

7 Cumulative Present Worth Analysis

Nalcor stated in its submission to the Board under its cover letter dated July 6, 2011⁶⁴:

“The outcome of the generation planning analysis is Cumulative Present Worth (CPW), which is the present value of all incremental utility capital and operating costs incurred Hydro to reliably meet a specific load forecast given a prescribed set of reliability criteria. Where the cost of one alternative supply future for the grid has a lower CPW than another, the option with the lower CPW will be recommended by Hydro, consistent with the provision of mandated least cost electricity service.”

The metric of least cost was not defined by the government in setting out its mandate to the Board. The analysis provided by Nalcor is based on a Cumulative Present Worth (CPW) methodology which focuses exclusively on costs, including capital expenditures for the construction of new facilities, fuel costs and power purchased, and operating expenses. The CPW approach does not take cash inflows related to revenues into account. The goal of the least-cost analysis is to choose the Option which minimizes the present worth of costs.

When analyzing the least cost as determined by Nalcor, MHI reviewed all Nalcor exhibits and RFI responses that related to the calculation of the CPW figures, and developed a spreadsheet based on data from these various sources. This spreadsheet was used to better understand and evaluate Nalcor’s assumptions and methodologies used in the CPW calculation. Over a subsequent series of RFIs submitted to Nalcor, MHI further assessed the specific details of the methodologies employed, both to evaluate the approach used to construct Nalcor’s two Options and to look for possible mechanical or methodological errors.

The CPW results (2010\$) presented by Nalcor are summarized in Table 13. Analysis completed by MHI validated these results.

Table 13: Nalcor’s CPW Breakdown for the two Options (\$ millions)

CPW Component	Isolated Island	Labrador Infeed
Operating and Maintenance	\$634	\$376
Fossil Fuel Costs	\$6,048	\$1,170
Existing Power Purchases	\$743	\$676
Muskrat Falls Power Purchases	NA	\$2,682
Depreciation	\$553	\$450
Return of Rate Base	\$831	\$1,297
Total	\$8,810	\$6,652
Differential	\$2,158	

(Source: Nalcor’s Final Submission, Table 28, pg. 124)

⁶⁴ Nalcor, “Synopsis of 2010 Generation Expansion Decision”, July 2011

7.1 Alternatives to CPW

Other types of analysis that are commonly used for determining the preferred option from a set of alternatives include Net Present Value (NPV) and Internal Rate of Return (IRR). Both of these methods require an estimate of the revenue stream generated by the power tariffs over the forecast period, as they weigh future cash in-flows related to revenue against cash out-flows, such as those associated with capital investment. These approaches rely on discounting future cash flows to the present and the result with the highest NPV is the preferred option. Differences in risk exposure are typically manifested in the choice of discount rate. MHI is satisfied that the CPW approach used by Nalcor is reasonable for the purpose intended, that being to identify the least cost choice between the two Options.

In summary, the least cost Option as defined by the use of CPW methodology is the Infeed Option. The CPW differential between the two Options is \$2.158 million.

7.2 PPA Versus COS Approach

In the process of discounting the costs for the CPW, Nalcor treated the costs related to the Muskrat Falls generation facility on a Power Purchase Agreement (PPA) basis, in contrast to a Cost of Service (COS) basis. The rationale provided by Nalcor for using a PPA approach was that the generation facility was to be developed by Nalcor who was then to act as an independent power producer and sell the energy to NLH. It also facilitated the costs associated with the Muskrat Falls Generating Station to be smoothed over the period under review. In contrast, using a COS approach tends to result in higher costs in the earlier years followed by lower costs in the latter years of a project. MHI tested the merits of using a full COS approach for Muskrat Falls Generating Station costs. Using an 8% interest rate for calculating AFUDC, the CPW using a COS approach is approximately equal to that using a PPA approach⁶⁵.

7.3 Discount Rate Sensitivity

MHI also tested the sensitivity of the level of discount rate used to discount the costs. Nalcor used a discount rate based on a weighted cost of capital of 8.0%, based on a weighting of 75% debt at 7.35% plus 25% equity at 10%. Recognizing there is some judgment applied in the selection of the appropriate discount rate, MHI tested the sensitivity of varying the discount rate and determined that within a reasonably close band, the level of discount rate does not substantially affect the CPW. In the extreme, the discount rate would have to be raised to 17% for the differential of the CPW between the two Options to become zero.

