

## EXECUTIVE SUMMARY AND KEY FINDINGS

Nalcor Energy has proposed a plan for the long term electricity supply for the Island of Newfoundland. This plan passed through Decision Gate 2 (DG2) where the Muskrat Falls with the Labrador-Island Link was chosen as the preferred alternative to meet future energy needs. Nalcor's Gateway Process is designed to ensure decisions are made at appropriate times, with the appropriate level of information, and at appropriate levels of expenditure. It focuses on key milestones to achieve gateway readiness and builds in "cold eyes" reviews at key decision points throughout the process.

Decision Gate 3 (DG3) – Project Sanction is the next step in the process. DG3 requires the advancement of project activities and work streams to a level of progression which provides the certainty needed to sanction or go ahead with the Project. Nalcor has retained Navigant to conduct an initial review using DG2 estimates. This report presents Navigant's findings related to Nalcor's recent DG2 decision. Navigant will provide a second report using DG3 project cost and schedule information as input to the DG3 decision.

### *Options Considered by Nalcor*

Nalcor's DG2 decision evaluated a number of potentially feasible generation expansion alternatives for the long-term supply of electricity to the Island of Newfoundland. The alternatives fell into two broad categories: 1) Isolated Island alternatives, and 2) Interconnected Island alternatives. The optimal generation plan for each category was selected from the potential feasible alternatives in each category. The optimal generation expansion plan in each of these two categories is described below:

1. ***Isolated Island*** alternative would entail continued isolation of the Island power grid and the inherent supply and operational limitations associated with isolation. The key elements are:
  - Development of limited renewable resources in the near-term
  - Pollution abatement, life extension improvements at the Holyrood plant, replacement of the Holyrood plant, and
  - Continued development of thermal power resources across the planning period 2010 to 2067.
2. ***Interconnected Island*** alternative would provide the capability to displace the Holyrood plant and meet the growth in provincial power requirements for years to come. In addition, this alternative would interconnect the Island with the regional North American power grid. The key elements are:
  - Muskrat Falls generation facility, and
  - Labrador-Island Link (LIL) transmission facility.

### *Nalcor's DG2 Results*

Based on the assumptions, inputs and analysis undertaken by Nalcor, the Cumulative Present Worth (CPW, present value in 2010\$ of annual utility revenue requirements) for each of the two generation expansion alternatives is shown in the following table.

Generation Expansion Alternative	Cumulative Present Worth (CPW) 2010\$ millions
Isolated Island	\$8,810
Interconnected Island	\$6,652
<b>Preference for Interconnected Island</b>	<b>\$2,158</b>

As shown above, Nalcor projects that developing the Interconnected Island alternative will result in lower utility costs for customers of \$2.2 billion in present value terms through 2067 as compared to the Isolated Island alternative.

### *Navigant's Independent Supply Decision Review Mandate*

Navigant was asked to review the reasonableness of:

- The long-term Island supply options considered by Nalcor
- Nalcor's assumptions associated with Island supply options, and
- The process followed to screen and evaluate the supply options.

Based on this review, Navigant was to provide an opinion on:

- Whether the Interconnected Island alternative represents the least cost option that also fulfills the additional criteria requirements of security of supply and reliability, environmental responsibility, and risk and uncertainty, and
- The accuracy of the rate projections.

### *Navigant's Conclusions*

Based on its independent review, Navigant has concluded that the Interconnected Island alternative is the long-term least cost option for the Island of Newfoundland. Relative to the Isolated Island alternative, the Interconnected Island alternative is also expected to provide similar levels of security and reliability, significantly reduced greenhouse gas (GHG) emissions and significantly less risk and uncertainty. The Interconnected Island alternative also provides a gradual decrease in real (adjusted for inflation) average wholesale electricity rates for the Island.

Navigant has concluded that Nalcor's consideration and screening of the supply options as well as the assumptions used by Nalcor regarding these options were reasonable and consistent with generally accepted utility practices. Nalcor's process to evaluate the supply options and estimate the rate projections under the two alternatives was also found to be reasonable and consistent with generally accepted utility practices.

