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# 9 Economic Evaluations – Reference Scenario

## 9.0 Overview

This chapter presents an evaluation of the economics of the 15 development plans described in ***Chapter 8 – Determination and Description of Development Plans*** based on inputs and assumptions associated with the reference scenario. The 15 plans are reduced to 12 plans which will be further tested through probabilistic analysis as described in ***Chapter 10 – Economic Uncertainty Analysis - Probabilistic Analysis and Sensitivities***.

The reference scenario represents the "most likely" outcomes for the factors affecting Manitoba Hydro's future. For the purpose of the main analysis in the NFAT submission, assumptions and forecasts for the reference scenario were based on 2012 resource planning assumptions with the exception of adjustments, primarily downwards, to the electricity export prices, as described in ***Appendix 9.3 – Economic Evaluation Documentation***. Economic comparisons are presented using the measure of incremental net present value (NPV). Section 9.3.2 provides the incremental NPVs to Manitoba Hydro for the reference scenario. Section 9.3.3 provides the incremental NPVs for the reference scenario including the incremental NPVs of the potential cash transfers to the Province for water rentals, capital taxes and provincial guarantee fee.

***Appendix 9.1 – High Level Development Plan Comparison Table*** provides a summary of the key technical, socio-economic/provincial, environmental and economic characteristics and provides an indicative measure of the impact of each on the 15 development plans.

## 9.1 Methodology for Economic Evaluation

Economic evaluation is integral to resource decisions. Economic comparisons of alternatives are used to assist in making decisions regarding which resources to pursue and when. When evaluating and choosing among alternative development plans, the appropriate measure is the incremental costs and benefits associated with one plan relative to another. This means that costs and benefits that are common to all development plans are not included in the analysis as these values are the same in each development plan. Likewise, sunk costs are not included in the economic evaluations as these represent money already spent or commitments that cannot be changed relative to the decision point when choosing among plans. While these costs could be included in the evaluations for all the development plans, the comparison of plans would yield the same result as not including the sunk costs in the evaluations. For the purpose of this submission, as appropriate for each development plan, all costs (incurred or estimated) prior to June 2014 will be considered as sunk and having been made to protect in-service dates for Keeyask and Conawapa generating stations as well as the option of a new U.S. interconnection and new export sale agreements. June 2014 was chosen because, according to the Needs For and Alternative To (NFAT) schedule, the NFAT panel report will have been made public and the Government of Manitoba will have made decisions on the development plans.

The economic evaluations present the incremental economic impact for a specific development plan relative to another development plan from the overall project perspective, without accounting for any aboriginal income-sharing. In effect, these evaluations are from the perspective of Manitoba Hydro with the income-sharing considered to be a relatively small proportion of the benefits Manitoba Hydro provides directly to Manitobans. Aboriginal income-sharing for Keeyask and Conawapa generating stations is accounted for in the financial analysis.

From an economic analysis perspective, a “do nothing” option is typically the basis for comparing alternatives. As shown in ***Chapter 4 – The Need for New Resources***, the need for new resources is being driven by persistent dependable energy deficits which begin in the year 2022/23. These persistent deficits mean that Manitoba Hydro is required to make an investment in order to continue to provide a dependable and reliable supply of power for the needs of the province, and therefore Manitoba Hydro does not have a "do nothing" option. In the case of Manitoba Hydro's analysis, the closest representation of a "do nothing" option is the least-capital cost investment alternative.

### 9.1.1 Net Present Value

Manitoba Hydro uses standard economic analysis for project evaluation, known as NPV. NPV is calculated by discounting the annual costs and annual revenues to a common point in time and allows for alternatives with different streams of costs and revenues occurring at different times to be compared on an equivalent basis at a single point in time.

The present value of the costs is the amount of money that would need to be invested today, at a stated discount rate, to pay for all of the costs of the project over its life. The present value of the revenues is the amount of money that would need to be invested today, at a stated discount rate, to provide the annual revenue of the project over its life. The NPV is the difference between the present value of the revenue and the present value of the cost. It is the amount of money, if invested today at a stated discount rate, that would grow to an amount sufficient to finance and to provide a return on the investment over the life of the project. When comparing alternatives, the incremental NPV represents the incremental net benefits (or net costs) associated with the increment of investment made for a higher cost investment option, e.g. the additional investment for the higher-cost option becomes the investment in the NPV calculation, the additional benefits (revenue) from the higher-cost option becomes the revenue in the NPV calculation. The higher-cost option is in fact economically preferable if it provides a positive incremental NPV.

The standard economic analysis approach is based on real dollars (constant dollars). For consistency, the discount rate applied to a real dollar cash flow excludes inflationary effects and is referred to as a real discount rate.

Another metric used in investment analysis is the internal rate of return (IRR)[1] which is the expected rate of return on a capital investment. IRR is more common when analyzing venture capital and private equity investment opportunities—IRR is not typically used to compare alternatives in a particular investment context such as selecting between technology options, but rather to compare/rank investments in a financial portfolio.

Traditionally, the incremental IRR associated with the difference in investment costs between alternatives has been determined based on the difference in the expected revenue and cost streams. Although the costs of alternatives may be similar, the composition and associated risks can be quite different. With a small difference in capital cost between alternatives, the resulting incremental IRR can be large or small, but does not reflect the relative risk associated with each of the alternatives. Conversely, with a large difference in capital cost, the incremental IRR can be small yet the total value may be significant. The use of NPV is a more informative measure in that it shows the net value of the incremental investment and allows the associated risk or opportunity to be evaluated separately using extensive sensitivities or probabilistic analysis.

