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13 Integrated Comparisons of Development Plans – Multiple Account Analysis

13.0 Chapter Overview

The Terms of Reference (TOR) of the Needs For and Alternatives To (NFAT) review of the Preferred Development Plan call for an assessment of its justification and its alignment with Manitoba Hydro's mandate, Manitoba's Clean Energy Strategy and the principles for sustainable development. The TOR also includes a call for an assessment of whether "the Plan has been justified to provide the highest level of overall socio-economic benefit to Manitobans and is justified to be the preferable long-term electricity development option for Manitoba when compared to the alternatives".[1]

The purpose of this chapter is to present the results of a multiple account benefit-cost analysis (MA-BCA) of Manitoba Hydro's Preferred Development Plan as compared to alternative plans with and without new U.S. interconnection capacity and new export sale commitments; and with and without new hydro generating capacity to meet domestic load growth. These alternatives, which are set out in detail in Section 13.2 below, were chosen to enable an assessment of the full range of consequences and benefits and costs to Manitobans of the key components of the Preferred Development Plan:

(i). relying on hydro to meet growing domestic load and

(ii). taking advantage of the current opportunity for new export sales agreements and the development of additional interconnection capacity with the U.S. power market.

[1] Manitoba Order in Council 00128/2013, Scope of the NFAT Review 2(f), p.3.

As explained in the next section, MA-BCA extends Manitoba Hydro's economic evaluation of the preferred and alternative development plans to take into consideration consequences for Manitobans that are not reflected in the revenues and expenditures facing Manitoba Hydro. It uses a set of evaluation accounts to move from a Manitoba Hydro perspective to a broader Manitoba social perspective. The objective is to provide a systematic, comprehensive assessment of all of the benefits and costs to Manitobans in a manner that can assist the NFAT panel address the question of overall socio-economic benefit.

13.1 Multiple Account Benefit-Cost Analysis

13.1.1 Basic Objective and Approach

Traditional cost-benefit analysis is a standard method economists use to assess the net benefits of alternative plans, projects or policies from a broad social perspective.[2] It is intended to take into account the positive and negative consequences of the alternatives being analyzed to everyone (with standing in the analysis)[3] that is affected. These would include not only commercially-valued consequences – those with well-defined market prices – but also the social and environmental consequences that people value.

[2] For a summary of the purpose and rationale of cost-benefit analysis, see Marvin Shaffer, *Multiple Account Benefit-Cost Analysis: A Practical Guide for the Systematic Evaluation of Project and Policy Alternatives*, University of Toronto Press, 2010, pp.3-15. A standard text with details on principles and methods is: A. Boardman et. al., *Cost-Benefit Analysis: Concepts and Practice*, 3rd ed., 2006. For guidelines on the application of cost-benefit analysis in relation to regulatory proposals, see Treasury Board of Canada Secretariat, *Canadian Cost-Benefit Analysis Guide: Regulatory Proposals*, 2007.

[3] 'Standing' is defined by the jurisdiction or parties for which the analysis is being done. For an assessment of the public interest in Manitoba, all people within the province would be considered to have standing.

With its broad scope, cost-benefit analysis attempts to calculate an overall bottom line to determine which of the alternatives is socially preferred, based on the value that people place on what is produced (what people in principle would be willing to pay for all of the positive consequences) relative to the cost people assign, or compensation they in principle would require, to pay for the inputs and offset the negative consequences.

MA-BCA is a variation of traditional cost-benefit analysis. It adopts the same broad scope and the same basic valuation principles. However, MA-BCA recognizes that not all consequences can meaningfully or reliably be monetized in order to calculate an overall bottom line. Furthermore it recognizes that an overall bottom line can mask important distributional considerations. It is not just overall net benefits but also the nature and distribution of those benefits and costs that can govern what is "preferred" from a broad social or public interest perspective.[4]

Accordingly, the objective of MA-BCA, like traditional cost-benefit analysis, is to identify the full range of positive and negative consequences of the alternatives and to assess their significance. However, the assessment does not have to be entirely in dollar terms and the consequences all aggregated to a bottom line. The results are presented in a matrix form for a disaggregated set of evaluation criteria or accounts. The purpose is to identify the advantages or disadvantages of

[4] One of the first government agencies to adopt a multiple account approach to project assessments in North America was the U.S. Water Resources Council, *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, 1983. For a recent review and explanation of the multiple account approach see Marvin Shaffer, *Multiple Account Benefit-Cost Analysis* (2010).

the alternatives and the key trade-offs for the different parties and interests that are affected, information with which judgments about the preferred alternatives can be made.[5]

13.1.2 The Evaluation Accounts

A standard way to conduct cost-benefit analysis is to start with the valuation of the project's inputs and outputs based on market prices – the net revenues or return on investment from the perspective of the proponent. Then the analysis proceeds by identifying and assessing positive and negative consequences – social benefits and costs – that the market valuation does not reflect. The MA-BCA of Manitoba Hydro's preferred and alternative resource plans follows that basic approach.

Similar to the cost-benefit assessment of the Wuskwatim project[6], the MA-BCA of Manitoba Hydro's preferred and alternative resource development plans starts with the incremental revenues and expenditures for Manitoba Hydro and its project partners. Then the MA-BCA addresses consequences for Manitoba Hydro customers, Manitoba taxpayers, the economy, the environment and affected communities that this market valuation does not capture or adequately reflect.

[5] MA-BCA is similar to multi-criteria or multi-attribute analyses that are commonly used in project and policy evaluations. In such analyses, a broad set of criteria and indicators of relative advantage or impact are established for the assessment of the alternatives. However, in multi-criteria analysis, criteria and indicators are established by the analyst or stakeholder group governing the evaluation process. In MA-BCA, the accounts and indicators are based on the principles of traditional cost-benefit analysis. They are designed to take into account impacts on everyone with standing that is affected, and to reflect the values of those affected. Unlike multi-criteria or multi-attribute analysis, MA-BCA is not an alternative to traditional cost-benefit analysis, but rather a variation of it. See Marvin Shaffer, *Multiple Account Benefit-Cost Analysis* (2010), pp 43-47.

[6] Marvin Shaffer & Associates Ltd., *Social Net Benefits of Advancing the Wuskwatim Project*, prepared for Manitoba Hydro, August, 2003, and *Social Net Benefits of Wuskwatim vs. Wind Development*, prepared for Manitoba Hydro, February 27, 2004.

Specifically, the MA-BCA assesses the preferred and alternative plans in terms of the following criteria or evaluation accounts:

Market Valuation

This account assesses the net benefit or cost of the preferred and alternative plans to Manitoba Hydro and its project partners. It analyzes the incremental revenues generated by the surplus electricity supply in the different plans, relative to the incremental capital and operating expenditures incurred. The present value difference between the incremental revenues and expenditures measures the net market value or cost of the investment in new electricity supply in each plan.

This market valuation account relies on the assessment of the economics of the different plans from a Manitoba Hydro perspective as presented in previous chapters. The same annual revenue and expenditure cash flows and residual asset values as estimated for the resource plan analysis are used here.

In this MA-BCA, however, the present values of the incremental revenues and expenditures are different. Present values are calculated here by applying a real discount rate that reflects the social opportunity cost of capital. A real rate of 6% is used, based on recent research on discounting in cost-benefit analysis.[7] In the previous resource planning economic analysis, a

[7] In their recent study, Burgess and Zerbe calculated a discount rate range of 6.6% to 7.3% real based on their estimates of the social opportunity cost of capital in the U.S. M. Moore *et al.* argue that rate is too high, and estimate the social opportunity cost of capital to be 5% real. The 6% rate used in this study is roughly mid-point between these estimates. Also, the 6% rate is more consistent with a provincial Manitoba perspective than the somewhat higher rate that Burgess and Zerbe might suggest. The social opportunity cost of capital is calculated by weighting and then summing the cost of the different potential sources of capital: savings, borrowing from outside

somewhat lower discount rate was used to reflect the estimated weighted average cost of capital from a corporate perspective.[8]

Manitoba Hydro Customer

This account assesses the consequences of the different plans for Manitoba Hydro customers. It relies on the financial analysis in Chapter 11 that provides estimates of the rate increases in the short to medium and long term that would be required to recover net system costs and meet corporate financial targets. It also addresses the extent and significance of differences in the reliability of supply under abnormal weather, water condition and other contingencies because of the different mix of assets and interconnection capacity in the different plans.

To provide consistency in the assessment of rates in the preferred and alternative plans, revenue requirements were calculated to achieve common financial targets. The even annual rate increases required to achieve a 75:25 debt/equity ratio by the 20th year of the planning period were calculated for each plan. After year 20 the rates were adjusted each year to maintain an interest coverage ratio of 1.2.

the jurisdiction, and displacement of other investment. The weights reflect the relative importance of each source. From a provincial perspective there will tend to be more outside borrowing than displacement of other investment within the provincial economy. The greater the weight of outside borrowing relative to displacement of other investment, the lower will be the discount rate. See D. Burgess and O. Zerbe, "Appropriate discounting for benefit-cost analysis", *Journal of Benefit-Cost Analysis*, 2(2), 2011 and M. Moore et al, "More appropriate discounting: the rate of social time preference and the value of the discount rate, *Journal of Benefit Cost Analysis*, 4(1), 2013.

[8] In Manitoba Hydro's financial analysis of rate impacts, a discount rate based on time preference is used. This time preference rate is lower than the social opportunity cost of capital used in this MA-BCA and Manitoba Hydro's weighted average cost of capital used for resource planning. The time preference rate is used in the rate analysis because the purpose of the discount rate in that analysis is simply to assign weights (discount factors) to present versus future rate impacts based on the trade-offs people would willingly make (e.g., as they do when they save, deferring present consumption for future consumption opportunities). It is important to note that in the financial analysis, the cost of capital is already reflected in the calculation of revenue requirements and rates; therefore it would in effect be double counting to apply a cost of capital-based discount rate.

While based on the same surplus sale revenues and capital and operating expenditures as in the market valuation account, this Manitoba Hydro customer account is different in that it indicates the impacts over time, not just an overall net present value; it takes into account the effect of partnership arrangements which affect the net revenues to Manitoba Hydro separate from its project partners; and it calculates rate impacts based on Manitoba Hydro's forecast actual cost of capital, as opposed to the discount rate used to calculate the present value net benefit or cost in the first account.

The rate impact assessment in this Manitoba Hydro customer account does not attempt to measure a social benefit or cost in addition to what is estimated by the market valuation. Rather, it serves to indicate a key distributional effect – how the net benefit or cost estimated in the market evaluation account is shared or borne by Manitoba Hydro's domestic customers through impacts on rates over time.

The assessment of system reliability, on the other hand, does address additional benefits or costs not captured in the market valuation. While all of the plans are designed to meet Manitoba Hydro and industry-standard reliability criteria, they differ in terms of their ability to meet load under all possible weather, water conditions, forced outage and other contingencies.

Differences in the estimated loss of load probability and consequently load carrying capability are used to indicate differences in the system reliability in the different plans. To illustrate the value of the different reliability in the different plans, estimates of the expected unserved energy are multiplied by an estimated cost of supply interruptions to calculate differences in the expected costs of the very infrequent, but nonetheless potentially very disruptive bulk system failures to meet demand.

Manitoba Government

This account assesses the net benefit or cost of the different plans to the Manitoba government and therefore Manitoba taxpayers. It analyzes the incremental net revenues accruing to the government. The present value of the incremental net revenues measures the net benefit from the point of view of taxpayers.

The construction and operation of the different projects in Manitoba Hydro's plans have a wide range of direct and indirect impacts on government tax revenues. There are the taxes and fees paid by Manitoba Hydro directly; there are income and sales taxes paid by those directly and indirectly employed by the projects, or by firms directly and indirectly supplying goods and services for the projects.

Many of these tax impacts, however, do not constitute incremental net revenues for government. The income and sales taxes paid by Manitobans who would otherwise be employed elsewhere would not be incremental to the extent those taxes would be paid in any event. The income and sales taxes paid by in-migrants (attracted to the province as a result of the increased economic activity due to the projects) may be incremental revenues but would not be incremental *net* revenues to the extent they are offset by the increased costs government must incur to supply the infrastructure and service they and their families need.

In order to ensure this account captures net benefits as opposed to gross impacts, and to avoid double counting benefits addressed in the Manitoba economy account,[9] only direct incremental taxes and fees paid by Manitoba Hydro net of incremental government costs or risks are included. In this analysis this is conservatively limited to the water rentals and capital taxes paid in each plan. They are clearly incremental revenues that government would not otherwise receive; and they are not offset by incremental expense. These incremental net governmental revenues are not captured as net benefits in the market valuation account. They simply appear as costs to Manitoba Hydro.

There are other taxes and fees that Manitoba Hydro pays to government. For example, there are debt guarantee fees. However, given that the provincial debt guarantee fee is provided in exchange for this guarantee, the multiple account analysis has excluded the debt guarantee fees from the analysis of net benefits to the Manitoba government. It is assumed that these fees serve to offset the risk of higher borrowing costs and consequently may not constitute net benefits for government. There are also sinking fund administration fees, but it is assumed they are intended to pay for incremental administration costs, again not constituting a net benefit for government.

Coal taxes and the carbon charges assumed to be paid by Manitoba Hydro are also reported, but not included as net benefits in the government account. First, the carbon charges may not be manifested in a tax; they could arise, for example, from the purchase of permits in a cap and trade system. Second, even if carbon tax payments were made (like the existing coal tax), these

[9] The Manitoba economy account assesses the incremental income due to the increased employment and economic activity generated by the different plans. The estimated benefits are measured pre-tax and therefore capture both the benefit to the affected individuals and government.

are clearly intended to reflect part of the cost to society of carbon emissions. They are not a net benefit per se.[10]

Manitoba Economy

This account assesses the consequences of the different plans for the Manitoba economy. It analyzes the amount of employment and wages generated by the projects in each plan and estimates the potential incremental income that employment offers for Manitobans. The present value of the incremental income is an indicator of the employment net benefit generated in the different plans.