⁶⁵ Response to RFI PUB-Nalcor-177

7.4 Capital Cost Sensitivity

The sensitivity of accuracy as related to the capital costs, particularly as related to the Infeed Option, was also tested. Given the level of accuracy associated with DG2 estimates, the final capital costs have the potential to increase by as much as 50% over the current estimates. Should such a result occur, the differential of the CPW between the two Options would be reduced from \$2.158 billion to \$194 million⁶⁶.

Similarly, should the Labrador-Island Link capital costs increase by 25%, the CPW differential in favour of the Infeed Option would be reduced by \$398.0 million, and if the Muskrat Falls Generating Station capital costs increased by 25%, the CPW differential in favour of the Infeed Option would be reduced by \$577.0 million⁶⁷. If both the Labrador-Island HVdc Link and the Muskrat Falls Generating Station costs increase by 25%, the CPW differential in favour of the Infeed Option would be reduced by \$975 million⁶⁸.

7.5 Load Forecast Sensitivity

Another consideration which could have a significant impact on the resulting CPW relates to the assumption used for the load forecast. The assumption used for the Isolated Island Option was based on the same planning load forecast⁶⁹ (PLF) described in the 2010 Capital Budget Application to the Board, but extended to 2067. However, the significance of a possible alternate future for the remaining pulp and paper mill was not considered as an additional Isolated Island scenario. The PLF makes the assumption that there is no change in status for the mill. MHI requested Nalcor to perform a sensitivity analysis with a reduction in system consumption of 880 GWh per year, equivalent to the total electric energy requirement of the mill including purchases from Nalcor and their own generation. In Exhibit 43, revision 1, Nalcor indicated the CPW differential between the two Options would be reduced from \$2.158 billion in the base case to \$408 million in favour of the Infeed Option.

7.6 Fuel Price Sensitivity

Another consideration for the CPW analysis is the impact of fuel costs. In its analysis, Nalcor relies on forecasts of fuel oil prices provided by PIRA Energy Group of New York (PIRA), an international supplier of energy market fuel forecasts. PIRA provided reference, low, high and expected fuel forecasts with the reference price forecast being used by Nalcor. Using PIRA's March 2010 low fuel price forecast, the CPW differential is reduced to \$120 million from the \$2.2 billion presented by Nalcor in its base case⁷⁰. The forecasting accuracy for fuel costs will remain a challenge over the duration of the projected review period, which is in excess of 50 years. There are many variables which could come into play over that period that could have a substantial impact on fuel costs, over which Nalcor has no control or influence.

⁶⁶ Response to RFI PUB-Nalcor-118

⁶⁷ Response to RFI MHI-Nalcor-41

⁶⁸ Exhibit 43 Rev.1, Nalcor, "Newfoundland and Labrador Hydro – 2010 Generation Expansion Analysis (Revision 1)"

⁶⁹ Exhibit 16, Nalcor, "Generating Planning Issues 2010 July Update", July 2010

⁷⁰ Response to RFI MHI-Nalcor-41

7.7 Combined Input Sensitivities

Additional sensitivities were performed by varying multiple inputs. For example, if there is a 20% decrease in fuel costs, combined with a 20% decrease in the annual percentage load growth post 2014, and a 20% increase in the capital cost estimate for both Muskrat Falls Generating Station and the Labrador-Island Link HVdc system, the CPW differential would be reduced to \$159 million in favour of the Infeed Option⁷¹.

Also, should the existing pulp and paper mill cease operations, and its generation capacity be available for use on the system (880 GWh), and should the capital costs of both the Muskrat Falls Generating Station and Labrador-Island Link HVdc projects increase by 10%, the CPW for the two Options would be approximately equal⁷².

7.8 CPW Sensitivity Analysis Summary

With projects of this magnitude, and considering the length of the analysis period, there are risks and uncertainties associated with the key inputs and assumptions. Changes in these key inputs and assumptions will affect the financial results and must be assessed to determine materiality. These changes in key inputs and assumptions can impact the results of the analysis and shift the preference for what is the least cost option. Fuel costs and construction material costs are variable with world economic conditions. Load forecasts are a major input based on local conditions and must be carefully monitored to ensure that generation development occurs in relation to future load requirements.

Table 14 summarizes the results of various sensitivities. Increases in capital cost, load forecast reduction, or fuel price reduction could result in the favourable CPW differential for the Infeed Option being substantially reduced or even eliminated. Given the sensitivity of the load loss on the CPW, particularly in combination with potential variations in fuel price and capital cost estimates, MHI considers it imperative that Nalcor obtain as much understanding as possible regarding the future prospects for the continued operation of its industrial customers and in addition, develop contingency plans to address the implications of reductions in industrial loads.