## 9.2 Manitoba Hydro's Economic Evaluation Process

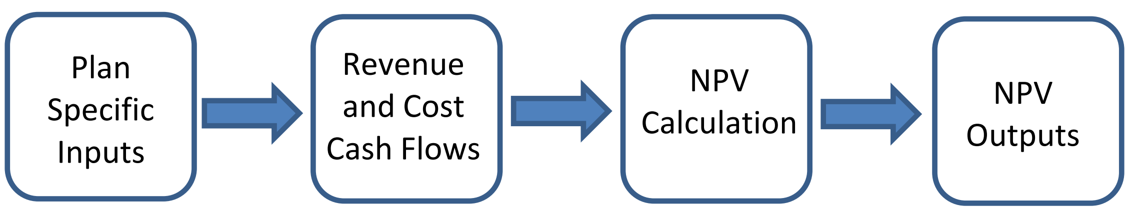
Manitoba Hydro's approach to economic evaluation is consistent with standard economic analysis methodology. Manitoba Hydro's use of development plan (portfolio) comparisons and the use of discounted cash-flow analysis to compare cash flows of two development plans (or sequences) has been reviewed and concurred with in previous

[1] Principles of Corporate Finance by Stewart Myers and Richard Brealey. McGraw Hill, pp 98-108

capital plan reviews (e.g. Report of the Public Utilities Board in respect of Major Capital Projects of Manitoba Hydro, November 1990; Report on Public Hearings Wuskwatim Generation and Transmission Projects, September 2004, Manitoba Clean Environment Commission.) The approach has been used by other major Canadian utilities to evaluate projects and development plans (e.g. Site C Clean Energy Project Environmental Impact Statement Volume 1: Introduction, Project Planning, and Description Section 5: Need for, Purpose of, and Alternatives to the Project , 5.5.3 Portfolio Modeling Framework, page 5-61, BC Hydro, January 2013).

Figure 9.1 shows Manitoba Hydro's process for the calculation of NPVs for all the development plans being evaluated, which is described in the following sections.

**Figure 9.1** **MANITOBA HYDRO'S PROCESS FOR CALCULATING NPVS**




### 9.2.1 Plan-Specific Inputs

Table 9.1 provides a general summary of plan-specific revenue and cost inputs used for economic evaluation. The specific revenue and cost components will be dependent on the formulation of each development plan.

**Table 9.1** ECONOMIC EVALUATION – SUMMARY OF REVENUE AND COST INPUTS

| Plan-Specific Inputs | Sources of Input for all Development Plans |
|---|---|
| **Revenue:** | |
| • Contract revenue from proposed electricity export sales | Export sale contracts |
| • Electricity export revenue from surplus power | Manitoba Hydro's consensus electricity export price forecast as used in the generation system model (SPLASH) |
| **Cost:** | |
| • Capital investment | Manitoba Hydro capital cost estimates for each resource option including associated transmission for each development plan and transmission interconnection as applicable |
| • Fuel | • Water rental rate from *The Water Power Act*<br>• Consensus natural gas price forecasts from Manitoba Hydro's Energy Price Outlook as used in the generation system model (SPLASH) |
| • Operating & Maintenance (O&M) including capital maintenance | Manitoba Hydro's O&M estimates for each facility in each development plan including capital maintenance items required over the life of the asset. |
| • Imports | Manitoba Hydro's consensus electricity export price forecast as used in the generation system model (SPLASH) |
| • Taxes | • Capital taxes based on *The Corporation Capital Tax Act*<br>• Carbon tax on coal from the *Climate Change and Emissions Reductions Act*<br>• Forecast of future carbon adder for Manitoba-based generation (federal/provincial) |

While there are a number of direct sources of input into the economic evaluation, a significant source of input is the information provided from the generation system production-costing model, Simulation Program for Long-term Analysis of System

Hydraulics (SPLASH). The forecast information associated with Manitoba domestic load, demand side management, electricity export prices, natural gas prices, current and future carbon adders, and proposed export power sales is incorporated into the SPLASH model. The SPLASH model outputs include flow-related electricity export revenues and production costs such as fuel and variable O&M. The requirements of the corporation's Generation Planning Criteria are incorporated into the SPLASH model. The SPLASH model is described in more detail in ***Appendix 9.2 – Description of the SPLASH Model***.

### 9.2.2 Revenue and Cost Cash Flows

The next step in the process is to prepare a single revenue cash-flow stream and a single cost cash-flow stream for each development plan over the life of the study in order to calculate respective NPVs. The revenue and cost cash flows are the sum of all individual revenue and cost cash flows from the detailed inputs.

The total study life used in this analysis is 78-years. For the total study life, Manitoba Hydro combines two approaches – a 35-year detailed evaluation and a long-life asset evaluation which extends from the end of the 35-year study period to the end of the service life of hydro-electric generation assets, as representing the longest-lived assets.

Economic evaluations recognize that the economic lives of assets developed in the different development plans may extend well beyond the 35-year planning period. While natural gas-fired generation resources are estimated to have economic lives of 30-years, hydro-electric resources are estimated to have economic lives of 100-years or longer, with the "weighted average" life of the plants being around 67-years when accounting for the periodic replacement of major equipment. For the 35-year study period, detailed forecast information related to the Manitoba Hydro system, including a representation of electricity export markets for a 35-year period, is used.

Beyond the 35-year study period, replacement capital costs are assumed for assets that reach the end of their economic lives before the end of the long-study period (78-years). In addition, a net production cost approximation is used beyond the 35-year study period (see ***Appendix 9.3 - Economic Evaluation Documentation***) which includes:

- extending fixed operating and maintenance costs throughout the economic life of all assets (including major capital O&M investments for large hydro-electric resources); and
- extending the average net revenues of the last three years in a development plan to capture the expected ongoing incremental revenues between development plans to the end of the study period.

### 9.2.3 Net Present Value Calculation

After determining the cash-flow streams, the discount rate that will be applied is determined. The starting point for development of a discount rate is a company's overall cost of financing. As a discount rate is used to guide investment decisions based on uncertainty, a risk premium may be identified to arrive at a discount rate which makes the investor indifferent between cash amounts received at different points in time. In the case of Manitoba Hydro, the discount rate consists of the cost of financing, which includes a guarantee fee to the Province, and a return on equity as described in ***Appendix 9.3 - Economic Evaluation Documentation.***

As described in Section 9.1.1, the NPV is then calculated by discounting the annual costs and annual revenues to a common point in time and allows for alternatives with different streams of costs and revenues occurring at different times to be compared on an equivalent basis at a single point in time.

### 9.2.4 Outputs – Net Present Value

The outputs are the NPV for each development plan. In order to compare one development plan to another, the development plans are arranged in order of lowest to highest capital investment, based on the present value of the capital costs. The difference in NPV of one development plan to another represents the net benefit of the incremental investment between the development plans.

## 9.3 Economic Results – Reference Scenario

Section 9.3 provides the results of the economic analysis completed on the 15 development plans described in ***Chapter 8 – Determination and Description of Development Plans*** using reference scenario assumptions. The reference scenario represents a future based on the "most likely" outcomes.