It is important to note that this account is different from economic impact analyses that serve to estimate the direct, indirect and induced demand for labour generated by a project's expenditures. Economic impacts do not indicate incremental employment or wages – they indicate gross effects. They are useful for understanding how a project may affect total economic activity and employment in different industries and regions, but not what net benefits that entails. The purpose of this analysis is to assess net benefits in accordance with the principles of cost-benefit analysis.[11]

[10] In the environmental account discussed below, the social cost of GHGs is measured by the externality they entail – the estimated social cost of GHGs less the carbon charges assumed in the market valuation. If the carbon charges were included as a benefit to government, the GHG cost in the environmental account would have to be correspondingly larger to include the total social cost of the GHG emissions. The net overall effect would be the same.

[11] For a discussion of the limitations of economic impact analysis and its difference from cost-benefit analysis see, P. Grady and R. Muller, "On the Use and Misuse of Input-Output Based Impact Analysis in Evaluation", *Canadian Journal of Program Evaluation*, 3(2), 1988, pp.49-61.

This account focuses on employment as opposed to purchases of goods and services because of the assumption that it is in the labour market where there is greatest potential for net benefits or "economic rents" to be earned – i.e., where there may be a significant difference between what is paid and the minimum compensation required to offset the incremental or opportunity costs of what is provided.[12] As in the Manitoba government account, the intent here is to capture the net benefit, not the total impact.

Employment net benefits are measured by the wages that are paid less the minimum amount the workers would have to receive to take the jobs: what those workers would otherwise have earned or the value of the activity they otherwise would have engaged in. In well-functioning economies, the incremental income (or in economic terms, the "economic rent") will be relatively small. People are paid more or less what is required to attract them from what they would otherwise be doing.

However, there are circumstances and regions where the net benefits can be significant – in particular, in regions where there is involuntary unemployment, limited alternative opportunities and limited willingness or ability to move to regions with better employment prospects. Here the net benefits from new job opportunities can be significant and, like the net benefit to taxpayers, they are not reflected in the market valuation account. The wages paid to construction and operating workers are simply costs from Manitoba Hydro's perspective.

[12] In competitive markets, the incremental income (or in economic terms, the 'economic rent') from sales will generally be small. Offsetting the gross revenues firms receive are the costs they must incur to provide the goods and services they sell. There would be some net return, but over the long run and under normal market conditions, one could expect that the net return is what is needed to attract capital – in other words it would reflect the cost of capital in the affected industries.

The assessment of the employment net benefits in the different plans is based on the amount and regional location of the jobs, and the estimated origin of the persons filling the available positions. No Manitoba net benefit is assigned to the jobs estimated to be filled by in-migrants because of the provincial perspective taken in this MA-BCA.

Environment

This account addresses the consequences of the different plans for the environment. It considers impacts on GHG emissions in Manitoba and elsewhere, criteria air contaminant (CAC) emissions in Manitoba, and bio-physical effects associated with the construction and operation of the projects in the different plans. The focus of this account is not the impacts in themselves, but rather the externality they represent – the external net benefit or cost to Manitobans not reflected in the market valuation or other accounts.

With respect to GHG emissions, what is measured is the estimated social cost of emissions in excess of the carbon taxes or charges assumed to be paid by Manitoba Hydro and therefore already taken into account. The social cost of GHG emissions in theory should reflect the maximum amount Manitobans would be willing to pay to reduce carbon emissions as part of the global effort to avoid serious, potentially catastrophic effects of climate change. The precise value of that willingness to pay is difficult to determine. However, there is considerable evidence that it is much greater than the carbon taxes or charges assumed in the market valuation account.[13] Estimates of the social cost of GHG emissions based on Environment

[13] Rough calculations indicate that the cost of the measure to phase out coal-fired generation in Manitoba was well in excess of \$100/tonne of CO_{2e} when first introduced and remains well over \$50/tonne of CO_{2e} at current coal and natural gas prices.

Canada and U.S. government reports[14] are used in this analysis to indicate the potential external costs associated with GHG emissions in the different plans.

With respect to CAC emissions, estimates of damage costs associated with nitrogen oxide (NO_x) and particulate matter (PM) emissions that have been developed in other jurisdictions are used to illustrate the potential magnitude of the external cost they entail for Manitobans.

With respect to biophysical effects, the issue is whether there are residual impacts despite the mitigation and compensation built into the projects' plans and costs. Summaries of the major impacts identified in the Keeyask EIS and preliminary descriptions and assessments for other projects in the plans are presented and the nature and extent of any residual effects – i.e., remaining externality – are discussed.

Social

This account addresses consequences of the different plans for aboriginal and non-aboriginal communities as well as other social effects not addressed in the other accounts.

One of the social consequences analyzed in this account is the net return and other benefits for Manitoba Hydro's project partners. This is not an additional net benefit to what is already

[14] See Environment Canada*, Heavy Duty Vehicle and Engine Greenhouse Gas Emissions Regulation,* section 7.3.3, Feb.22, 2013 (http://gazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html#footnoteRef.82118), and U.S. Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866*, May 13, 2013.

estimated in the market valuation, but rather an important distributional consequence. It indicates the share of the economic return that will accrue to the project partners.

This account also considers other impacts on communities affected by the projects in the different plans. As with the environmental account the focus here is not the impacts in themselves, but rather the externality they represent: the external net benefit or cost to affected communities as a result of impacts on services, infrastructure or well-being not avoided or offset by mitigation and compensation plans – i.e., not reflected in the market valuation.

Finally, this account addresses other consequences not considered elsewhere such as the long-term sustainability attributes of the different plans – in particular the heritage value of assets remaining at the end of the planning period. The issue analyzed here is whether the "bequest value" Manitobans place on the assets they leave for future generations is fully captured by the discounted present value of the residual asset values taken into account in the market valuation.[15]

[15] The economic concept of bequest value was first raised in a seminal article by John Krutilla ("Conservation Reconsidered", *American Economic Review*, Vol. 57, no. 4, September 1967) who argued that the main reason people are willing to allocate considerable resources (or forego immediate development benefits) for conservation is because of their desire to preserve important environmental attributes for the benefit of future generations. While developed with regard to the value of preserving natural resources, the concept of bequest value more generally recognizes a willingness to pay or allocate resources today for the benefit of future generations. It is a fundamental factor underlying the argument for greater investment in measures that will reduce the risk of climate change many years into the future.

Risk

The estimated consequences of the preferred and alternative plans depend on a number of factors including capital costs, energy prices and economic variables. The assessments under each account are done initially for a reference scenario set of assumptions in order to determine the advantages and disadvantages of the different plans under these mid-range assumptions. However, given the underlying uncertainties, the range of possible outcomes the different plans entail are important considerations in the overall assessment.

In this account, the probability of different net cost and rate implications are used to depict the extent of uncertainty in the relative advantages for the different plans. The potential effect of modifying the plans at key decision points is then considered to indicate how the different downside risks in the different plans can be mitigated.

Summary

Table 13.1 summarizes the multiple account framework. It shows the criteria, nature of analysis and indicators that are used to evaluate and compare the preferred versus alternative development plans.

Table 13.1 SUMMARY OF MULTIPLE ACCOUNT FRAMEWORK

Account	Purpose	Analysis	Indicators
Market Valuation	Net benefit to Manitoba Hydro and project partners.	Incremental revenues from surplus sales less incremental capital and O&M expenditures.	Present value of net revenues or cost (market valuation of investment).
Manitoba Hydro Customer	Consequences for customers in short to medium and long term.	Rate increases required to recover costs and meet MH financial targets. System reliability.	Average annual and cumulative rate increases over the planning period. Load carrying capability and cost of expected unserved load.
Manitoba Government	Net benefit to taxpayers.	Incremental government net revenues. Amount of additional Manitoba Hydro debt guarantee.	Present value of incremental revenues to government, net of incremental costs (including consideration of risk of debt guarantee).
Manitoba Economy	Consequences for the economy.	Employment generated and incremental income earned.	Present value of incremental income.
Environment	Consequences for emissions and natural and bio-physical effects.	Impact on GHGs in Manitoba and elsewhere. Manitoba CAC emissions Biophysical impacts.	Present value of social cost of Manitoba GHGs in excess of carbon charge. Present value of CAC damage costs. Nature and extent of residual biophysical impacts.
Social	Consequences for aboriginal and non-aboriginal communities. Other social impacts not addressed elsewhere.	Benefits to project partners. Impacts on affected communities. Value people place on assets remaining at end of planning period.	Nature and significance of partner benefits. Nature and extent of residual community impacts. Potential bequest value of remaining assets.
Risk	Nature and significance of key assumptions.	Range of possible consequences. Risk mitigation potential.	Probability distribution of system net revenues and rates.

13.2 The Resource Development Plans

The MA-BCA assesses the preferred and three alternative resource development plans. Two of the alternative plans assume no new U.S. interconnection or firm export sales: one based on the development of new gas-fired thermal generation as required to meet growing domestic loads; and one based on hydro – specifically the development of Keeyask G.S. The other alternative resource development plan assumes a new interconnection and firm export sales, but on a smaller scale than in the Development Plan with a 250 MW (230kV) as opposed to a 750MW (500kV) interconnection.

13.2.1 Manitoba Hydro's Preferred Development Plan

Manitoba Hydro's Preferred Development Plan combines the development of new hydro generation to meet growing domestic load with new access to the U.S. market and new firm export sales in order to enhance the value of the new hydro development and existing hydro system, and thereby reduce the long-term cost for customers. This plan would see the development of the Keeyask generating station (G.S.) and related transmission for 2019/20; Conawapa generating station (G.S.), related transmission, and north-south network upgrades for 2025/26; a new 750 MW interconnection with the U.S. for 2020/21; and new export sales with Minnesota Power (250 MW from 2020-2035) and Wisconsin Power Service (108 MW from 2014-2021, 100 MW from 2021 to 2027 and 300 MW from 2026-2036) as well as an expansion of the Northern States Power export sale (125 MW from 2021-2025). It is assumed that toward the end of the planning period (starting in 2041), Manitoba Hydro would add simple cycle gas thermal units as required to meet currently forecast domestic load growth.

In terms of the pathway[16] this plan represents, it is a commitment to the development of Keeyask G.S., the 750 MW interconnection and new export sales. While the pathway anticipates the development of Conawapa G.S. for 2025/26, the decision on that is not required

[16] The concept of pathways is developed in the next chapter where it is recognized that long term development plans may be modified in the future as new information becomes available. In this sense the pathway defines what is set and what adjustments to the plan may be considered after initial decisions and commitments are made following the NFAT process.

at this time, and the precise in-service date could be deferred if warranted by load growth, market or other conditions. What is done toward the end of the planning period will be determined in the future, depending on precise needs and opportunities available at that time. The assumption of gas plants starting in 2041 is simply a method used in all of the plans to ensure the forecast load can be met in a manner consistent with Manitoba Hydro's planning criteria through the end of the planning period.

13.2.2 The Smaller Interconnection Alternative (K19/Gas24/250MW)

Like the Preferred Development Plan, this smaller interconnection alternative combines the development of hydro generation to meet growing domestic requirements with new interconnection and export sales in the U.S. However, the interconnection in this case would only be 250 MW and the firm export sales commitments would be less. This plan also does not include the development of the Conawapa G.S. and related transmission and network upgrades. Gas-fired thermal generation is added as required to meet growing load after the development of Keeyask G.S.

The specific planning assumptions for this alternative are as follows:

- The construction of the Keeyask generating station and related transmission with an in-service date of 2019/20.
- The construction of a new 250 MW transmission interconnection with the U.S. with an in-service date of 2020/21.
- New export sale commitments of 250 MW with Minnesota Power from 2020-2035, 100 MW with Wisconsin Power Service from 2021-2027, and 125 MW with Northern States Power from 2021-2025.
- New SCGTs starting in 2024/25 and CCGTs starting in 2032/33.

This smaller interconnection alternative serves to indicate the advantages or disadvantages of following a similar strategy as in the preferred case, but with smaller capital cost and export commitments. It also represents a fallback option if the 750 MW (500 kV) line does not receive regulatory approval or the firm export sales are not all satisfactorily concluded.

In terms of the pathway this plan represents, it commits to the development of Keeyask G.S. and a small interconnection. What transpires after the development of Keeyask G.S., however, could change. One variant for example, would be to develop Conawapa G.S. instead of gas plants when required to meet domestic load.

13.2.3 Keeyask with No New Interconnection (K22/Gas)

This plan assumes that Manitoba Hydro would develop Keeyask G.S., without a new interconnection, solely as required to meet domestic load growth. The plan assumes that there would be a relatively small new firm export commitment to absorb some of the surplus that Keeyask G.S. would generate when first developed. It further assumes the development of gas-fired thermal generation after Keeyask G.S. as required to meet growing domestic demand.

The specific planning assumptions for this alternative are as follows:

- The construction of the Keeyask generating station and related transmission with an in-service date of 2022/23.
- New export sale commitments of 100 MW with Wisconsin Power Service from 2023-2027.
- New SCGTs starting in 2029/30 and CCGTs starting in 2034/35.

This plan serves to indicate the advantages or disadvantages of retaining a preference for hydro to meet growing load, but without the new interconnection and export sales opportunity currently available to Manitoba Hydro.

In terms of the pathway this plan represents, it commits to the development of Keeyask G.S. and abandons the opportunity for and benefits of the current new interconnection opportunity. As with the previous plan, what transpires after the development of Keeyask G.S. could change. Again one variant would be to develop Conawapa G.S. instead of gas plants when required to meet growing domestic load.

13.2.4 Gas Thermal with No New Interconnection (All Gas)

This plan assumes that Manitoba Hydro would not develop a new interconnection or any new firm export sales with the U.S. and would rely on gas-fired thermal generation to meet growing load. Based on the current load growth forecast, Manitoba Hydro would develop SCGTs starting in 2022/23 and CCGTs starting in 2031/32.