Navigant has concluded that the CPW calculated by Nalcor for each of the generation expansion alternatives fairly represent the costs that would be incurred under the alternative supply futures. Thus, the \$2.2 billion preference for the Interconnected Island alternative, as estimated by Nalcor in the DG2 decision gate, is a reasonable estimate of the expected cost difference between the two alternatives.

To explore the sensitivity of the CPW difference between the two alternatives to changes in the supply options or assumptions, Nalcor and Navigant analyzed a number of sensitivity cases covering:

- different fuel price forecasts
- lower load growth
- additional wind generation
- introduction of carbon pricing
- aggressive CDM, and
- higher capital costs and the recently announced Federal Loan Guarantee for Muskrat Falls and the LIL.

All of the sensitivity cases resulted in a CPW advantage for the Interconnected Island alternative. This clearly indicates that the DG2 decision preference for the Interconnected Island alternative was robust given the underlying risk and uncertainty in key assumptions.

## Key Findings

1. Nalcor's Gateway Process is a rigorous means of providing quality assurance for key decisions at crucial points in a project's lifecycle and is consistent with best practices.
2. The level and accuracy of the information used in Nalcor's DG2 Island Supply Decision was appropriate for the decision stage.
3. The 50 year generation expansion analysis period used by Nalcor was appropriate given the long-lived supply options being analyzed.
4. Nalcor appropriately included Muskrat Falls in Labrador and Island Pond, Portland Creek and Round Pond on the Island as hydroelectric generation in their generation expansion alternatives.
5. Nalcor appropriately excluded Gull Island in the Interconnected Island alternative because the purchase price for power from Gull Island would have to be 60 percent higher than power from Muskrat Falls under the same pricing framework.
6. Nalcor appropriately excluded other potential hydroelectric facilities in both generation expansion alternatives because the expected cost of power from other potential hydroelectric facilities would be approximately 20 percent higher than wind power.
7. Nalcor's exploration and analysis of alternatives for the LIL was rigorous and the transmission options developed and considered by Nalcor were reasonable.
8. LIL will be implemented using proven and reliable HVdc technology.
9. Nalcor's rejection of deferring the in-service date of the link until 2041 and using Churchill Falls as a supply option for the Island was reasonable given the higher costs and greater risks as compared to the Interconnected Island alternative.
10. Wind power is expected to be the lowest cost of the other renewable electricity supply options on the Island and Nalcor's inclusion of wind power in the Isolated Island alternative was reasonable.
11. Provided the power system constraints identified in the 2004 wind integration study can be addressed cost-effectively, Nalcor's Isolated Island alternative could consider 100 MW of additional wind power in 2025 and a further 100 MW in 2035 when it would be potentially expected to displace fossil fuel-fired generation most of the time.
12. No amount of wind generation could eliminate the need for the firm capacity provided by Holyrood or any replacement thermal facilities given the limited and uncertain capacity of wind generation.

13. Nalcor would have the capacity to integrate significantly more than 200 MW of wind only in the Interconnected Island alternative given the performance characteristics of Muskrat Falls.
14. Nalcor appropriately excluded biomass from both generation expansion alternatives because of the relatively limited biomass accessible through NL's existing forestry infrastructure.
15. Nalcor appropriately excluded solar photovoltaic (PV) generation in both generation expansion alternatives because of Newfoundland's low insolation rates and the cost of power from solar PV installations.
16. Nalcor appropriately excluded wave and tidal generation in both generation expansion alternatives because of its unproven commercial viability.
17. Nalcor appropriately included the continuation of oil-fired generation in both generation expansion alternatives because it is a proven resource in the Island's generation supply mix.
18. Nalcor appropriately excluded natural gas generation in both generation expansion alternatives because natural gas is not commercially available on the Island and there are, as yet, no firm development plans to bring natural gas to the Island.
19. Nalcor appropriately excluded liquefied natural gas (LNG) generation in both generation expansion alternatives because there is no clear economic advantage to using LNG given the required capital for LNG-related facilities, coupled with the linkage of long term LNG pricing to oil.
20. Nalcor appropriately excluded coal-fired generation in both generation expansion alternatives because of its significant environmental risks.
21. Nalcor appropriately excluded nuclear generation in both generation expansion alternatives because of provincial legislation, project capital costs and risk factors.
22. Nalcor's forecast methodology is consistent with generally accepted utility practice and the base forecast for demand and energy growth is reasonable.
23. Absent new supply, the Island will experience a capacity deficit in 2015 and an energy deficit in the 2020 timeframe
24. Nalcor could consider the impact of a longer term CDM initiative.
25. Nalcor's risk assessment analysis for Muskrat Falls and the Labrador-Island Link project was thorough and comprehensive.