### 9.3.1 Reference Scenario Inputs

Assumptions and forecasts for the reference scenario were based on 2012 resource planning assumptions with the exception of adjustments, primarily downwards, to the electricity export price forecast as described in ***Appendix 9.3 – Economic Evaluation Documentation***. Key assumptions for the reference scenario are provided in Table 9.2.

1 **Table 9.2 KEY ASSUMPTIONS – REFERENCE SCENARIO**

| Economic Evaluation Inputs | Reference Scenario Assumption (See *Appendix 9.3 - Economic Evaluation Documentation*) | Appendix Reference |
|---|---|---|
| Electricity Export Revenue | • Adjusted 2012 electricity export price forecast<br>• Proposed and existing export sale contracts | • Section 1.5.1.3, Appendix 9.3<br>• Section 1.6, Appendix 9.3 |
| Power Purchases (Import Cost) | • Adjusted 2012 electricity export price forecast<br>• Generation Planning Criteria | • Section 1.5.1.3, Appendix 9.3<br>• Appendix 4.1 |
| Capital Costs – generation and transmission | • Base estimate in 2014$<br>• Real escalation applied to hydro and natural gas-fired generation | • Section 3, Appendix 9.3<br>• Section 2.1.3, Appendix 9.3 |
| Fuel Costs | • Water rental costs<br>• Natural gas fuel costs associated with Manitoba generation | • Section 3, Appendix 9.3<br>• Section 3, Appendix 9.3 |
| Net Load | • 2012 Electric load forecast, base forecast<br>• 2012 base DSM Forecast | • Appendix C<br>• Appendix E |
| CDN/U.S. Exchange Rate | • 2012/13 consensus forecast of exchange rates | • Appendix F |
| Discount Rate | • Real weighted average cost of capital = 5.05% | • Section 1.4, Appendix 9.3 |
| Total Study Life | • 2012 to 2090 | • Section 1.2, Appendix 9.3 |

2

In Table 9.3, the 15 development plans, as described in ***Chapter 8 – Determination and Description of Development Plans***, are listed in order of lowest incremental capital investment (Plan 1 - All Gas) to highest incremental capital investment (Plan 15 - K19/C25/750MW).

1 **Table 9.3** LIST OF FIFTEEN DEVELOPMENT PLANS

| Order of Capital Investment (Plan Number) | Development Plan Short Name | Description of Development Plan |
|---|---|---|
| 1 | All Gas | Natural Gas-Fired Generation starting in 2022/23 |
| 2 | K22/Gas | Keeyask 2022/23, Natural Gas-Fired Generation starting in 2029/30 |
| 3 | Wind/Gas | Wind Generation starting in 2022/23 supported by Natural Gas-Fired Generation starting in 2025/26 |
| 4 | K19/Gas24/250MW | Keeyask 2019/20, Natural Gas-Fired Generation starting in 2024/25, 250 MW Export/50 MW Import U.S. Interconnection 2020/21, 250 MW MP Sale |
| 5 | K19/Gas25/750MW (WPS Sale & Inv)[2] | Keeyask 2019/20, Natural Gas-Fired Generation starting in 2025/26, 750 MW Import/Export U.S. Interconnection 2020/21, 250 MW MP Sale, Proposed 300 MW WPS Sale |
| 6 | K19/Gas31/750MW | Keeyask 2019/20, Imports, Natural Gas-Fired Generation starting in 2031/32, 750 MW Import/Export U.S. Interconnection 2020/21, 250 MW MP Sale |
| 7 | SCGT/C26 | Simple Cycle Gas Turbine in 2022/23, Conawapa 2026/27, Natural Gas-Fired Generation starting in 2038/39 |
| 8 | CCGT/C26 | Combined Cycle Gas Turbine in 2022/23, Conawapa 2026/27, Natural Gas-Fired Generation starting in 2039/40 |
| 9 | Wind/C26 | Wind in 2022/23, Conawapa 2026/27, Natural Gas-Fired Generation starting in 2036/37 |
| 10 | K22/C29 | Keeyask 2022/23, Conawapa 2029/30, Natural Gas-Fired Generation starting in 2040/41 |
| 11 | K19/C31/250MW | Keeyask 2019/20, Natural Gas-Fired Generation starting in 2024/25, Conawapa 2031/32, 250 MW Export/50 MW Import U.S. Interconnection 2020/21, 250 MW MP Sale |
| 12 | K19/C31/750MW | Keeyask 2019/20, Imports, Conawapa 2031/32, Natural Gas-Fired Generation starting in 2041/42, 750 MW Import/Export U.S. Interconnection 2020/21, 250 MW MP Sale |
| 13 | K19/C25/250MW | Keeyask 2019/20, Conawapa 2025/26, Natural Gas-Fired Generation starting in 2040/41, 250 MW Export/50 MW Import U.S. Interconnection 2020/21, 250 MW MP Sale |
| 14 | K19/C25/750MW (WPS Sale & Inv)[2] Preferred Development Plan | Keeyask 2019/20, Conawapa 2025/26, Natural Gas-Fired Generation starting in 2041/42, 750 MW Import/Export U.S. Interconnection 2020/21, 250 MW MP Sale, Proposed 300 MW WPS Sale |
| 15 | K19/C25/750MW | Keeyask 2019/20, Conawapa 2025/26, Natural Gas-Fired Generation starting in 2041/42, 750 MW Import/Export U.S. Interconnection 2020/21, 250 MW MP Sale |

[2] Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.

### 9.3.2 Reference Scenario Results – Net Present Value

The results provide the NPV of the incremental investment associated with each development plan. The incremental investment associated with a more costly development plan is economically preferable if it provides a positive incremental NPV.

For the purposes of this evaluation, as appropriate for each development plan, costs will continue to be incurred until at least June, 2014 in order to protect earliest in-service dates for Keeyask and Conawapa generating stations as well as the option of a new U.S. interconnection and new export sale agreements. All incurred or estimated costs to June, 2014 are excluded from the analysis as they are assumed to be sunk.

In order to compare development plans in terms of economics, typically, a “do nothing” option is used as the basis for comparing alternatives. For Manitoba Hydro, the closest representation of a “do nothing” option is the least-capital investment development plan, which is the All Gas development plan.