This plan serves to indicate the advantages or disadvantages of relying on gas thermal instead of hydro for the foreseeable future. It is the lowest capital cost alternative and the one with the least facility and export commitments.

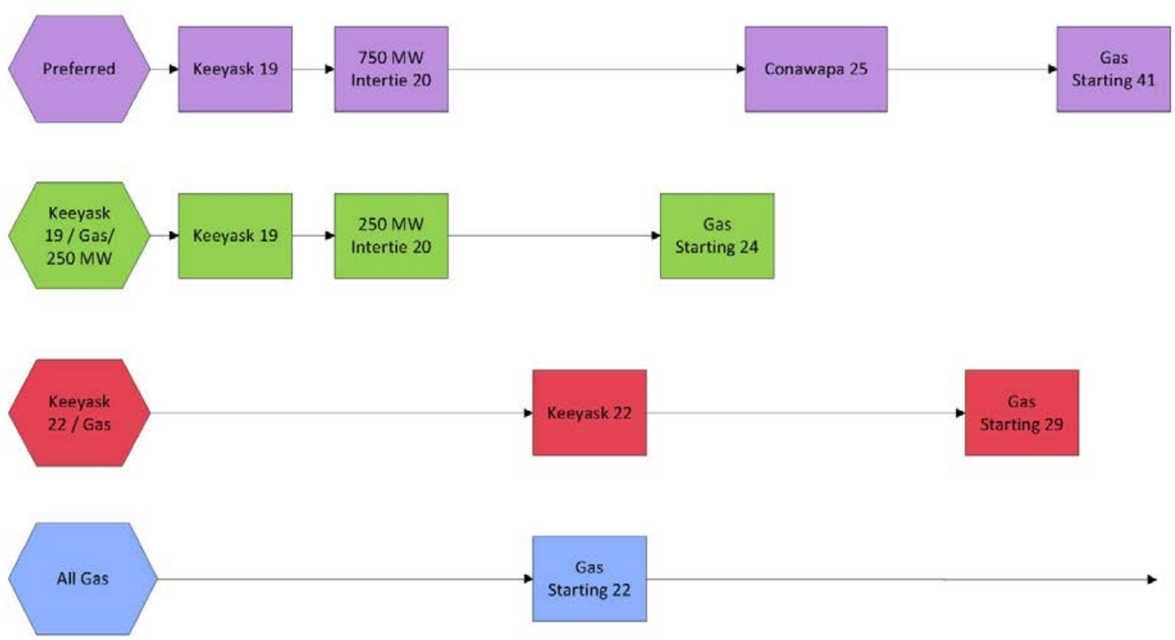
In terms of the pathway this plan represents, it abandons the development of Keeyask G.S. for the foreseeable future, and the current opportunity for and benefits of a new interconnection. It could, however, see the development of new hydro in the future if warranted by unfolding conditions.

1 **13.2.5 Summary**

2 The specific components in the preferred and alternative plans assessed in this MA-BCA are
3 shown in Figure 13.1 below.

4

5 **Figure 13.1** PREFERRED AND ALTERNATIVE DEVELOPMENT PLANS



6

13.3 Evaluation by Account

13.3.1 Market Valuation Account

The total present value expenditures and revenues for the preferred and the alternative plans under the reference scenario set of assumptions are shown in Table 13.2. The present values are based on the estimated annual incremental capital and system operating expenditures and revenues over the 2014-2047 planning period presented in previous chapters. The residual asset values reflect the present value of the estimated net benefit that the assets remaining at the end of the planning period would provide in subsequent years relative to the costs Manitoba Hydro would be facing in the all gas development plan.[17] The present values are calculated at a 6% real discount rate, a rate intended to reflect the weighted average social opportunity cost of capital from a provincial perspective.

[17] The zero value shown for the all gas plan does not mean there would be no assets remaining at the end of the planning period. It is simply that the residual values were calculated relative to that case.

Table 13.2 **MARKET VALUATION OF PREFERRED AND ALTERNATIVE PLANS**

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Incremental capital exp.	7,373.9	3,812.1	3,338.0	1,158.9
Less: residual asset value (relative to all gas)	[1,933.3]	[804.6]	[849.6]	0.0
Fuel exp (excl tax)	307.7	856.3	767.6	1,151.2
Imports	971.0	893.0	847.7	1,030.9
O&M, other (excl tax)	2,220.5	2,227.6	2,170.3	2,171.2
Taxes and carbon charge	3,008.1	2,729.8	2,676.7	2,445.2
Total Expenditures	**11,947.9**	**9,714.1**	**8,950.7**	**7,957.4**
Firm export sales	4,513.6	2,685.1	1,606.0	1,331.7
Spot / opportunity sales	4,818.5	4,430.2	4,458.4	3,355.8
Total Revenues	**9,332.1**	**7,115.3**	**6,064.4**	**4,687.5**
Net Cost	**2,615.8**	**2,598.8**	**2,886.3**	**3,269.9**
Difference from Development Plan	**0**	**(17.0)**	**270.5**	**654.1**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

As shown in the table, the preferred and the smaller interconnection plans exhibit the lowest net costs, followed by the plan with Keeyask G.S. but no new interconnection. The all gas plan with no new interconnection exhibits the highest net costs.

The Preferred Development Plan entails much higher capital expenditures than the others, but these are offset by the much higher firm export sale revenues and a much higher residual value of the assets, with Conawapa G.S. as well as Keeyask G.S. remaining at the end of the planning period. The Preferred Development Plan also incurs much lower fuel costs, most notably as compared to the all gas plan.

13.3.2 Manitoba Hydro Customer Account

Rate Impact

The present value net costs of the different plans indicates their relative advantage to Manitoba Hydro and its customers over the long term, but the impacts on rates in the short to medium versus longer term depend as much on the mix of expenditures as their total amount.

Capital-intensive plans give rise to more marked rate impacts in the short to medium term, as revenue and cash flow requirements have to increase to achieve debt-equity and other financial targets. Fuel-intensive plans give rise to more marked rate impacts in the longer term with their relatively large ongoing and escalating annual costs.

Under the reference scenario assumptions the short to medium term rate increases required for the Preferred Development Plan would be greater than with the three alternative plans. With the Preferred Development Plan, a projected even annual rate increase of 3.95% would be required to achieve a target 75:25 debt/equity ratio by year 20 of the planning period.[18] The projected cumulative rate increase by 2031/32 would be 108%. For the three alternative plans projected even annual rate increases in the 3.4 to 3.5% range would be required to achieve the target 75:25 debt/equity ratio by year 20. The projected cumulative rate increase to year 2031/32 is estimated at 90% for the all gas and small interconnection plans and 92% for the plan with Keeyask G.S. but no interconnection – approximately 16 to 18 percentage points less than the Preferred Development Plan.

[18] This and all other rate increases discussed in this section are expressed in nominal dollars, that is, including the effect of the general rate of inflation. The real increases, after adjusting for inflation, would be approximately 1.9% per year less.

The higher rates with the Preferred Development Plan would be needed in the short to medium term to raise revenues and cash flow to achieve the target debt-equity ratio. However, the higher rates would be an investment for the long term. Upon completion of the intensive capital investment period and the achievement of the target debt/equity ratio in year 20, there would be reduced inflationary pressure on costs with the predominately hydro system in place. At that point the cumulative rate increases with the Preferred Development Plan would fall below those in the other plans within a relatively short time frame.

Under the NFAT reference scenario assumptions, the projected cumulative rate increase with the Preferred Development Plan would be 106% by year 50 (2061/62) virtually the same as the cumulative increase to year 20 (2031/32). The projected cumulative long term rate increase for the two plans with Keeyask G.S. would be between 140% (Keeyask G.S. with no interconnection) and 143% (Keeyask G.S. with the small interconnection), approximately 34 to 37 percentage points more than with the Preferred Development Plan. The projected cumulative long term rate increase for the all gas plan would be 176%, approximately 70 percentage points more than the Preferred Development Plan.

Reliability

The different development plans are all designed to ensure Manitoba Hydro has sufficient resources to be able to meet its peak and annual load, even under a wide range of forced outage, extreme weather and other circumstances. Manitoba Hydro's planning criteria provide for a very high degree of system reliability – there is a very high probability of being able to meet system requirements under all contingencies. Nevertheless, system reliability is never 100%. There generally will be some combinations of adverse circumstances under which

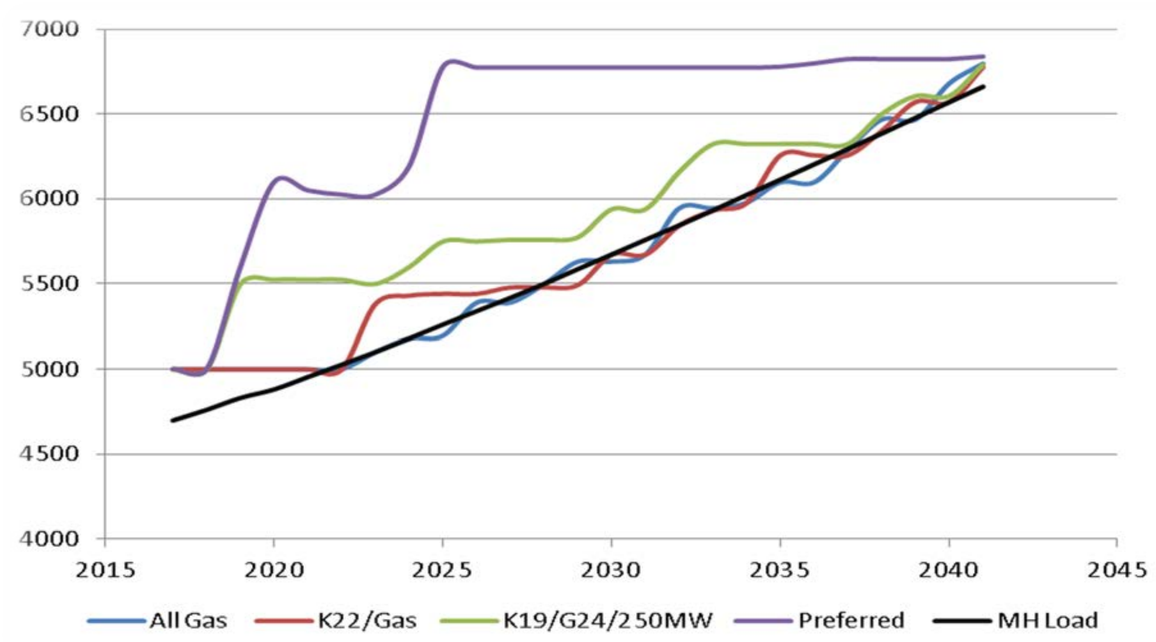
Manitoba Hydro's generating and bulk transmission capacity would not be sufficient to meet the system load.

The degree of system reliability can be measured by what planners call the "loss of load expectation" – the average number of days per year that the load could not be fully met. A common industry standard is .1 days per year, or an inability to meet system load one day every 10 years. The lower the loss of load expectation, the greater is the system reliability. This can equivalently be expressed in terms of the system's load-carrying capability. With greater reliability the system can reliably carry or meet a greater amount of peak load.

Figure 13.2 shows the estimated load-carrying capability of the Manitoba Hydro system (at the industry standard loss of load expectation of .1 day per year) with the preferred and alternative plans.[19] As shown in the figure, the load-carrying capability of the Preferred Development Plan is significantly greater than the others. The interconnection combined with the additional hydro resources contributes to much higher reliability. For the same reason, though to a lesser extent, the alternative with the smaller interconnection and Keeyask G.S. has a greater load-carrying capability than the two alternatives without a new interconnection.

[19] See Appendix 13.1, Reliability Evaluation, August 1, 2013.

Figure 13.2 **PEAK LOAD CARRYING CAPABILITY (MW)**



With greater reliability, customers could expect less failure of bulk supply and consequently less unserved load. While failures in bulk supply would be very infrequent, they can have major consequences. To indicate the potential significance of the differences in unserved load, the expected unserved energy costs were estimated based on an outage value of $10,000/MWh. The expected unserved energy cost for the all gas and Keeyask/gas alternatives would be greater than for the Preferred Development Plan by $101 million and $105 million in present value, respectively, over the planning period. The expected unserved energy cost for the small interconnection alternative would be less, but still some $56 million greater than with the Preferred Development Plan.

While the precise outage value is uncertain and would depend on the timing and nature of the outages, the estimates serve to indicate the relative advantage of the large interconnection over the smaller one and the advantage of both of those compared to the two alternatives without a new interconnection.

In addition to this reliability benefit, the Preferred Development Plan offers customers more security against the risks of extreme drought. The import capability with the large new interconnection plus the advancement of hydro generating capacity for export would provide Manitoba Hydro greater access to back-up supply and flexibility to manage extreme droughts than with the other alternatives, particularly those without any new interconnection.

Summary of Customer Account

In sum, the Preferred Development Plan would result in greater rate increases than the other plans in the short to medium term, with the projected cumulative rate increase approximately 16 to 18 percentage points more than the alternatives by 2031/32. However, the Preferred Development Plan would result in the lowest rates over the longer term. By 2061/62 the projected cumulative rate change in the Preferred Development Plan would be approximately 34 to 70 percentage points less than the other plans.

The Preferred Development Plan would benefit customers with its greater system reliability and significantly lower expected cost of unserved load, as well as its greater ability to manage extreme drought.

13.3.3 Manitoba Government Account

Included in the annual expenditures and financing costs that Manitoba Hydro incurs, and that are reflected in its rates, are taxes and other fees and charges paid to the provincial government. These include the capital taxes and water rental fees that constitute a significant component of the annual expenditures captured in the market valuation account; the debt guarantee and sinking fund administration fees that add roughly 1% to Manitoba Hydro's cost of capital, and thereby directly affect rates; and the coal taxes and assumed carbon charges[20] that add to the cost of thermal power operations.