26. Nalcor's focus on time, tactical and strategic risks for the Muskrat Falls and Labrador-Island Link is consistent with best practices and provides a high level of confidence in the integrity of capital cost estimates.
27. Nalcor's estimated capital costs and escalation methodology for the various supply options considered in the two generation expansion alternatives was reasonable.
28. The fuel cost forecast used by Nalcor in its analysis of the generation expansion alternatives was reasonable.
29. The heat rates, operating and maintenance costs, operating lives, projected retirements, and outage rates used by Nalcor in its analysis of the generation expansion alternatives were reasonable.
30. Nalcor could consider how future environmental legislation, such as limits on the unit emission rates for fossil-fuel fired generation that could force the closure of Holyrood or the introduction of carbon pricing that would increase thermal production costs, would affect its supply alternatives.
31. The Muskrat Falls pricing approach used by Nalcor was appropriate and sufficiently well defined for the purposes of 1) estimating the Muskrat Falls power purchase price, and 2) informing the DG2 decision.
32. Nalcor's use of the Strategist model in developing the two generation expansion alternatives is consistent with generally accepted utility practice.
33. The CPWs for the generation expansion alternatives fairly represent the costs that would be incurred under the alternative supply futures. Therefore, the \$2.2 billion CPW preference for the Interconnected Island alternative is a reasonable estimate of the expected cost difference between the two alternatives.
34. The sensitivity cases run by Nalcor and Navigant capture the key risks in the assumptions for, and the impacts of potential refinements to, the generation expansion alternatives.
35. All of the sensitivity cases maintained the CPW preference for the Interconnected Island alternative. This clearly indicates that the DG2 decision preference for the Interconnected Island alternative was robust given the underlying risk and uncertainty in key assumptions in the generation expansion alternatives.
36. The CPW preference for the Interconnected Island alternative is maintained after adding more wind or CDM to the Isolated Island alternative.

37. Current information, and specifically the updated May 2011 PIRA long term fuel forecast and the recently announced federal loan guarantee commitment, increases the CPW preference for the Interconnected Island alternative.
38. Relative to the Isolated Island alternative, the Interconnected Island alternative is also expected to provide similar levels of security and reliability, significantly reduced GHG emissions and significantly less risk and uncertainty.
39. The criteria used by Nalcor in the Island supply decision were reasonable and consistent with generally accepted utility practices.
40. The Interconnected Island alternative represents a fundamental change to a more stable and certain utility cost structure for the Island by minimizing thermal generation and its associated fuel cost uncertainty.
41. Nalcor's wholesale electricity rate impact analysis accurately reflects the rate projections and provides a reasonable basis for assessing unit cost trends with respect to the two alternatives.
42. Short-term increases in real (before considering inflation) wholesale electricity rates would occur over the next few years under either alternative. Beyond 2017, the wholesale electricity rates for the Interconnected Island alternative decline in real terms.
43. Wholesale electricity rates are lower in the Interconnected Island alternative than the Isolated Island alternative except for a brief period at the end of this decade. This short-term issue could be mitigated through ratemaking.