The order of the development plans is based on the principle that Manitoba Hydro would undertake the lowest-capital cost option available, unless the incremental investment associated with a more costly option provides greater incremental benefits when evaluated at the reference scenario discount rate of 5.05% (see ***Appendix 9.3 – Economic Evaluation Documentation***). Thus, the All Gas development plan, as the plan requiring the lowest capital investment, is compared to development plans of increasingly higher investment. Table 9.4 provides a comparison of two development plans: the All Gas development plan to the development plan with the next lowest capital investment, K22/Gas.

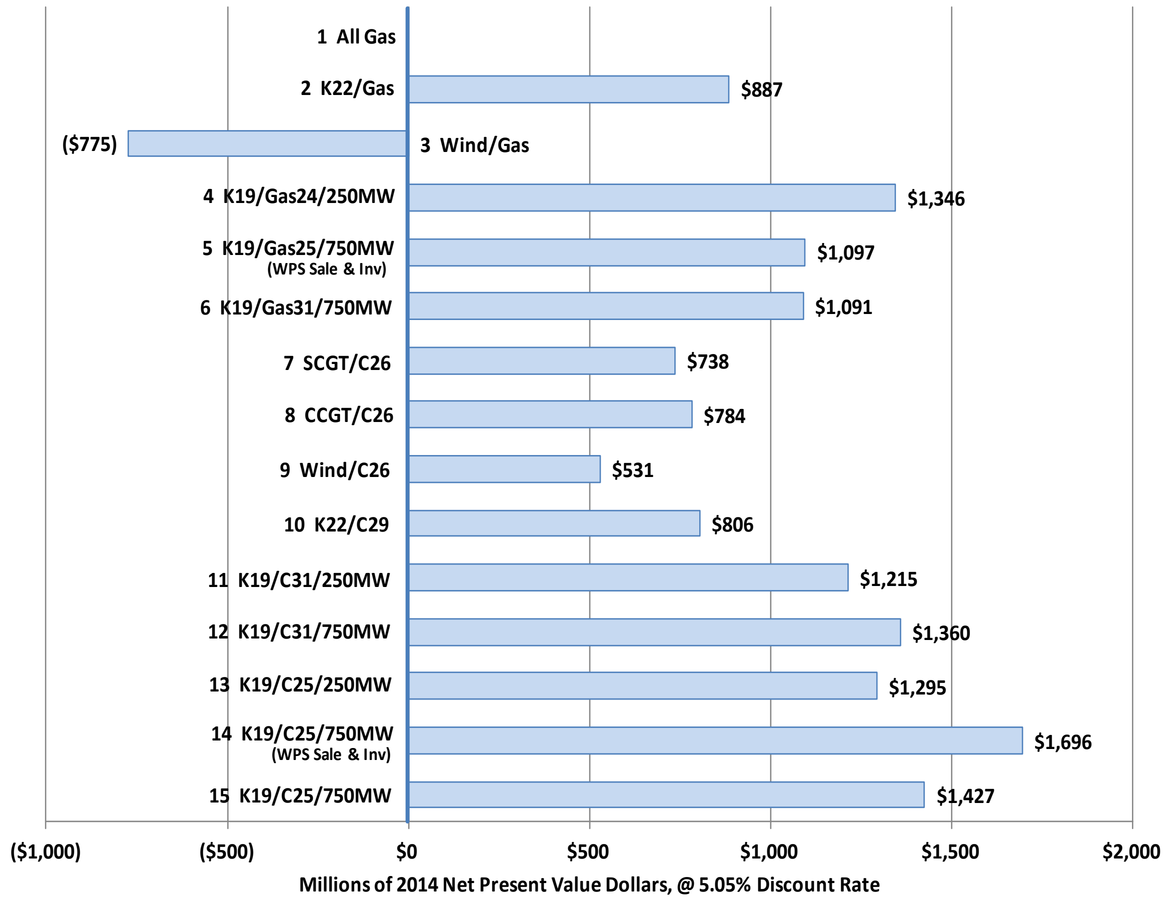
**Table 9.4** INCREMENTAL ECONOMICS – ALL GAS COMPARED TO K22/GAS

| Development Plan | Incremental NPV<br>millions of 2014 Dollars<br>@ 5.05% Discount Rate |
|---|---|
| | 1 All Gas |
| 1 All Gas<br>Lowest Capital Investment Development Plan | - |
| 2 K22/Gas | 2 minus 1 |
| | $887 |

The incremental NPV benefit of $887 million, shown in Table 9.4 as "2 minus 1", represents the net benefit of investing the additional capital required for the K22/Gas development plan when discounted at 5.05%.

Figure 9.2 provides a summary which compares the incremental NPV for each of the 15 development plans based on the incremental investment relative to the investment for the All Gas development plan, from the perspective of Manitoba Hydro (defined here as the economic benefits that Manitoba Hydro can pass on directly to its ratepayers – not including any transfers to the Province of Manitoba). The development plans are shown in order of lowest incremental investment (All Gas) to highest incremental investment (K19/C25/750MW).

**Figure 9.2** DEVELOPMENT PLAN NPVS – BENEFITS TO MANITOBA HYDRO (RELATIVE TO ALL GAS PLAN)




The following sections discuss the reference scenario results, in terms of NPV, for:

- Development plans with no new interconnection – seven plans
- Development plans with a 250 MW U.S. interconnection – three plans
- Development plans with a 750 MW U.S. interconnection – five plans
- All development plans with either a U.S. 250 MW or a U.S. 750 MW interconnection.

#### 9.3.2.1 Development Plans with No New U.S. Interconnection – Seven Plans

Table 9.5 provides a comparison of seven development plans that meet Manitoba Hydro's domestic load and firm export commitments starting in 2022/23 with no new U.S. interconnection and no new export contract commitments.

As previously shown in Table 9.4, there is a net benefit of $887 million associated with the incremental investment for the K22/Gas development plan as compared to the All Gas development plan. As shown in Figure 9.2, there is a net benefit between the K22/C29 plan and the All Gas development plan of $806 million. In comparing the K22/Gas development plan to the K22/C29 development plan, the net benefit between the two plans is not large enough to be decisive between the plans on the basis of the NPV.