In Table 13.3 below the amount of these payments that would be made in the preferred and alternative development plans are shown. As shown in the table, the total payments are substantial, ranging from $4.3 to $5.6 billion in present value over the planning period. The largest amount of payments arises with the Preferred Development Plan – some $660 to $770 million greater than the two plans with Keeyask G.S., and $1.27 billion greater than the all gas plan.

Table 13.3 DIRECT MH PAYMENTS TO MANITOBA GOVERNMENT

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Capital Tax	1,457.1	1,202.7	1,188.0	991.9
Water Rentals	1,512.4	1,413.3	1,385.6	1,303.4
Debt Guarantee Fee	2,597.5	2,218.3	2,162.1	1,894.9
Sinking Fund Admin Fee	7.1	6.3	5.9	4.4
Coal Tax	10.3	10.3	10.3	10.3
Potential Carbon Charges	28.3	103.4	92.8	139.6
Total Payments	**5,612.7**	**4,954.3**	**4,844.7**	**4,344.5**
Difference from Preferred Development Plan	**0**	**[658.4]**	**[768.0]**	**[1,268.2]**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

[20] The carbon charges are included to indicate their potential contribution to the total payments to government, but they may or may not be manifested as a tax, depending on the policy government were to adopt to implement such charges.

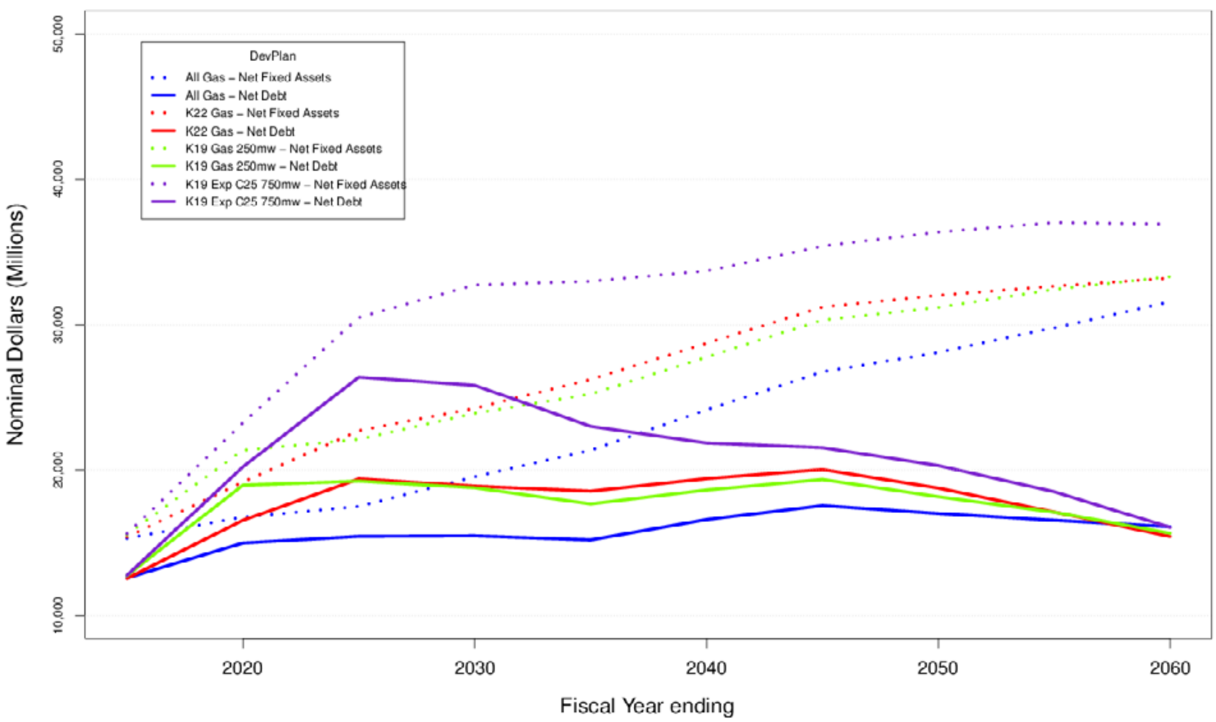
In terms of the economic significance of these payments to government, and therefore Manitoba taxpayers, the question is what net benefit do they provide. To what extent do they constitute incremental revenues for government not offset by incremental costs or risks?

The coal taxes and carbon charges do not offer net benefits. As explained in section 2, the carbon charges may not result in direct payments to government, for example in a cap and trade system, and in any event would be intended to internalize at least part of the social cost of GHG emissions. The sinking fund administration fee also would not constitute a significant net benefit for government, on the assumption that the fee serves to compensate government for the administration costs it incurs.

The debt guarantee fees are substantial, but so too is the amount of debt that government would be guaranteeing. Figure 13.3 shows the projected balances of net fixed assets and net debt with the preferred and the alternative plans. As shown in the figure, there would be an increase in the total amount of Manitoba Hydro's debt with all of the plans, but particularly in the Preferred Development Plan with its development of both Keeyask G.S. and Conawapa G.S.

Figure 13.3 **MANITOBA HYDRO'S PROJECTED BALANCES OF NET DEBT AND NET FIXED ASSETS – NFAT REFERENCE SCENARIO ASSUMPTIONS**

(MILLIONS OF NOMINAL$)



The level of net debt must be considered in the context of the entire balance sheet, including the associated net assets that are under construction or in service. In the medium term, while net debt levels are the highest with the Preferred Development Plan, that plan also has the overall highest capital investment, fixed assets and retained earnings.

The Province of Manitoba provides a flow through credit to Manitoba Hydro and guarantees the vast majority of its debt. Given that the provincial debt guarantee fee is provided in exchange for this guarantee, the multiple account analysis has not included the debt guarantee fees as part of the net benefits to the Manitoba government. It is assumed that the fee does not provide a net benefit. Under this assumption, the net benefits for government (and taxpayers) would arise only from the capital taxes and water rentals that Manitoba Hydro pays.

Accordingly, the estimated net benefit to government is shown in Table 13.4 for the preferred and alternative plans.[21]

Table 13.4 NET BENEFITS TO MANITOBA GOVERNMENT

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Capital tax	1,457.1	1,202.7	1,188.0	991.9
Water rentals	1,512.4	1,413.3	1,385.6	1,303.4
Total net benefit	**2,969.5**	**2,616.0**	**2,573.6**	**2,295.3**
Difference from Preferred Development Plan	**0**	**[353.5]**	**[395.9]**	**[674.2]**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, while smaller than the total payments Manitoba Hydro would make to government, the total net benefit from capital taxes and water rentals is substantial, ranging from $2.3 to almost $3.0 billion in present value over the planning period. The net benefits are greatest for Manitoba Hydro's Preferred Development Plan – some $350 to $400 million

[21] No expenditures are shown in the calculation of net benefits as there are no significant incremental expenditures that government would incur as a result of the different plans. The provincial government has contributed to training programs for Keeyask and as well road improvements in the area. However, these expenditures have already been incurred and no significant further expenditures are expected.

greater than the two alternative plans with Keeyask G.S., and $670 million greater than the all gas plan.

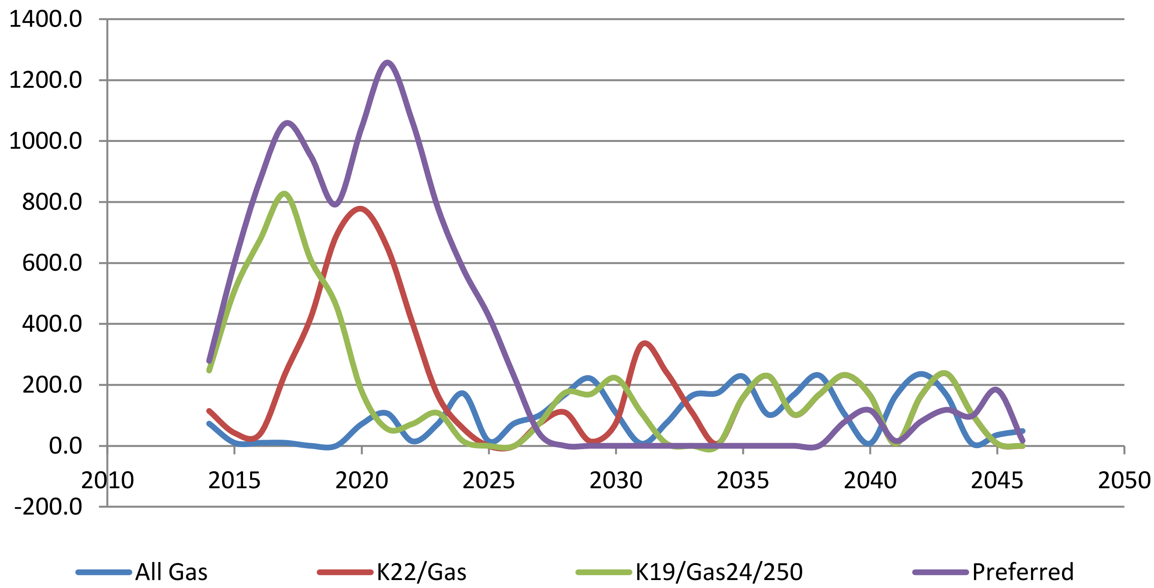
13.3.4 Manitoba Economy Account

Manitoba Hydro's Preferred Development Plan will significantly affect the Manitoba economy as a result of the demand for goods, services and labour generated by the construction and operation of the different projects in the different plans. As explained in section 2, of particular interest in this MA-BCA are the impacts on the demand for labour. That is where there is greatest potential for "economic rents" or net benefits to be generated.

As shown in Figure 13.4, there is a marked difference in the level and pattern of capital investment in the preferred and the alternative plans. The difference is most pronounced in the first part of the planning period, through to the completion of Conawapa G.S. in the Preferred Development Plan. During that initial period the Preferred Development Plan exhibits the greatest level of spending, followed by the two alternatives that include the development of Keeyask G.S. (which differ in the timing but not significantly in the amount of capital spending). The all gas alternative has the least amount of capital spending in the first part of the planning period, with only small amounts invested for thermal power plants starting in the 2020s. Later in the planning period, capital spending is relatively low in all of the plans, but least with Manitoba Hydro's Preferred Development Plan because of the limited need for additional generating capacity once Conawapa G.S. is built.

Figure 13.4 ANNUAL CAPITAL EXPENDITURES - NFAT REFERENCE SCENARIO ASSUMPTIONS

(MILLIONS OF 2014$)

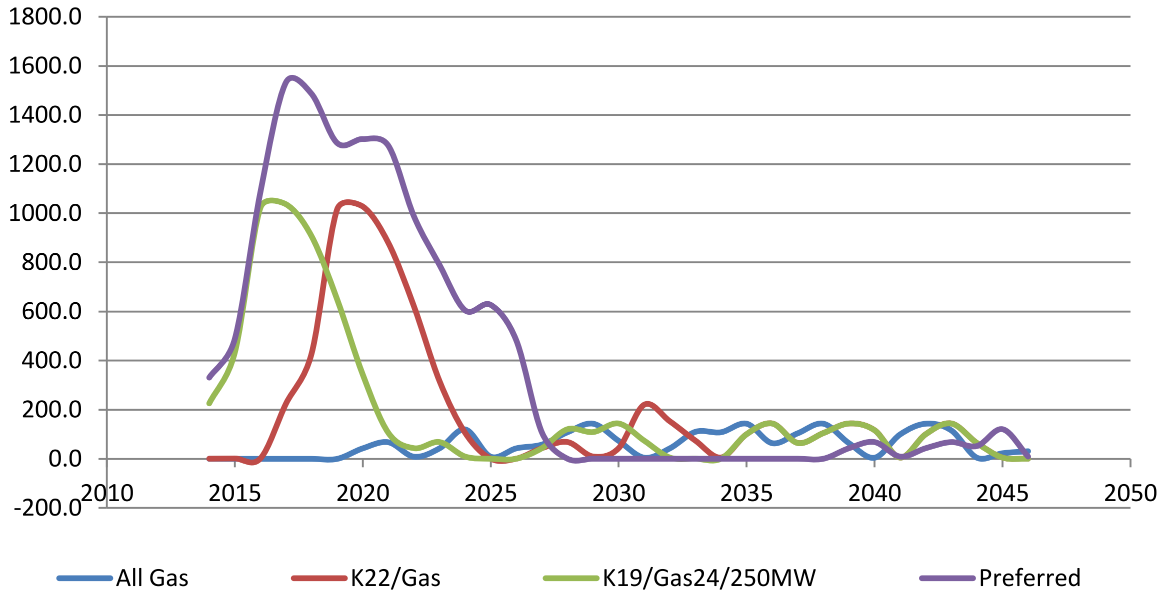


These differences in capital spending carry over into the demand for labour. Figure 13.5 shows the total annual employment directly required for the construction of the generating and transmission projects in the different plans.[22] The largest amount of construction employment is generated by the Preferred Development Plan, again followed by the two plans that include Keeyask G.S. The all gas alternative generates the least amount of construction employment, far less than the other plans.

[22] Employment and wage estimates in this section are based on project data in Manitoba Hydro, Range of Resource Options, Appendix 7.2.

Figure 13.5 ANNUAL EMPLOYMENT FOR PROJECT CONSTRUCTION

(PERSON YEARS)



The demand for labour in operations and maintenance (O&M) is different. Figure 13.6 shows the total annual O&M employment directly required for the projects developed in the preferred and the alternative plans. All of the plans generate an increasing amount of annual O&M employment. Toward the end of the planning period, however, the three alternatives without Conawapa G.S. generate more annual employment than the Preferred Development Plan because of the need to add more thermal plants to meet growing load.

