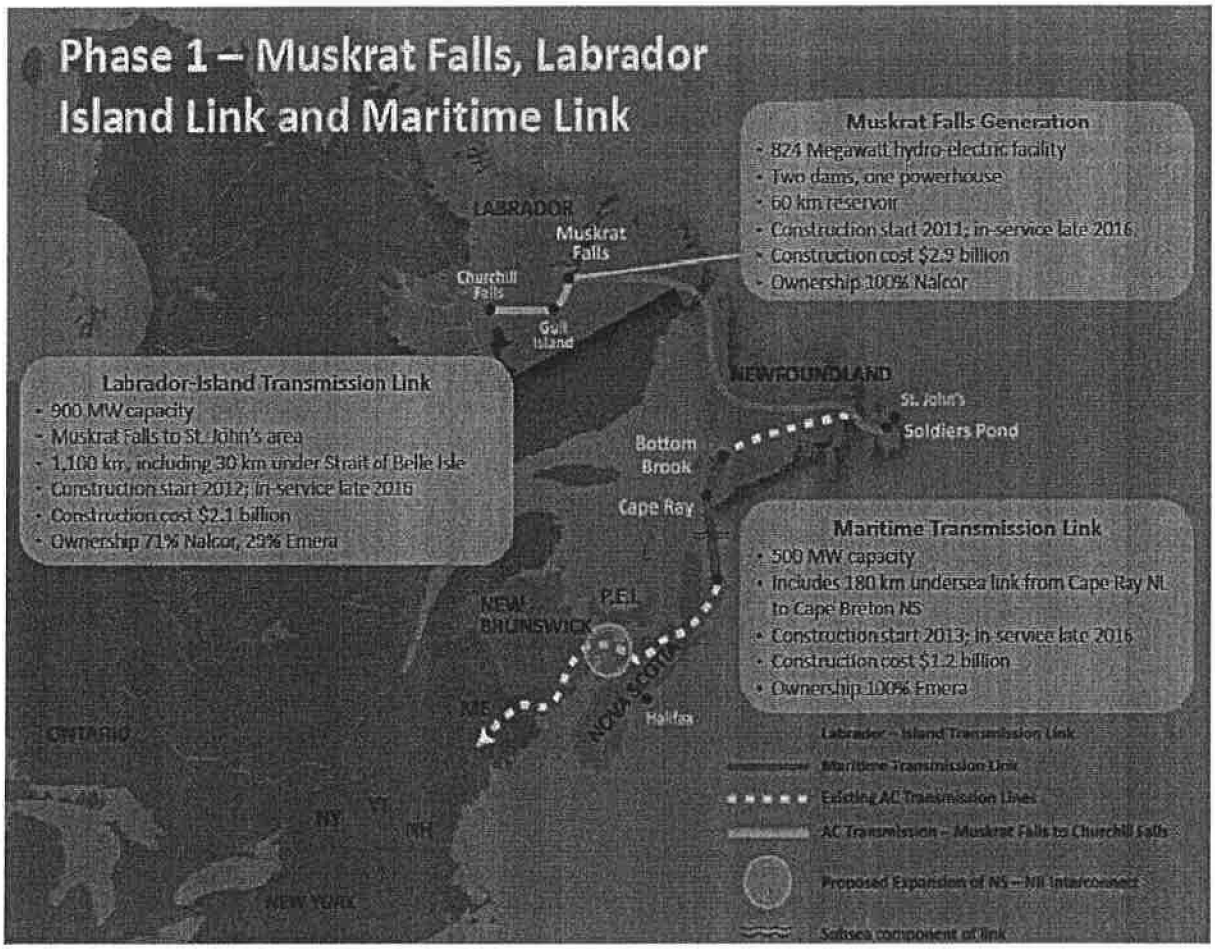


Figure 2: Historical and Forecast Energy Needs

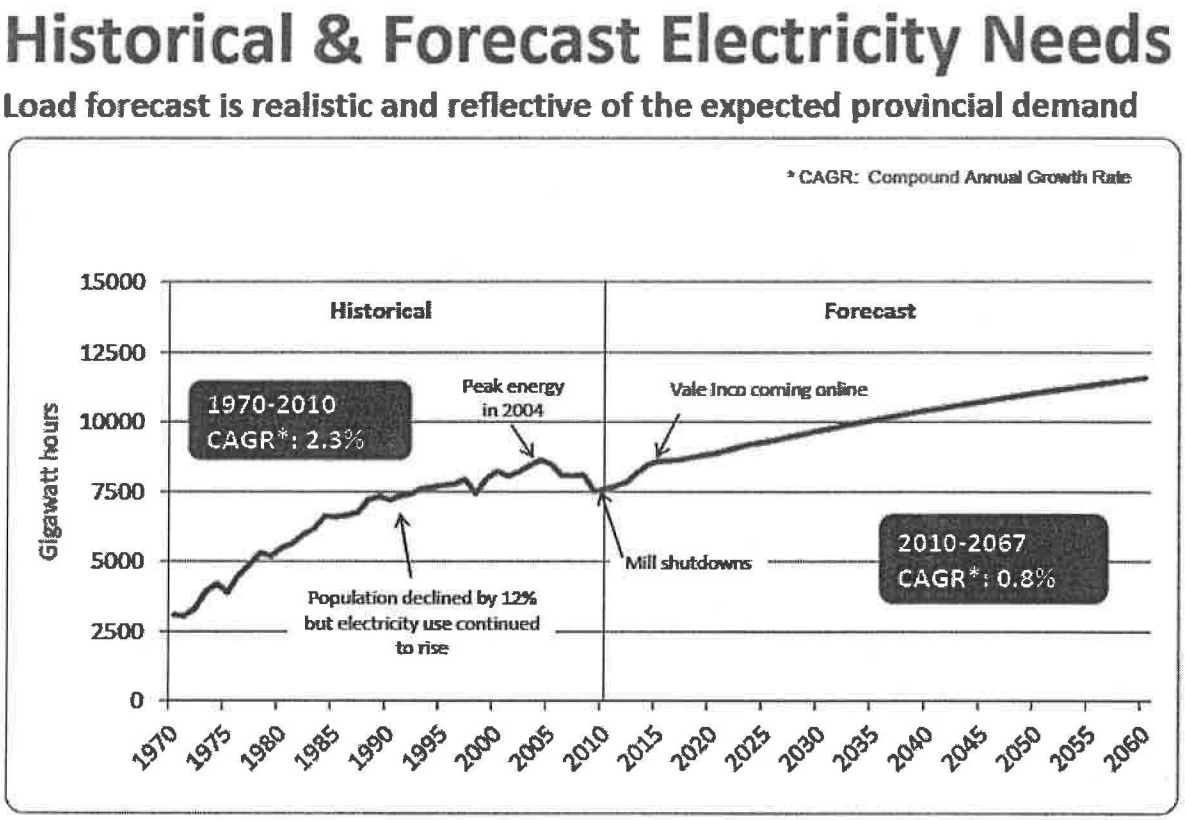


Figure 3: Comparison of CPW of Muskrat Falls with Isolated Island Option