The purpose of the Wind/Gas development plan is to provide a wind-based development plan which incorporates wind generation to meet energy requirements, combined with the most cost-effective natural gas-fired generation to provide capacity and to support the intermittent nature of the wind resource. When the Wind/Gas development plan is compared to either the All Gas or the K22/Gas development plans in Table 9.5, the NPV is significantly negative. Similarly, when all remaining development plans in Table 9.5 are compared to the Wind/Gas development plan, the incremental NPV is in the order of $1,300 to $1,600 million greater than that of the Wind/Gas development plan. These comparisons show that it would be significantly more beneficial to invest in any one of the other six development plans than in the Wind/Gas development plan.

The three development plans SCGT/C26, CCGT/C26 and Wind/C26 allow for the comparison to determine which of the non-hydro resources, when combined with the Conawapa generating station (G.S.), will be selected for further evaluation. In this comparison, the requirement of the non-hydro resources, including wind in the Wind/C26 development plan, is to fulfill the energy requirement prior to the development of the

Conawapa G.S. The Wind/C26 development plan requires an additional increment of investment, making it the development plan with the second-highest capital investment requirement in Table 9.5. Based on the measure of NPV, the CCGT/C26 development plan yields a marginally higher net benefit than the SCGT/C26 development plan and a substantially higher net benefit than the Wind/C26 development plan. In comparing development plans, the net benefit between SCGT/C26 and CCGT/C26 is small enough to result in indifference between the plans.

Of this group of seven development plans listed in Table 9.5, the K22/Gas plan has one of the highest incremental NPVs when compared to the All Gas plan. As stated earlier in this section, the net benefit of the K22/Gas development plan as compared to the K22/C29 development plan is small enough to result in indifference between the plans. However, the significantly greater investment required for the Conawapa G.S. in the K22/C29 development plan results in it being excluded from further evaluation.

**Table 9.5 INCREMENTAL ECONOMICS – NO NEW INTERCONNECTION**

| Development Plan | Incremental NPV, millions of 2014 Dollars @ 5.05% Discount Rate | | | | | |
|---|---|---|---|---|---|---|
| | 1 All Gas | 2 K22/Gas | 3 Wind/Gas | 7 SCGT/C26 | 8 CCGT/C26 | 9 Wind/C26 |
| 1 All Gas | | | | | | |
| Lowest Capital Investment Development Plan | - | | | | | |
| 2 K22/Gas | 2 -1 | | | | | |
| | $887 | | | | | |
| 3 Wind/Gas | 3 -1 | 3 -2 | | | | |
| | ($775) | ($1,662) | | | | |
| 7 SCGT/C26 | 7 -1 | 7 -2 | 7 -3 | | | |
| | $738 | ($149) | $1,513 | | | |
| 8 CCGT/C26 | 8 -1 | 8 -2 | 8 -3 | 8 -7 | | |
| | $784 | ($103) | $1,559 | $46 | | |
| 9 Wind/C26 | 9 -1 | 9 -2 | 9 -3 | 9 -7 | 9 -8 | |
| | $531 | ($356) | $1,306 | ($207) | ($253) | |
| 10 K22/C29 | 10 -1 | 10 -2 | 10 -3 | 10 -7 | 10 -8 | 10 -9 |
| | $806 | ($81) | $1,581 | $68 | $22 | $275 |

Of the seven development plans shown in Table 9.5, three development plans with no new interconnection have been selected for further analysis: All Gas, K22/Gas and

SCGT/C26. For consistency in ongoing corporate analysis, the SCGT/C26 development plan has been selected over the CCGT/C26 development plan. Due to the high level of interest in analyzing a development plan with substantial amounts of wind generation, the Wind/Gas development plan is also being included in the economic probabilistic analysis in ***Chapter 10 – Economic Uncertainty Analysis – Probabilistic Analysis and Sensitivities***.

**9.3.2.2 Development Plans with a 250 MW U.S. Interconnection – Three Plans**

As described in ***Chapter 8 — Determination and Description of Development Plans***, the executed agreement with MP for 250 MW (megawatt) of system power is contingent upon a new transmission interconnection with a minimum export capability of 250 MW as well as an import capability of up to 250 MW (50 MW minimum import capability has been assumed for evaluation purposes). In addition, Manitoba Hydro and Wisconsin Public Service (WPS) have a signed term sheet for a proposed sale by Manitoba Hydro of up to 500 MW of system power of which 400 MW would require the construction of a new transmission interconnection. For evaluation purposes a 300 MW sale to WPS has been assumed, which would require 200 MW of new transmission service. An interconnection with a transfer capability of larger than 250 MW would be required to accommodate new sales to both MP and WPS. In the event that the sale to WPS does not materialize, a smaller transmission interconnection would be sufficient to meet the 250 MW Minnesota Power (MP) sale. This section deals with such a situation.

Table 9.6 provides a comparison of the three development plans—Plan 4 (K19/Gas24/250MW), Plan 11 (K19/C31/250MW), and Plan 13 (K19/C25/250MW)—that enable the construction of a new U.S. interconnection, which is assumed to provide 250 MW of export and 50 MW of import capability. These development plans are facilitated by the MP 250 MW sale. When these three development plans are compared to the All Gas development plan in Table 9.6, the incremental NPV is greater than $1,200 million, showing that it would be significantly more beneficial for Manitoba Hydro to invest in one of these three development plans. When directly comparing these development plans, the net benefit is small enough to result in indifference between the K19/Gas24/250MW and K19/C25/250MW plans. The K19/C31/250MW plan is considered to be marginally less beneficial when compared to the other two plans. A significant difference between these plans is the substantial incremental investment required with the addition of Conawapa in the K19/C25/250MW and K19/C31/250MW development plans.

**Table 9.6** **INCREMENTAL ECONOMICS – 250 MW U.S. INTERCONNECTION**

| Development Plan | Incremental NPV, millions of 2014 Dollars @ 5.05% Discount Rate | | |
|---|---|---|---|
| | 1 All Gas | 4 K19/Gas24/250MW | 11 K19/C31/250MW |
| 1 All Gas | | | |
| Lowest Capital Investment Development Plan | - | | |
| 4 K19/Gas24/250MW | 4 -1 | | |
| MP Sale | $1,346 | | |
| 11 K19/C31/250MW | 11 -1 | 11 -4 | |
| MP Sale | $1,215 | ($131) | |
| 13 K19/C25/250MW | 13 -1 | 13 -4 | 13 -11 |
| MP Sale | $1,295 | ($51) | $80 |

All three of the development plans that include the 250 MW U.S. interconnection have been selected for further analysis.