Figure 13.6 ANNUAL EMPLOYMENT FOR PROJECT OPERATIONS AND MAINTENANCE

(PERSON YEARS)

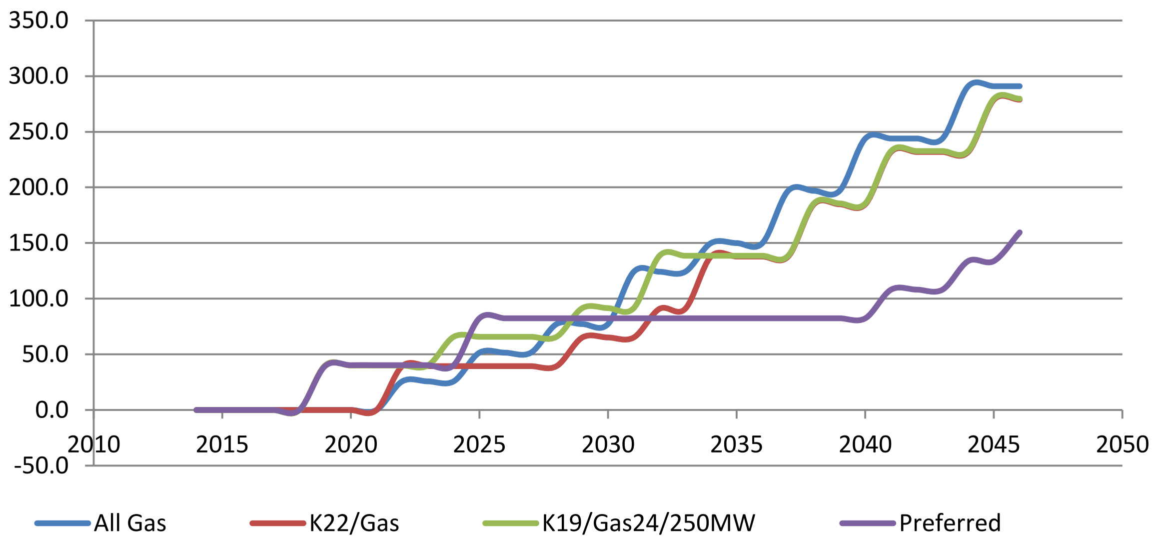


Table 13.5 shows the present value of the gross wages generated by the direct employment in project construction and O&M in the preferred and alternative plans. The wages are shown separately for the employment that takes place in northern versus southern Manitoba.

Table 13.5 GROSS WAGES FOR CONSTRUCTION AND O&M

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Construction – N. Man.	1,317.4	599.9	503.9	--
Construction – S. Man.	142.0	95.0	72.0	62.6
Total Construction	1,459.4	694.9	575.9	62.6
O&M – N. Man.	85.0	49.6	40.5	--
O&M – S. Man.	4.2	47.4	37.3	71.5
Total O&M	89.2	97.0	77.8	71.5
Total Gross Wages	1,548.6	791.9	653.7	134.1
Difference from Preferred Development Plan	0.0	(756.7)	(894.9)	(1,414.5)

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table the total gross wages directly generated by the Preferred Development Plan would be much greater than with the other plans and more heavily concentrated in northern Manitoba.

The net benefits derived from the employment on Manitoba Hydro's projects, however, are measured not by the gross wage impact, but rather by the incremental income or other benefits Manitobans would realize. That would depend on the *increase* in income or other benefit that Manitobans would earn in relation to what they would otherwise be doing. And that in turn would depend on where the workers originate from and what alternative opportunities they would have.

Significant net benefits would only be realized to the extent that the jobs provide opportunities for Manitobans which are better than what would otherwise be available. That is most likely in regions where there are high levels of unemployment, or when there are complementary programs and other measures enabling workers to upgrade their skills and earning potential, or where the jobs simply offer better wages or benefits than available elsewhere.

There will not likely be widespread unemployment over the long term in Manitoba as a whole without these projects. Labour force data indicate that the unemployment rate in Manitoba is relatively low and growing demand for labour combined with the impact of "baby boomer" retirements are expected to maintain low rates of unemployment, with shortages in some occupations.[23] The net benefit from new jobs will generally be limited to the advantage they offer relative to alternative sources of employment – the amount required to attract the workers away from what they would otherwise do.

At the same time, however, it is important to recognize that there has been chronic unemployment in northern Manitoba, particularly in Aboriginal communities, with limited alternative prospects and with social and cultural barriers to migration to areas where employment prospects are better.[24] Jobs opportunities created in northern Manitoba,

[23] See Manitoba Government, *Manitoba Government Labour Force Trends* and Manitoba Construction Sector Council, *Construction Looking Forward 2012-2020 Key Highlights*.

[24] Statistics Canada data indicated that the 2001 unemployment rate for Keeyask Cree Nations was 40% and for the northern Manitoba Aboriginal population [Census divisions 19,21,22 and 23] it was 28% compared to 6.1% for Manitoba as a whole. While the rates have no doubt changed since 2001 (in part because of the Wuskwatim project), the relative pattern and vulnerability to unemployment is likely the same. See Keeyask Hydropower Limited Partnership, *Environmental Impact Statement-Response to EIS Guidelines*, Chapter 6, Environmental Effects Assessment, June 2012, p.6-143.

combined with training and other measures to enable northern Manitobans to fill those positions, can provide significant net benefit.

For this assessment it is assumed that the net benefits of the jobs filled by Manitobans would generally be in the order of 15% of the gross wages. That is consistent with a study of the relationship between wages and the social opportunity cost of labour (what the workers would otherwise have earned) for a major project developed when labour markets were generally tight, as one could expect in this case.[25] However, the net benefit for northern Aboriginal employment, supported by training, recruitment and retention policies and programs, is assumed to be in the order of 50% of the gross wages paid. Again this is consistent with estimates of the relationship between wages and the social opportunity cost of labour where alternative opportunities are more limited.[26] With respect to in-migrants it is assumed the net benefits would be zero from a Manitoba perspective. The in-migrants would pay income and other taxes, but it is conservatively assumed these would be offset by the cost of services that government would have to provide for them.

With respect to the origin of the workers filling the jobs generated in the different plans, it is assumed that for the northern projects 40 to 45% of the construction positions would be filled by Manitobans, and of the Manitobans, 50% would be northern Aboriginal. The Manitoba share of the construction employment is less than what has been observed for the Wuskwatim Project and may be conservative, but reflects the larger size of the projects. The northern aboriginal share (50% of the Manitoba workers or 20 to 22.5% of the total number of jobs) is

[25] See Chun-Yan Kuo, "Evaluating the Social Cost of Job Creation", *Canadian Journal of Program Evaluation"*, Special Issue, 1997, pp. 67-82.

[26] Ibid.

within the range for northern aboriginal construction employment estimated in the Keeyask EIS.[27]

With respect to the southern construction jobs, it is assumed that Manitobans would fill just over 50% of the gas plant related employment and almost all of the tie-line and head office related employment. The share of gas plant jobs going to Manitobans is based on consulting reports indicating that they require a large amount of specialized work combined with the fact that Manitoba has not undertaken such projects in recent years.

With respect to the O&M jobs in the north and the south, it is assumed all would be filled by Manitobans. For the northern O&M jobs it is assumed that at least 45% would be filled by northern Aboriginal people based on current shares of northern operations employment and targeted measures expected with Keeyask G.S.[28]

Based on these employment assumptions—plus an estimate that the average wages for the mix of construction jobs filled by northern Aboriginal people would be approximately 75% of the total project average wages—the net benefits of construction employment in the north would equal 12.2 to 12.4% of the total gross wages paid; for construction employment in the south

[27] For a breakdown of the person-years of employment on the Wuskwatim project through to November 2012 see Manitoba Hydro, *Wuskwatim GS Employment, November 2012 Monthly Report*, p.11. In the Keeyask EIS it was estimated that northern aboriginal would fill between 13 and 40% of the direct construction employment for Keeyask. See Keeyask Hydropower Limited Partnership, *Environmental Impact Statement,* Chapter 6 p.6-434.

[28] Northern Aboriginal people currently account for 42% of northern operations employment. The Joint Keeyask Development Agreement calls for the placement of 182 Keeyask Cree Nation members in operating jobs throughout the hydro system. That would be equivalent to more than 100% of the O&M jobs that would be created by Keeyask and Conawapa combined. The 45% assumption is conservative, recognizing it may take some time until the target can be reached.

net benefits per dollar of gross wages paid would range from 7.8% (for the all gas case where a large number of the workers would be from out-of province) to 14.6% (for the preferred case for which most of the southern employment would be filled by Manitobans). The net benefits of O&M employment in the north would be 30.8% of the total gross wages paid; for O&M employment in the south net benefits would be 15% of the total gross wages paid. In Table 13.6 the resulting employment net benefits generated by the preferred and alternative plans are shown.

Table 13.6 EMPLOYMENT NET BENEFITS FOR PROJECT CONSTRUCTION AND O&M

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Construction – N. Man.	160.7	74.4	62.5	--
Construction – S. Man.	20.7	10.8	7.6	4.9
Total Construction	**181.5**	**85.2**	**70.1**	**4.9**
O&M – N. Man.	26.2	15.3	12.5	--
O&M – S. Man.	0.6	7.1	5.6	10.7
Total O&M	**26.8**	**22.4**	**18.1**	**10.7**
Total Net Benefits	**208.3**	**107.6**	**88.2**	**15.6**
Difference from Preferred Development Plan	**0.0**	**(100.7)**	**(120.1)**	**(192.7)**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, the employment net benefits, though much smaller than gross wages, would still be significant in the plans that include northern hydro development. Those plans generate a significant number of jobs, a large proportion of which would be in a region where they would be particularly beneficial. The employment net benefits would be greatest with the

Preferred Development Plan - $100 to $120 million greater than the two plans with Keeyask G.S. and over $190 million greater than the all gas plan.

Clearly the assumptions used to develop these estimates are rough, and arguably conservative for purposes of estimating the net benefits from the employment and other economic activity generated by the projects in the different plans. Nevertheless, they do serve to indicate the relative magnitude of the employment net benefits and the advantage of the Preferred Development Plan.

13.3.5 Environment Account

The preferred and alternative development plans differ in terms of the impacts they would have on GHG emissions; NO_x and other local CAC emissions; and terrestrial and aquatic habitat and natural resource impacts.

GHG Emissions

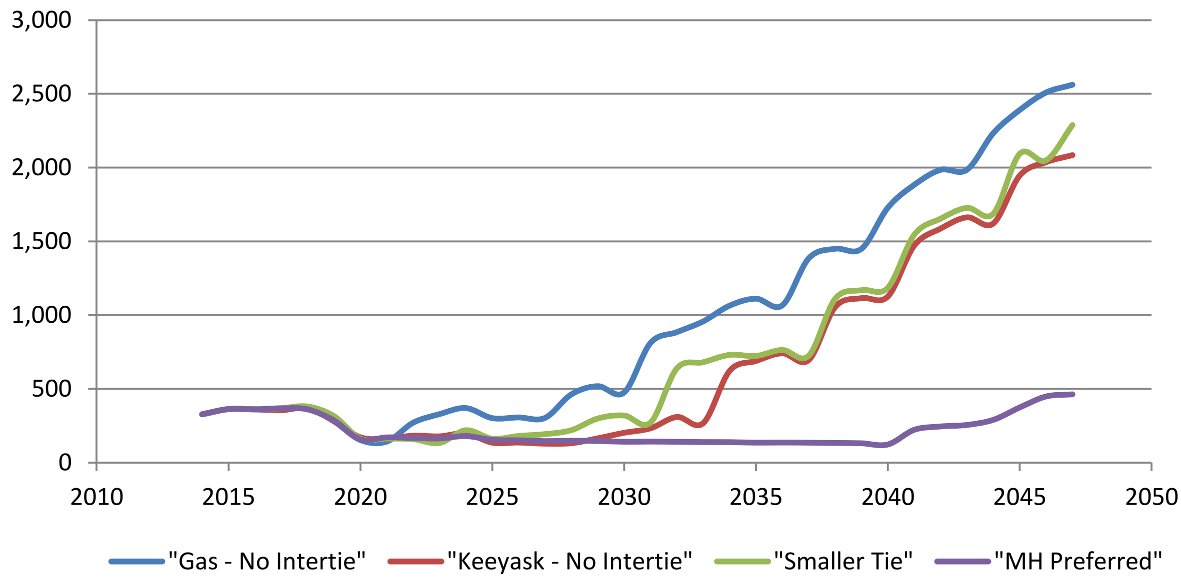
The development plan that Manitoba Hydro undertakes will affect GHG emissions both within and outside Manitoba. Within Manitoba, the plan will determine the amount of thermal generation that would be used to meet growing load and backup low-water conditions, and consequently affect thermal power-related GHG emissions. It will also govern the development of new hydro reservoirs, generating stations and transmission lines, and therefore the production of associated lifecycle GHG emissions. With respect to GHG impacts outside Manitoba, the plan will determine Manitoba Hydro's exports and imports of power, and consequently affect the amount of thermal power generation and related GHG emissions in the interconnected jurisdictions. There are also lifecycle GHG impacts outside Manitoba associated with the project development plans.

Figure 13.7 shows the estimated amount of Manitoba Hydro thermal generation-related GHG emissions associated with the preferred and alternative plans. As shown in the table, emissions are lowest with the Preferred Development Plan.[29] Unlike the alternatives, the Preferred Development Plan incorporates the development of both Keeyask G.S. and Conawapa G.S., and consequently entails far less thermal generation than the others. The highest level of emissions is with the all gas plan. By the end of the planning period the annual emissions in that plan would be some 2 million tonnes (CO_{2e}) per year greater than with the Preferred Development Plan.

[29] The Preferred Plan is the only plan which emissions are lower than Manitoba Hydro's annual greenhouse gas emissions target of 520 kilotonnes of CO_2e throughout the planning horizon.