⁷¹ Response to RFI PUB-Nalcor-56

⁷² MHI derived

Table 14: CPW Sensitivity Analysis Summary

	Sensitivity Summary	Isolated Island Option	Infeed Option	Difference
1	Base case	\$8,810	\$6,652	\$2,158
2	Annual load decreased by 880 GWh	\$6,625	\$6,217	\$408
3	Fuel costs: PIRA's low price forecast	\$6,221	\$6,100	\$120
4	Fuel price reduced by 44% from base case	\$6,134	\$6,134	\$0
5	Labrador-Island Link capital cost increased by 25%	\$8,810	\$7,050	\$1,760
6	Muskrat Falls GS capital cost increased by 25%	\$8,810	\$7,229	\$1,581
7	Muskrat Falls GS and Labrador-Island HVdc Link capital cost increase by 25%	\$8,810	\$7,627	\$1,183
8	Labrador-Island HVdc Link and Muskrat Falls capital cost increased by 50%	\$8,810	\$8,616	\$194
9	Scenario with <ul style="list-style-type: none"> Fuel cost decreased 20% Annual load growth decreased of 20% Capital cost increased for Muskrat Falls GS and Labrador-Island HVdc Link by 20% 	\$7,037	\$6,878	\$159
10	Scenario with <ul style="list-style-type: none"> Annual load decreased by 880 GWh Muskrat falls GS and Labrador-Island HVdc Link Capital cost increased by 10% 	\$6,625	\$6,598	\$27

(Sources:

Scenarios 1,2,3,4,5,6,7: Response to RFI MHI-Nalcor-41 Revision 1 and EX-43 Rev.1

Scenario 8: Response to RFI PUB-Nalcor-118

Scenario 9: Response to RFI PUB-Nalcor-56

Scenario 10: MHI derived)

In addition, the matter of meeting environmental guidelines in the future could be problematic. Nalcor stated that it may not be able to continue operating its oil fired generation facilities if a natural gas combined cycle benchmark for GHG emission intensity levels is applied to oil fired generation⁷³.

It is also noted, that while no consideration has been given to carbon pricing in either option, the impact of any future value of carbon credits will be more significant on the Isolated Island Option, which will lead to increasing the differential between the two Options.

⁷³ "Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from the Lieutenant-Governor in Council on the Muskrat Falls Project", November 2011, pg. 64.

7.9 CPW Analysis Key Finding

The key finding from the review of the CPW analysis is as follows:

- Based on the capital and operating costs estimated by Nalcor for each option and a common load forecast, Nalcor has determined that the Infeed Option has a lower cumulative present worth than the Isolated Island Option by approximately \$2.2 billion. The detailed analysis performed by MHI determined that Nalcor's cumulative present worth analysis was completed using recognized best practices and the cumulative present worth for each option was correct based on the inputs used by Nalcor. These inputs were reviewed in the technical and financial analyses conducted by MHI and were generally found to be appropriate. There are, however, other considerations related to risks associated with the assumptions used for certain key inputs such as load, fuel prices and cost estimates which may impact the cumulative present worth analysis for the two options. These were tested with the use of several sensitivity analyses and the results of these are summarized as follows:

- Load Forecast

A major input to the cumulative present worth analysis is the load forecast, and as a result any large changes in the load would have a significant impact. For example, should the existing pulp and paper mill cease operations, and its generation capacity be available for use on the system, and should the capital costs of both of the Muskrat Falls Generating Station and Labrador-Island Link HVdc projects increase by 10%, the cumulative present worth for the two Options would be approximately equal⁷⁴.

- Capital Cost Estimates

The current capital estimates are within the accuracy of an AACE Class 4 estimate which has a plus factor variance potential of as much as 50%. Should cost overruns reach that level, the difference between cumulative present worth values for each of the two Options would be less than \$200 million in favour of the Infeed Option.

- Fuel Price

There remains significant uncertainty in fuel price forecasts. Global disruptions in supply could drive the price of oil well above inflation. However, new sources of supply, such as shale oil or downward trends in natural gas pricing, may have the potential to minimize fuel price increases.

If fuel prices drop by 44% below those used by Nalcor, the difference between the two cumulative present worth results becomes neutral. However, if fuel prices rise more

⁷⁴ MHI derived

than the reference price used in the cumulative present worth analysis, an even greater difference between the cumulative present worth results would occur.

The risks associated with these inputs are further magnified considering the 50+ year period (2010 – 2067) used in the preparation of the cumulative present worth analysis.