#### 9.3.2.3 Preferred Development Plan and Other Development Plans with a 750 MW U.S. Interconnection – Five Plans

There are five development plans with a 750 MW U.S. interconnection in this group of plans. This group of plans recognizes the uncertainty associated with the finalization of and approvals for the proposed 300 MW WPS sale and the complexities associated with development of a 750 MW international power line, including agreements and regulatory approvals.

As shown in Table 9.7, the Preferred Development Plan (Plan 14) provides the highest net benefits relative to the other four development plans evaluated but requires the second highest incremental capital investment relative to the All Gas development plan.

All five of the development plans enable the construction of a new U.S. interconnection with 750 MW of import and export capability. Two of the development plans, the Preferred Development Plan (K19/C25/750MW (WPS Sale & Inv)) and Plan 5 (K19/Gas25/750 (WPS Sale & Inv)) are facilitated by both the 250 MW MP sale and the proposed 300 MW WPS sale. In these development plans, it is assumed that Manitoba Hydro will be responsible for 40% of the capital and ongoing operating costs, associated with the U.S. portion of the 750 MW interconnection facilities. In addition, Manitoba Hydro will be responsible for the full cost of the Manitoba portion of the new interconnection.

Plan 5 (K19/Gas25/750MW (WPS Sale & Inv)) and the Preferred Development Plan (Plan 14) are similar plans, with the major difference being the development of natural gas-fired generation instead of the Conawapa G.S. This plan allows for the comparison of the option of building natural gas-fired generation as an alternative to building Conawapa G.S. in 2025/26. For the sales requiring new hydro generation, power from the Keeyask G.S. is assumed to be sufficient to meet the contract requirements.

The other three development plans provided in Table 9.7 represent potential futures which continue to enable the development of a 750 MW U.S. interconnection in the event that the proposed 300 MW WPS sale does not proceed. For the purposes of the NFAT evaluation, while Manitoba Hydro will not enter into an arrangement where it owns more than 49% of the proposed U.S. interconnection, a conservative assumption has been used where Manitoba Hydro will be responsible for approximately two-thirds of the capital and ongoing operating costs associated with the U.S. portion of the 750 MW interconnection facilities. In addition, Manitoba Hydro will be responsible for the entire cost of the Manitoba portion of the new interconnection.

Plan 15 (K19/C25/750MW) contemplates development of the same resources as the Preferred Development Plan (K19/C25/750MW (WPS Sale & Inv)) but without the proposed 300 MW WPS sale. Without the proposed 300 MW sale to WPS and WPS investment in the 750 MW U.S. interconnection, the net benefits of this development plan decrease by $269 million as shown in Table 9.7.

Plan 12 (K19/C31/750MW) incorporates a deferral of Conawapa G.S. while still facilitating the sale of surplus power over the interconnections, including the new 750 MW U.S. interconnection. The K19/Gas31/750MW (Plan 6) development plan allows for the comparison of the option of building natural gas-fired generation as an alternative to building Conawapa G.S. in 2031/32, while still facilitating the sale of surplus power over the interconnections including the new 750 MW U.S. interconnection. The Preferred Development Plan (Plan 14) provides $336 million in net benefits when compared to Plan 12 (K19/C31/750MW) and $605 million in net benefits when compared to Plan 6 (K19/Gas31/750MW).

As shown in Table 9.7, when compared to the All Gas development plan, the Preferred Development Plan (K19/C25/750MW (WPs Sale & Inv)) yields net benefits of $1,696 million, while the other four development plans with a 750 MW interconnection show net benefits greater than $1,000 million: $1,097 million, $1,091 million, $1,360 million and $1,427 million, respectively.

**Table 9.7** INCREMENTAL ECONOMICS – 750 MW U.S. INTERCONNECTION

| Development Plan | Incremental NPV, millions of 2014 Dollars @ 5.05% Discount Rate | | | | |
|---|---|---|---|---|---|
| | 1 All Gas | 5 K19/Gas25/750MW WPS Sale & Inv | 6 K19/Gas31/750MW | 12 K19/C31/750MW | 14 K19/C25/750MW WPS Sale & Inv |
| 1 All Gas | | | | | |
| Lowest Capital Investment Development Plan | - | | | | |
| 5 K19/Gas25/750MW | 5 -1 | | | | |
| MP Sale, WPS Sale & Inv | $1,097 | | | | |
| 6 K19/Gas31/750MW | 6 -1 | 6 -5 | | | |
| MP Sale | $1,091 | ($6) | | | |
| 12 K19/C31/750MW | 12 -1 | 12 -5 | 12 -6 | | |
| MP Sale | $1,360 | $263 | $269 | | |
| 14 K19/C25/750MW | 14 -1 | 14 -5 | 14 -6 | 14 -12 | |
| MP Sale, WPS Sale & Inv Preferred Development Plan | $1,696 | $599 | $605 | $336 | |
| 15 K19/C25/750MW | 15 -1 | 15 -5 | 15 -6 | 15 -12 | 15 -14 |
| MP Sale | $1,427 | $330 | $336 | $67 | ($269) |

The five development plans that include the 750 MW U.S. interconnection have been selected for further analysis.

#### 9.3.2.4 Comparison of Development Plans with a New Interconnection

Table 9.8 provides a comparison of a number of development plans that include either the 250 MW or the 750 MW U.S. interconnection. All five of the plans with a 750 MW U.S. interconnection are shown in Table 9.7. The two development plans with a 750 MW U.S. interconnection and with Keeyask G.S. followed by natural gas-fired generation have incremental NPVs of $1,091 million (K19/Gas31/750MW) and $1,097 million (K19/Gas25/750MW) when compared to the All Gas plan. When Plan 4 (K19/Gas24/250MW) is compared to these two plans, its incremental NPV exceeds that of each plan by $255 million ($1,346 million minus $1,091 million) and $249 million ($1,346 million minus $1,097 million), respectively.