Figure 13.7 MANITOBA HYDRO THERMAL GENERATION-RELATED GHG EMISSIONS

('000 TONNES CO_{2E})



In the market valuation of the different plans, it was assumed that Manitoba Hydro would pay a charge for its carbon emissions from natural gas-fired thermal generation as well as a tax on the coal used in the single remaining coal-fired unit. The timing and level of charges depend on future policies in Manitoba and Canada with respect to new emission taxes or membership in a cap and trade system. In the absence of defined policies at this time, the carbon pricing from other regions was considered and judgment applied to create a plausible range of future GHG-emission charges. For the reference scenario analysis, the GHG emissions charge for natural gas-fired thermal generation was assumed to be approximately \$5/tonne CO_2 in 2015 rising to approximately \$25/tonne CO_2 by 2048 (in constant 2012\$).

These assumed charges, however, do not reflect the full social cost of GHG emissions – i.e., the maximum amount people would be willing to pay to reduce emissions in order to reduce the expected costs and risks of global warming and climate change.

Recent estimates of the social cost of GHG emissions are much higher than the assumed carbon charge. Environment Canada has estimated that the social cost of GHG emissions, based on the present value of expected climate change costs is currently over $28/tonne CO_2, rising to almost $60/tonne CO_2 by 2050 (in constant 2011$).[30] Including consideration of the willingness to pay to avoid uncertain, but potentially catastrophic, climate change impacts raises the estimated cost to over $112/tonne CO_2. Similarly, a U.S. government inter-agency team recently estimated the social cost of GHG emissions at $38/tonne CO_2 in 2015 rising to $71/tonne CO_2 in 2050 (in constant 2007$ US),[31] and recognized that the cost would be much greater the more that people are willing to pay to avoid damages in the future (the lower the discount rate), and the more that people are willing to pay to avoid uncertain, catastrophic risks.[32]

For purposes of estimating the external cost of the Manitoba GHG emissions in the different plans – the difference between the estimated social cost of GHG emissions and the carbon charges plus coal taxes included in Manitoba Hydro's estimated expenditures – it is assumed that the social cost of GHG emissions would be $40/tonne CO_2 in 2014, rising to $80/tonne CO_2 by 2048 (in constant 2012$). This is somewhat higher than Environment Canada's estimate of GHG damage costs, but less than its estimate of the willingness to pay to avoid the risks of uncertain but catastrophic effects. It is broadly consistent with the most recent U.S. estimates, again without any provision for the willingness to pay to avoid uncertain, catastrophic risks.

[30] In constant 2012$ that would be over $28.50 rising to almost $61/tonne.

[31] In constant 2012$ Cdn that would be $42 rising to $78/tonne.

[32] See Environment Canada*, Heavy Duty Vehicle and Engine Greenhouse Gas Emissions Regulation,* section 7.3.3, Feb.22, 2013 (http://gazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html#footnoteRef.82118), and U.S. Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866*, May 13, 2013.

Table 13.7 shows the estimated present value of the external GHG costs from the Manitoba thermal generation in the different plans based on these assumptions.

Table 13.7 EXTERNAL COST OF MANITOBA THERMAL GENERATION-RELATED GHG EMISSIONS

	Preferred Development Plan	K19/G24/ 250MW	K22/Gas	All Gas
Estimated social cost of GHG emissions	188.8	472.6	427.6	620.4
Estimated coal tax and carbon charge payments	38.6	113.8	103.1	149.9
External Cost of GHG Emissions	**150.2**	**358.8**	**324.5**	**470.5**
Difference from Preferred Development Plan	-------	**208.6**	**174.3**	**320.3**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS 2014$)

As shown in the table, the estimated external costs of the Manitoba thermal generation-related GHG emissions in the Preferred Development Plan are significantly less than the alternatives. As compared to the all gas case, the present value external cost in the Preferred Development Plan is an estimated $320 million less.

In addition to thermal generation-related GHG emissions there would be the emissions associated with the development of reservoirs, generating stations and transmission lines. Estimates are not available for all of the project development impacts in all of the plans. However, the largest GHG emission impacts within Manitoba would likely result from the Keeyask and Conawapa Projects, with the clearing, flooding and construction-related impacts they would have.

A lifecycle GHG assessment for the Keeyask Project[33] indicates that land-use changes including reservoir clearing and flooding would result in an estimated 496,000 tonnes CO_{2e} of emissions. Construction activities, including building materials and manufacture, transportation and on-site construction activities, would result in approximately 454,000 tonnes CO_{2e} (an estimated 40% of which would occur within Manitoba). In total the lifecycle development impacts for Keeyask G.S., including provision for future maintenance and refurbishment activities and decommissioning, would amount to some 979,000 tonnes CO_{2e} of emissions. Approximately 700,000 tonnes CO_{2e} would occur within Manitoba. The development of the Conawapa Project would also generate some GHG emissions, though less than Keeyask Project because of the much more limited flooding it entails.

Taking into account the social cost of the emissions resulting from the development of Keeyask G.S. would reduce the GHG advantage of the plans with Keeyask G.S. relative to the all gas plan. However, the impact would be relatively small. The Keeyask G.S. emissions would be some two orders of magnitude less than the emissions from the thermal operations they displace. Similarly, taking into account the emissions from the development of Conawapa G.S. would reduce the GHG advantage of the Preferred Development Plan relative to the others. But the impact here would also be relatively small, especially with Conawapa G.S. emissions even less than Keeyask G.S.

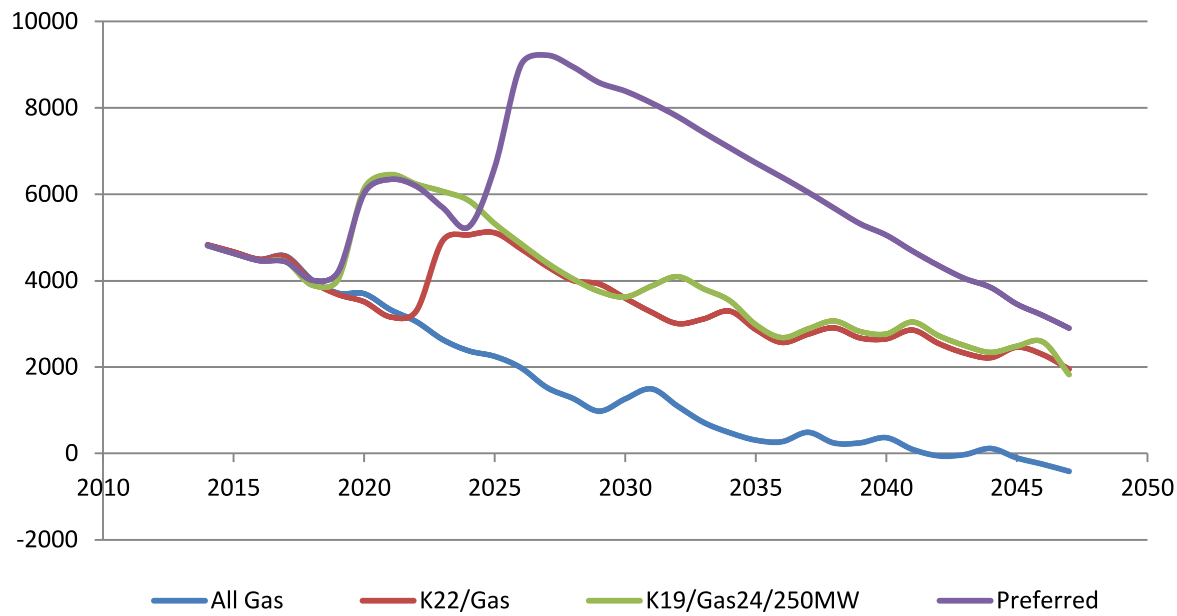
Moreover, whatever GHG emissions impacts would result from the development of Keeyask G.S. and Conawapa G.S., they would be more than offset by the very significant positive impact those projects have on global displacement of GHG emissions. Figure 13.8 shows the estimated

[33] Appendix 7.3: Life Cycle Greenhouse Gas Assessment Overview.

impact of the different development plans on GHG emissions outside Manitoba due to Manitoba Hydro's exports and imports, and consequently on thermal power generation outside the province.

Figure 13.8 **REDUCTION OF THERMAL GENERATION-RELATED GHG EMISSIONS OUTSIDE MANITOBA**

('000 TONNES OF CO_{2E})



As shown in the figure, the plans with Keeyask G.S. would all significantly reduce GHG emissions in the U.S. The Preferred Development Plan with Keeyask G.S. and Conawapa G.S. would have an even greater impact. In some years the annual displacement of GHG emissions outside Manitoba with the Preferred Development Plan would exceed 8 million tonnes. This single-year impact is many times larger than the total 100-year lifecycle GHG impacts of these projects. Overall, the Preferred Development Plan, and to a lesser extent the Keeyask-gas and smaller interconnection alternatives, would make very significant contributions to the reduction of global GHG emissions.

Local CAC Emissions

In addition to GHG emissions, thermal generation in Manitoba produces emissions of nitrogen oxide (NO_x), fine particulates (PM_{10}) and other criteria air contaminants (CACs). Figures 13.9 and 13.10 show the estimated tonnes of NO_x and PM_{10} emissions in Manitoba in the different plans. As shown in the figures, the all gas alternative has the greatest amount of emissions, followed by the two alternatives that include the development of Keeyask G.S. The Preferred Development Plan, with the development of both Keeyask G.S. and Conawapa G.S. has significantly less CAC emissions than the others.

Figure 13.9 **NO_X EMISSIONS IN MANITOBA IN PREFERRED AND ALTERNATIVE PLANS**

(TONNES)

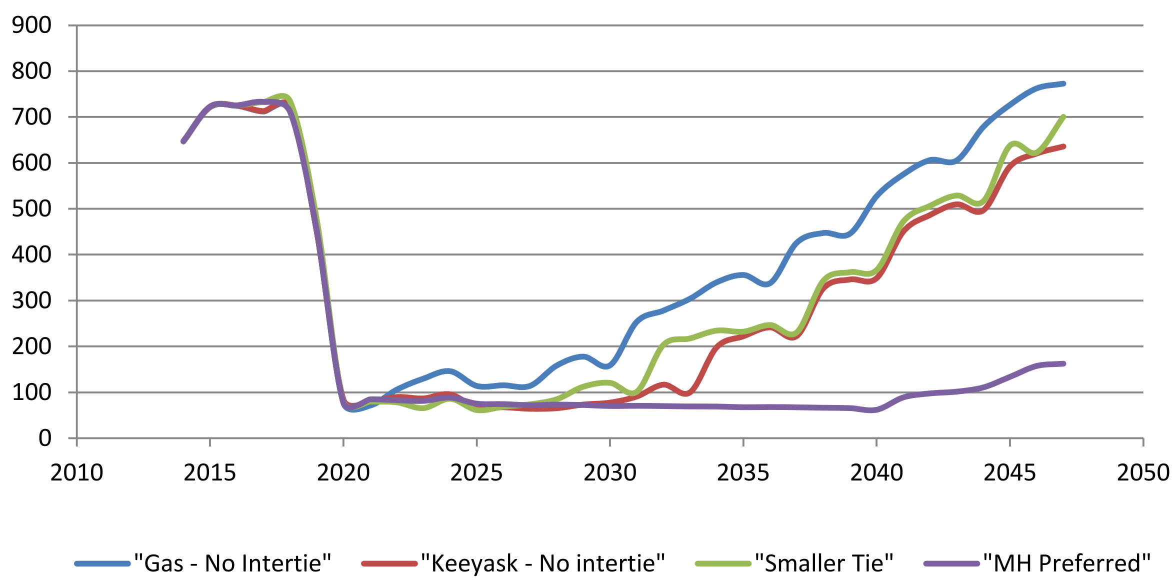
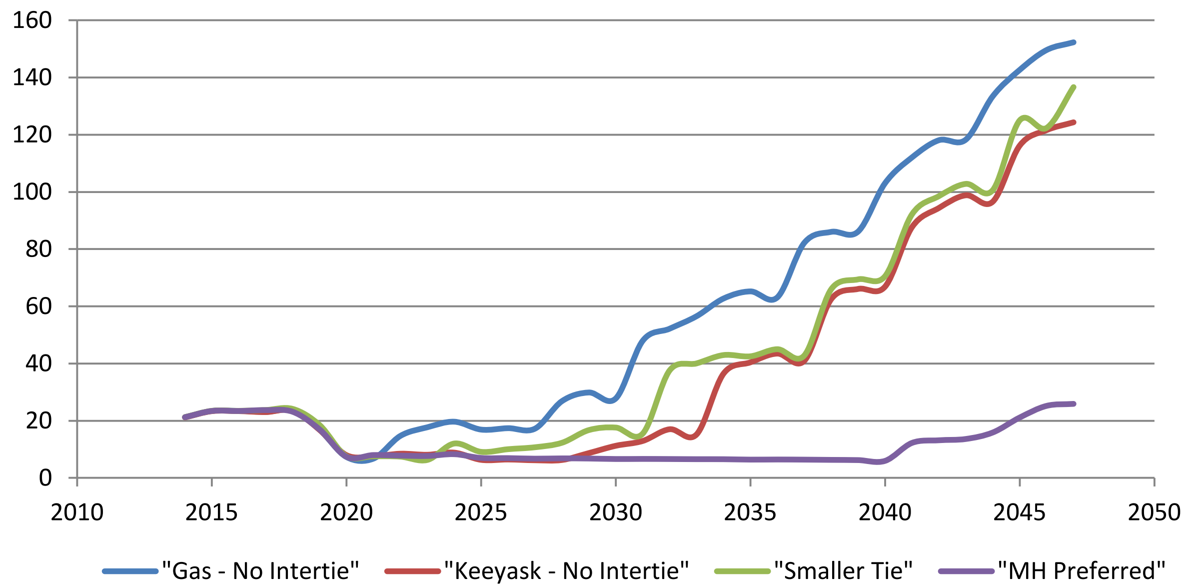


Figure 13.10 PM_{10} EMISSIONS IN MANITOBA IN PREFERRED AND ALTERNATIVE PLANS

(TONNES)



These emissions are of concern because of the health and other adverse impacts they can have. A measure of the cost they entail is their total damage costs – the estimated costs of the illness and premature death, as well as any agricultural or other adverse resource impacts they may have.