The Preferred Development Plan (K19/C25/750MW (WPS Sale & Inv)), which includes a 750 MW U.S. interconnection, yields the highest net benefits ($481 million, $350 million and $401 million), when compared to the development plans that have a 250 MW U.S. interconnection. In addition, Plan 12 (K19/C31/750MW) yields incremental NPVs that are $14 million, $65 million and $145 million higher than the development plans that have a 250 MW U.S. interconnection. In the event that the process for development of an international power line results in a 250 MW U.S. interconnection, Tables 9.7 and 9.8 show that the net benefits associated with a smaller line are greater than $1,200 million compared to the All Gas development plan and exceed the incremental NPVs of development plans that have a 750 MW U.S. interconnection with Keeyask G.S. followed by natural gas-fired generation.

**Table 9.8 DEVELOPMENT PLANS WITH A NEW U.S. INTERCONNECTION**

| Development Plan | Incremental NPV, millions of 2014 Dollars @ 5.05% Discount Rate | | | | | |
|---|---|---|---|---|---|---|
| | 1 All Gas | 4 K19/Gas24/250MW | 11 K19/C31/250MW | 12 K19/C31/750MW | 13 K19/C25/250MW | 14 K19/C25/750MW WPS Sale & Inv |
| 1 All Gas | | | | | | |
| Lowest Capital Investment Development Plan | - | | | | | |
| 4 K19/Gas24/250MW | 4 -1 | | | | | |
| MP Sale | $1,346 | | | | | |
| 11 K19/C31/250MW | 11 -1 | 11 -4 | | | | |
| MP Sale | $1,215 | ($131) | | | | |
| 12 K19/C31/750MW | 12 -1 | 12 -4 | 12 -11 | | | |
| MP Sale | $1,360 | $14 | $145 | | | |
| 13 K19/C25/250MW | 13 -1 | 13 -4 | 13 -11 | 13 -12 | | |
| MP Sale | $1,295 | ($51) | $80 | ($65) | | |
| 14 K19/C25/750MW | 14 -1 | 14 -4 | 14 -11 | 14 -12 | 14 -13 | |
| MP Sale, WPS Sale & Inv Preferred Development Plan | $1,696 | $350 | $481 | $336 | $401 | |
| 15 K19/C25/750MW | 15 -1 | 15 -4 | 15 -11 | 15 -12 | 15 -13 | 15 -14 |
| MP Sale | $1,427 | $81 | $212 | $67 | $132 | ($269) |

### 9.3.3 Reference Scenario Results – NPVs Including Cash Transfers to the Province of Manitoba

Section 9.3.3 provides the NPVs for the reference scenario showing the additional assumed cash transfers to the Province of Manitoba for water rentals, capital taxes and provincial guarantee fee over the 78-year study period for the 15 development plans. ***Appendix 9.3 - Economic Evaluation Documentation*** includes the assumptions used in the analysis that relate to cash transfers to the Province.

Water rentals are based on the operation of Manitoba Hydro's hydro-electric generation and are calculated and paid to the Province of Manitoba in accordance with *The Water Power Act*.

Capital taxes are a provincial tax assessed under *The Corporation Capital Tax Act* of Manitoba. In general terms, this tax is applied at a rate of 0.5% to the capital invested by Manitoba Hydro in the province, where "capital" can be generally defined as "the total debt and retained earnings of the corporation".

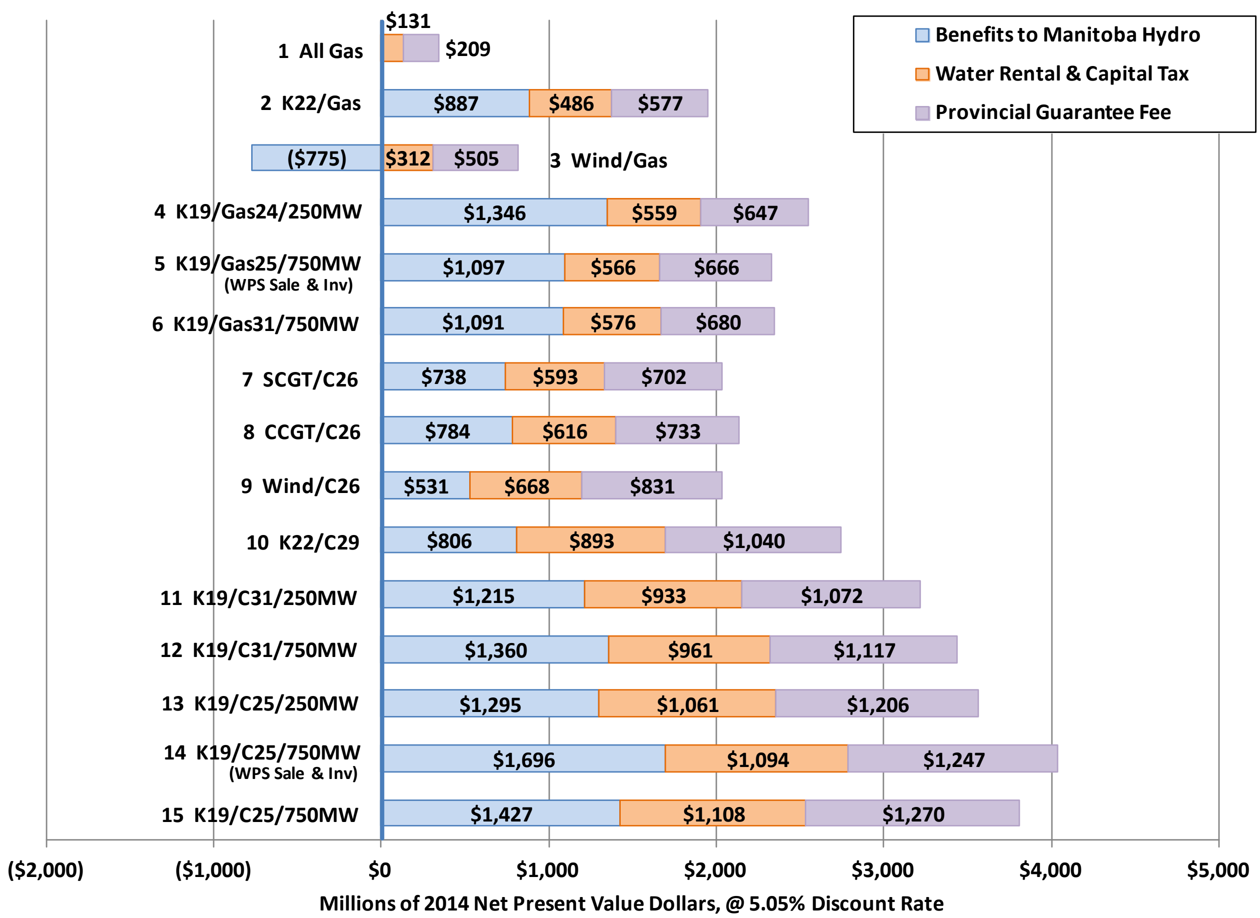
The provincial guarantee fee is an annual fee payable to the Province of Manitoba in return for the guarantee of the corporation's debt (with the exception of some MHEB bonds) and is calculated using a rate of 1% multiplied by the gross outstanding debt at March 31 of the previous fiscal year.

These cash transfers are provided here as an addition to the economic benefits noted earlier because they benefit the provincial government and indirectly Manitobans. (It must be recognized that the debt guarantee fee provides Manitoba Hydro a benefit and has the potential to incur costs to the Province. See ***Chapter 11 – Financial Evaluation of Development Plans*** for discussion of provincial borrowing and credit rating implications). As shown in Figure 9.3, cash transfers to the Province of Manitoba for water rentals and capital taxes are included as costs when performing economic evaluations. The provincial guarantee fee shown in Figure 9.3 represents the 1% fee applied to the total capital investment for each of the 15 development plans evaluated. The water rental rate, the capital tax rate and the provincial guarantee fee percentages are assumed to remain the same.

For the development plans evaluated, the majority of the cash transfers to the Province are from the provincial guarantee fee; while the capital taxes make up approximately 30%

of the cash transfers; and the water rentals make up approximately 10% (with the exception of the All Gas and Wind/Gas development plans in which incremental water rentals are zero). The greatest cash transfers to the Province result from those development plans that include both Keeyask and Conawapa generating stations; these cash transfers are significantly greater than for those development plans that include only one or no hydro-electric generating station.

**Figure 9.3** DEVELOPMENT PLAN NPVS COMPARED TO ALL GAS DEVELOPMENT PLAN - INCLUDING POTENTIAL CASH TRANSFERS TO THE PROVINCE




### 9.3.4 Development Plans Selected for Economic Uncertainty Analysis

As demonstrated by the economic evaluations for the reference scenario shown throughout this chapter, development plans with a U.S. interconnection provide higher net benefits than those development plans without a U.S. interconnection. The Preferred

Development Plan (K19/C25/750MW (WPS Sale & Inv)) yields the highest net benefits across all of the development plans evaluated.

Table 9.9 lists the 12 development plans that will be further considered in the economic uncertainty analysis provided in ***Chapter 10 – Economic Uncertainty Analysis – Probabilistic Analysis and Sensitivities***.

**Table 9.9** **DEVELOPMENT PLANS SELECTED FOR ECONOMIC UNCERTAINTY ANALYSIS**

| Development Plan | Incremental NPV, millions of 2014 Dollars @ 5.05% Discount Rate | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 All Gas | 2 K22/Gas | 3 Wind/Gas | 4 K19/Gas24/250MW | 5 K19/Gas25/750MW WPS Sale & Inv | 6 K19/Gas31/750MW | 7 SCGT/C26 | 11 K19/C31/250MW | 12 K19/C31/750MW | 13 K19/C25/250MW | 14 K19/C25/750MW WPS Sale & Inv |
| 1 All Gas | | | | | | | | | | | |
| Lowest Capital Investment Development Plan | - | | | | | | | | | | |
| 2 K22/Gas | 2 -1 | | | | | | | | | | |
| | $887 | | | | | | | | | | |
| 3 Wind/Gas | 3 -1 | 3 -2 | | | | | | | | | |
| | ($775) | ($1,662) | | | | | | | | | |
| 4 K19/Gas24/250MW | 4 -1 | 4 -2 | 4 -3 | | | | | | | | |
| MP Sale | $1,346 | $459 | $2,121 | | | | | | | | |
| 5 K19/Gas25/750MW | 5 -1 | 5 -2 | 5 -3 | 5 -4 | | | | | | | |
| MP Sale, WPS Sale & Inv | $1,097 | $210 | $1,872 | ($249) | | | | | | | |
| 6 K19/Gas31/750MW | 6 -1 | 6 -2 | 6 -3 | 6 -4 | 6 -5 | | | | | | |
| MP Sale | $1,091 | $204 | $1,866 | ($255) | ($6) | | | | | | |
| 7 SCGT/C26 | 7 -1 | 7 -2 | 7 -3 | 7 -4 | 7 -5 | 7 -6 | | | | | |
| | $738 | ($149) | $1,513 | ($608) | ($359) | ($353) | | | | | |
| 11 K19/C31/250MW | 11 -1 | 11 -2 | 11 -3 | 11 -4 | 11 -5 | 11 -6 | 11 -7 | | | | |
| MP Sale | $1,215 | $328 | $1,990 | ($131) | $118 | $124 | $477 | | | | |
| 12 K19/C31/750MW | 12 -1 | 12 -2 | 12 -3 | 12 -4 | 12 -5 | 12 -6 | 12 -7 | 12 -11 | | | |
| MP Sale | $1,360 | $473 | $2,135 | $14 | $263 | $269 | $622 | $145 | | | |
| 13 K19/C25/250MW | 13 -1 | 13 -2 | 13 -3 | 13 -4 | 13 -5 | 13 -6 | 13 -7 | 13 -11 | 13 -12 | | |
| MP Sale | $1,295 | $408 | $2,070 | ($51) | $198 | $204 | $557 | $80 | ($65) | | |
| 14 K19/C25/750MW | 14 -1 | 14 -2 | 14 -3 | 14 -4 | 14 -5 | 14 -6 | 14 -7 | 14 -11 | 14 -12 | 14 -13 | |
| MP Sale, WPS Sale & Inv Preferred Development Plan | $1,696 | $809 | $2,471 | $350 | $599 | $605 | $958 | $481 | $336 | $401 | |
| 15 K19/C25/750MW | 15 -1 | 15 -2 | 15 -3 | 15 -4 | 15 -5 | 15 -6 | 15 -7 | 15 -11 | 15 -12 | 15 -13 | 15 -14 |
| MP Sale | $1,427 | $540 | $2,202 | $81 | $330 | $336 | $689 | $212 | $67 | $132 | ($269) |