The exact damage costs associated with these emissions depend on many factors, including meteorological conditions, topography, and the size, proximity and demographics of exposed populations. External cost studies undertaken for the European Commission (2005) show estimates of the damage costs of NO_x emissions ranging from 1,000 euros/tonne to over 9,000 euros, and damage costs of PM ranging from just over 4,000 euros/tonne to over 60,000 euros per tonne.[34] Higher ranges are reported with higher assumed values for the willingness to pay to reduce the risk of loss of life years. A key factor governing the costs is nearby population, as human exposure to the pollutants is critical in determining the incidence of illness and death due to the emissions.

For purposes of illustrating the potential damage costs of the CAC emissions in the preferred and alternative plans, damage cost values of \$3,000/tonne for NO_x and \$20,000/tonne for PM_{10} are assumed (2012\$ Cdn). These are in the lower end of the range of the EU study, which is appropriate for relatively small southern population centres like Brandon and Selkirk where much of the thermal generation would likely take place.

Table 13.8 shows the total present value costs of the CAC emissions in each plan based on these damage cost estimates. As shown in the table, the total costs and differences from the referred plan are relatively small. While arguably the costs estimates are conservative[35], the fact remains that with appropriate siting and modern pollution control technology, the pollution-related external costs of thermal generation can be minimized. There are advantages in avoiding CAC emissions, but they are relatively small compared to GHG impacts and other consequences of the different plans.

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[34] See European Commission publication, *Damages per tonne of emissions of $PM_{2.5}$, NH_3, NO_x and VOCs from each EU25 Member State (excluding Cyprus) and Surrounding Seas*, March 2005.

(*http://ec.europa.eu/environment/archives/cafe/activities/pdf/cafe_cba_externalities.pdf*)

[35] The European PM damage cost estimates are for $PM_{2.5}$. One could expect higher costs for finer particulates (PM_{10}) because of the greater health hazard they present. Also the damage cost estimates could increase over time. See U.K. Department of the Environment, Air Quality: economic analysis, May 10, 2013 (www.gov.uk/air-quality-economic-analysis) where it is recommended to assume an increase in the real value of damage costs over time due to an expected increased willingness to pay to reduce the risk of loss of life as incomes rise. It is also recommended to use a lower discount rate (3.5% real) as compared to the 6% real rate used to calculate present values in this study.

Table 13.8 CAC DAMAGE COSTS FROM MANITOBA THERMAL GENERATION IN PREFERRED AND ALTERNATIVE PLANS

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Estimated damage cost of NO_x emissions	13.4	16.9	16.3	18.9
Estimated damage cost of PM emissions	4.1	9.2	8.3	11.9
Total CAC Damage Costs	**17.5**	**26.1**	**24.6**	**30.8**
Difference from Preferred Development Plan	-------	**8.6**	**7.1**	**13.3**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

Bio-physical Impacts

The development of new generation and transmission facilities in the different plans would have a wide range of physical, aquatic and terrestrial environmental impacts.

In the Preferred Development Plan, there would be the impacts associated with the development of the Keeyask and Conawapa hydro stations, related transmission and network upgrades; a new 750 MW interconnection with the U.S.; and some 600 MW of simple cycle gas turbine capacity should that capacity be needed toward the end of the planning period (2041-46) to meet requirements.

In the smaller-interconnection alternative there would be the impacts of the development of Keeyask G.S. and related transmission; a 250 MW interconnection to the U.S.; and over 1,600 MW of simple and combined cycle gas turbine capacity. The Keeyask-gas alternative would give rise to the same development impacts, except for the interconnection to the U.S. which would not be built in that case. With the all gas alternative there would be the impacts associated with the development of gas turbine capacity – some 900 MW of simple cycle capacity and 1,540 MW of combined cycle capacity.

As discussed in ***Chapter 2 – Manitoba Hydro's Preferred Development Plan Facilities,*** Manitoba Hydro and its Cree Nation partners have undertaken a detailed environmental assessment of the Keeyask generation project. The assessment sets out the scope of the project, its potential effects, plans to avoid and mitigate adverse effects and an evaluation of residual effects (i.e. those that remain after mitigation).[36]

The project would entail the flooding of 45 km^2 of land initially, increasing another 7 or 8 km^2 over time. There would be increases in water levels upstream and flow impacts up to 3 km downstream. There would as well be clearing of land for construction, access and transmission line right of ways.

Among the aquatic impacts, there would be some loss of spawning and foraging habitat as well as some blockage of fish passage. Extensive mitigation measures have been planned to minimize and offset these effects. These include plans in construction and for turbine design to minimize impacts; development of new habitat and fish passage; and implementation of a fish stocking program. While some short term declines in fish populations are expected, no declines are expected over the long term, and lake sturgeon populations in the region are expected to

[36] Keeyask Hydropower Limited Partnership, *Environmental Impact Statement-Response to EIS Guidelines*, Chapter 6, Environmental Effects Assessment, June 2012.

increase with the stocking and stewardship programs despite the loss of habitat due to the project.[37]

The federal government is considering whether to list lake sturgeon in the Nelson River as endangered under the *Species at Risk Act (SARA)*. Manitoba Hydro's planning is based on the assumption that this will not occur, particularly given the stocking and stewardship programs that are being developed and implemented. Were listing under *SARA* to occur the Keeyask and Conawapa Projects could be delayed or cancelled. If Manitoba Hydro (and in the case of Keeyask the partnership) decided to proceed with the projects, federal permits would be required.

The development of Keeyask G.S. would result in an increase in methylmercury concentrations in fish peaking 3 to 7 years after impoundment. It is expected the methylmercury concentrations would revert back to original levels after 30 years. Monitoring and communication programs, as well as funding of offsetting programs to support harvesting in alternative locations are planned to mitigate these effects.

Among the terrestrial impacts is the loss of habitat, including wetland areas, affecting mammals, birds and waterfowl. There would also be impacts due to sensory disturbance, increased traffic and human presence, and greater access to and pressure from hunting. For birds there could as well be impacts from wire strikes. Mitigation measures include careful

[37] Manitoba Hydro has been working on stewardship activities with provincial and federal regulators, academic institutions, First Nations and stakeholder organizations such as the Nelson River Sturgeon Board and the Saskatchewan River Sturgeon Management Board. The objective is to develop a comprehensive set of programs designed to protect and enhance lake sturgeon populations. See NFAT, Appendix 2.1 for details.

siting of infrastructure facilities away from sensitive sites, such as caribou calving habitat and regionally rare habitat types. New wetland habitat and nesting areas would be developed. Cumulative effects for all priority habitat types would be maintained below 10%, a key indicator of ecosystem sustainability. An access management and hunting control plan would also be implemented.

Manitoba Hydro is of the view that these mitigation measures combined with offsetting programs and the compensation provided for in the adverse effects agreements, plus the fact that from the very outset a low-level development option was selected to minimize flooding and the increase in water levels upstream, would serve to ensure that the residual impacts would be relatively small.

The economic measure of the cost of any residual impact on environmental resources and attributes is the compensation required by those people who would be adversely affected to willingly accept the impacts and risks. The acceptance and participation of the KCNs in the Joint Keeyask Development Agreement suggests that the cost (for social as well as natural resource and environmental effects as they affect local residents) would be largely internalized in the design, plans and agreements governing the project development. There would be no major *external* cost to take into account.

Detailed environmental assessments have not been undertaken for the other projects in the preferred and alternative plans. Preliminary assessments indicate, however, that the impacts of the Conawapa Project would be similar in nature to the Keeyask Project, except the flooding and related aquatic impacts would be much less. It would entail only 5 km^2 of flooding as compared to 45 km^2 for Keeyask G.S. There would be less linear development to connect

Conawapa generation to the system than for Keeyask G.S. – five 7-km lines would be required to connect the generating station to the converter station. However, the combined development of Keeyask G.S. and Conawapa G.S. would require upgrades to the HVDC collector system as well as upgrades to some 470 km of the north-south 230 kV AC transmission system.

At this point, and subject to the findings in project-specific environmental assessment reviews, Manitoba Hydro is of the view that preliminary project designs and cost estimates for Conawapa G.S. and the related upgrades provide for sufficient mitigation to minimize residual adverse effects to acceptable levels. It is also expected that some form of local agreements would be entered into to ensure whatever residual biophysical impacts or risks remain, they would be addressed. Thus, as with the Keeyask Project, it is not anticipated there would be significant external environmental costs from the projects' impacts on aquatic or terrestrial habitat and resources as they affect local residents.

The same general conclusion applies to other projects in the different plans. Careful siting, construction methods, and right-of-way maintenance provisions would be used to minimize the environmental impacts of the U.S. interconnection. With respect to gas thermal plants, the land requirements are small (some 2.8 hectares for a 320 MW CCGT plant and 1.7 hectares for a 216 MW SCGT, and linear development of 2 to 55 km depending on the exact site). New terrestrial impacts could be minimized further with brownfield development at existing power station sites. There would be some steam and cooling water requirements, but these would be minimized with efficient water recycling design.

Some residual impacts could occur with these projects, but they would be the subject of detailed environmental reviews and arrangements with directly affected individuals or communities. It is anticipated that most, if not all of the costs, would be internalized in the measures that would be undertaken in securing easements and land, and in the project construction and operations.

In summary, while the bio-physical impacts would differ across the different plans, there would not appear to be a major difference in the external costs they give rise to. For the most part the impact-related costs have been internalized with the project designs and plans, and consequently are already reflected in the revenues and expenditures in the market valuation account.

13.3.6 Social Account

The project developments in the preferred and alternative plans would have a wide range of social and economic effects for project partners, local and regional communities, and Manitobans as a whole.

For partners there would be the expected returns and other benefits from their investment and participation in the projects. For affected communities there would be employment and business impacts, as well as potential impacts on traditional and commercial resource activity. There would also be potential impacts on population, housing, infrastructure and services; transportation; family and community well-being; health and safety; and culture and heritage resources. For Manitobans generally, there would be potential impacts on widely held values, including the long-term sustainability or bequest value people in principle may be willing to pay for.

Project Partners

In the preferred and alternative plans that include the development of the Keeyask Project, the investment, employment, direct contract award and other provisions of the JKDA would take effect. These would generate significant benefits for the four Cree Nations (KCNs) that would partner with Manitoba Hydro in the development of the project.

In the Keeyask Environment Impact Statement (EIS) it was estimated that the project would generate between 235 and 600 person-years of construction employment for the KCN partners. There would as well be direct negotiated contracts generating employment and profits from the provisions of camp services, clearing and site preparation, road construction, and other work. For the longer term, there would be a target placement of 182 KCN members in operating positions in Manitoba Hydro.[38]

The investment provisions would enable KCN to acquire an equity interest up to 25% in the project, with the potential of generating significant net returns from their investment. Agreements have not yet been reached for Conawapa, but it is expected for that project, too, there would be benefit-sharing arrangements with local First Nations in the vicinity of the project, as well as a range of local and regional employment, training and business opportunities.

As for the other projects in the preferred and alternative plans, in particular the thermal projects that would be developed, there are no plans to enhance local employment

[38] Keeyask Hydropower Limited Partnership, *Environmental Impact Statement* Chapter 6, pp. 6-434 to 6-439.

opportunities as in the JKDA and no investment participation or direct income benefit arrangements are envisaged at this time.

The net returns to Manitoba Hydro project partners and other direct income beneficiaries would be significant in all of the plans with Keeyask G.S., but particularly if it is built in conjunction with new sales and a new interconnection. That enhances the average export price and participant returns. The largest benefits would be realized with the Preferred Development Plan because of the larger interconnection and sales it includes and because of the benefit-sharing agreement that Conawapa G.S. is assumed to entail.

Local and Regional Community Impacts

A detailed socio-economic impact assessment has been undertaken for the Keeyask Project, but not for the other projects in the preferred and alternative plans.

The Keeyask G.S. assessment has indicated that there would be significant employment benefits throughout the region, and spin-off business benefits in Gillam and Thompson. Gillam would realize longer-term benefits because of the permanent jobs that would be located there to support Keeyask operations. While there are concerns about wage pressure and cost-of-living impacts that could result, these are not expected to be significant because of an anticipated business closure and consequent weakness elsewhere in the regional economy.

There are expected to be some adverse impacts on domestic resource use and commercial trapping due to disturbance to fish and wildlife resources and habitat. However, they would be limited and offset by the provision of alternative harvesting opportunities and compensation arrangements. Licensed trapline holders would be eligible for compensation.

There could be some in-migration to local and regional communities during construction, with consequent pressures on housing, recreational and other facilities, and community services. The impacts are expected to be limited, in part because the existing housing shortage in nearby local communities would discourage project workers from returning to those communities. However, the impacts would be monitored and mitigation measures taken as required. Additionally, plans are being developed to address infrastructure and service requirements in Gillam, with an expected increase in its permanent population.

Concerns about transportation have been expressed, including impacts due to increased traffic on provincial roads. Impacts on provincial roads would be mitigated by improvements to PR 280, and impacts on winter road access and ferry landings would be monitored.

As with other major projects in remote areas, there would be both positive and negative potential impacts on families and community well-being. The increased income and employment opportunities can significantly benefit families, but at the same time they can give rise to undesirable activities such as drug and alcohol abuse. Undesirable interaction between construction workers and local residents would be expected to be much reduced compared to previous experiences, but this issue would remain a priority of Manitoba Hydro, the communities, RCMP and other local service providers to monitor and address. Similarly, monitoring and mitigation measures would be implemented to address other community and health concerns, in particular with regard to increased methylmercury levels in fish after impoundment.

Overall, while there would be some adverse effects, for the most part they would be mitigated and limited in duration. Some concerns would no doubt remain, but again, the KCNs support and participation in the project suggest that local adverse effects would be offset by the positive impacts and expected benefits.

Detailed assessments for the other projects in the preferred and alternative plans have not been undertaken. The impacts and mitigation plans for Conawapa G.S. would be similar to Keeyask G.S., with similar net effects. The impacts for thermal power plant developments would be different, but again it could be expected that siting and mitigation plans would minimize residual adverse effects. Transmission line development through private lands raise different social issues, including disputes about the compensation paid for easements. For the transmission lines associated with generation-related, network upgrade and interconnection projects, siting would be carefully done to minimize impacts, and fair market value paid for access to or purchase of private land. In most instances the number of parties and amount of money involved would be relatively small. Nevertheless, while not necessarily significant from a broad provincial perspective, any residual impacts could be quite important from the perspective of those directly affected.

In sum, there would be the full range of positive and negative impacts major projects can have on nearby communities and affected property owners. For the most part, adverse impacts would be minimized or offset with careful project planning, siting, monitoring, mitigation and compensation arrangements. However, some negative residual effects could still occur for some individuals and families.

Manitobans as a Whole

For Manitoba as a whole, the cost-benefit question is whether there are social benefits or costs – consequences that people in principle value positively or negatively – not reflected in the other accounts. There could be some broad community support for the engagement with Aboriginal Communities in the plans with northern hydro development. There could as well be strong preference for development plans that rely on renewable as opposed to non-renewable fossil-fuel resources. For some Manitobans there may be a willingness to pay for such consequences or attributes that go beyond what is already reflected in Manitoba Hydro's aboriginal partnership agreements and in the costing of GHG emissions already taken into account, though it is not clear how significant that would be from a broad provincial perspective.

One aspect of the plans, however, that may be more broadly significant and that may not have been fully recognized in the other accounts, is what one could describe as a bequest value – the value of the assets that will benefit future generations of Manitobans over the very long term.

The residual value of the assets at the end of Manitoba Hydro's planning period was included in the present value calculations in the market valuation account. This was done by projecting and comparing for the different plans the capital and O&M costs net of export revenues required to maintain the system from 2047 through to 2090. The residual value of the hydro generating and related assets in the preferred and two alternative plans with Keeyask G.S. was then calculated by calculating the long-term net cost saving relative to the all gas plan, with its greater need for replacement investment, greater O&M and lower export revenues.

The calculated residual values for the hydro assets remaining at the end of the planning period were significant, as one would expect given their long life and minimal operating cost. However, their 2047 residual value was calculated at a real discount rate of 5.05% reflecting Manitoba Hydro's weighted average cost of capital; and its 2014 present value in this MA-BCA was calculated with a 6% real discount rate reflecting the weighted average social opportunity cost. The question is whether those discount rates give adequate weight to the future benefits – whether they truly reflect what people would be willing to pay today for benefits passed onto future generations.

Discount rates of 5.05% and 6% (real) are lower than the rates that private industry would use to calculate the present value significance of residual assets remaining at the end of the planning period. However, that is because private industry typically assigns much greater weight to the more immediate consequences of its decisions. It is precisely because of that, it has been Crown Corporations that have undertaken the major hydro developments in Canada in the past. As a matter of public policy and with government support Crown Corporations were able to give much greater weight to the long-term value of their investments. In effect, they applied much lower discount rates in the assessment of their investment decisions; and as can be seen with the very low electricity prices in Manitoba, Quebec and British Columbia as compared to other jurisdictions, that has served this present generation very well.

In recent years, a number of economists specializing in cost-benefit or related analyses argue that traditional cost of capital-based discount rates do not give adequate weight to the intergenerational consequences of investment and policy decisions. Some economists advocate and some government cost-benefit guidelines have in fact adopted declining real discount rates over time to give greater weight to intergenerational impacts in the distant future.[39] This has been particularly important in the assessment of climate change concerns; it is also relevant to any long-lived assets providing benefits into the very distant future.

The application of lower, intergenerationally sensitive discount rates would increase the weight or present value significance of the assets remaining at the end of the planning period and increase the advantage of the plans with Keeyask G.S. and especially the Preferred Development Plan with Keeyask G.S. and Conawapa G.S. as compared to the all gas plan. In economic terms it would add an important bequest value to these plans, over and above what has already been taken into account. No attempt is made in this assessment to quantify the magnitude of that potential value; it is simply recognized as a potentially important qualitative consideration to take into account in the overall assessment of the relative merits of the different plans.

13.3.7 Summary of Reference Scenario Assessment

In Table 13.9, the assessment of the preferred and alternative development plans under the market valuation, customer, Manitoba government, Manitoba economy, environment and social accounts are summarized. The dollar values show the estimated present value difference from the Preferred Development Plan under Manitoba Hydro's NFAT reference scenario set of assumptions, with positive values indicating a net advantage (higher net revenue/benefit or lower net cost) relative to the Preferred Development Plan; negative values indicate a net disadvantage (higher net cost).

[39] See e.g. M. Weitzman, "Why the Far-Distant Future Should be Discounted at Its Lowest Possible Rate", *Journal of Environmental Economics and Management*, Vol.36, 1998, pp.201-8; P. Portnoy and J. Weyeant, *Discounting and Intergenerational Equity*, Resources for the Future, 1999; and U.K. HM Treasury, *The Green Book: Appraisal and Evaluation in Central Government*, p.26.

As shown in the table, the market valuation – the incremental revenues and expenditures for Manitoba Hydro and its project partners – shows that the plan with Keeyask G.S. and no new interconnection is preferable to the all gas plan and that the plans with a new interconnection (large or small) are preferable to the two alternatives without one. As between the Preferred Development Plan and the one with the smaller interconnection, there is little difference. The smaller interconnection is slightly better with its estimated present value net revenues (at a 6% real discount rate) $17 million greater than with the Preferred Development Plan.

In summary, from a long-term Manitoba Hydro perspective it is advantageous to develop Keeyask G.S. (as opposed to gas thermal) and even more advantageous when developed in conjunction with a new interconnection and firm export sales to the U.S.

As one moves from a strictly Manitoba Hydro to broader social or public interest perspective, the long-term advantage of the plan with Keeyask G.S. and particularly Keeyask G.S. with a new interconnection relative to all gas, become even more pronounced. There are significant advantages for customer reliability, government, the economy, and in relation to GHG emissions for the plans with Keeyask G.S. as compared to all gas. And with these broader net benefits taken into account there is a significant advantage of the Preferred Development Plan relative to the plan with the smaller interconnection. The estimated present value of the monetized net benefits of the Preferred Development Plan is $654 million greater than the plan with the smaller interconnection; $967 million greater than the plan with Keeyask G.S. and no interconnection; and $1.855 billion greater than the all gas plan.

Table 13.9 SUMMARY OF REFERENCE SCENARIO ASSESSMENT

	Preferred Development Plan	K19/G24/250MW	K22/Gas	All Gas
Market Valuation Net revenues (cost) to MH and partners	--	17.0	(270.5)	(654.1)
Customer Account Cumulative rate increase	Preferred Development Plan has highest rate increases in first 20 years (cumulatively 16 to 18 percentage points more than the alternative plans) but has lowest rate increases over long term (cumulatively by year 50 approximately 34 to 37 percentage points less than the two alternatives with Keeyask G.S. and 70 percentage points less than the all gas plan).			
Reliability	Preferred Development Plan and to lesser extent the alternative with the smaller interconnection provides greater load carrying capability, lower expected loss of unserved energy and greater ability to manage extreme drought			
Government Incremental revenues net of costs/risk	--	(353.5)	(395.9)	(674.2)
Manitoba Economy Employment net benefits	--	(100.7)	(120.1)	(192.7)
Environment Manitoba GHG external cost	--	(208.6)	(174.3)	(320.3)
Global GHG impact	Preferred Development Plan and to lesser extent the two plans with Keeyask G.S. would contribute to a reduction in global emissions by displacing thermal generation in US.			
Manitoba CAC damage cost	--	(8.6)	(7.1)	(13.3)
Residual biophysical	Aquatic and terrestrial impacts with hydro projects in Preferred Development Plan and plans with Keeyask G.S.; subject to detailed environmental hearings, residual effects and local external cost expected to be relatively small with initial design, extensive mitigation, monitoring, compensation and benefit-sharing arrangements.			
Social Partner net return	Significant net returns from up to 25% interest in Keeyask G.S. and income benefits from Conawapa G.S. in Preferred Development Plan; significant benefits from up to 25% interest in two alternatives with Keeyask G.S., greater with new sales and interconnection.			
Community impacts	Wide range of potential impacts on local employment and business; population, infrastructure and service; social and community well-being; owners of land needed for rights of way and easements; major commitments and plans to minimize adverse residual effects with extensive mitigation, monitoring, compensation and partnership arrangements.			
Other Manitoba	Potentially significant bequest value from the hydro assets remaining at end of planning period; greatest with Preferred Development Plan and to a lesser extent in the alternatives with Keeyask G.S.			
Overall Monetized Net Benefit (Cost)	**--**	**(654.4)**	**(967.5)**	**(1,854.6)**

NFAT REFERENCE SCENARIO ASSUMPTIONS (2014 PRESENT VALUE IN MILLIONS OF 2014$)

There are important distributional and non-monetized impacts that the monetized net benefit numbers do not show. A key distributional issue is the pattern of rate impacts over time. The Preferred Development Plan exhibits the lowest rate increases over the long run, but the largest increases in the short to medium term. On the other hand the Preferred Development Plan offers the greatest bequest value for future generations – a value that may not be fully captured by the residual value in Manitoba Hydro's assessment of net system costs.

This distributional trade-off calls for careful consideration of short to medium versus long-term interests. A long-term perspective strongly supports the Preferred Development Plan with its development of Conawapa G.S. as well as Keeyask G.S. A shorter-term perspective will favour less capital expenditure, though the results would still indicate an advantage for the plans with Keeyask G.S., and especially Keeyask G.S. and a new interconnection over the all gas plan. There is not the same short to medium versus long term trade-off when comparing the Keeyask/gas or Keeyask/small tie alternatives versus the all gas plan as there is with the Preferred Development Plan.

The main non-monetized issues concern the environmental and social impacts of the projects in the different plans. The assessment does not indicate that there would be major residual effects or trade-offs to consider given the extensive monitoring, mitigation and other measures that are planned, but this will be addressed in detail in the environmental hearings the projects require.

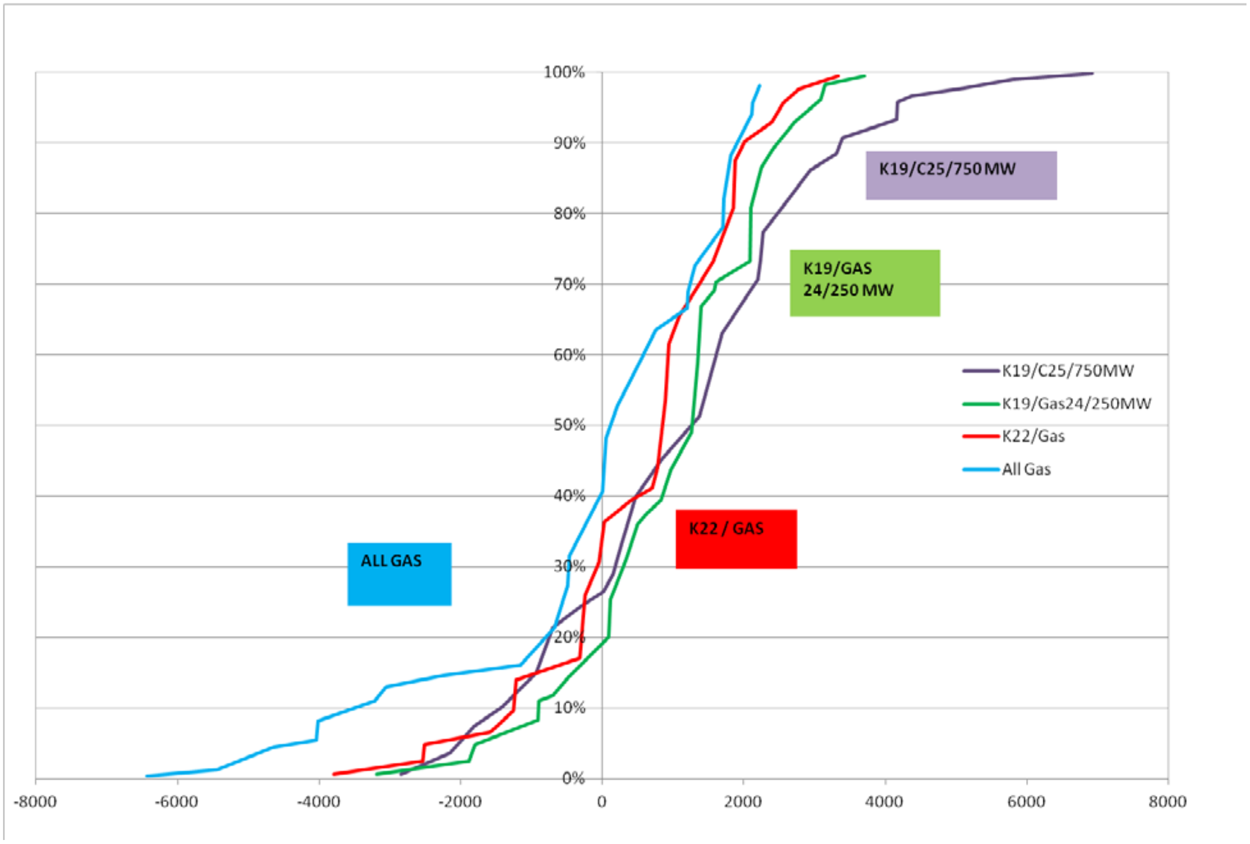
13.3.8 Uncertainty and Risk

The benefits and costs estimated with Manitoba Hydro's reference scenario set of assumptions indicate that the development of Keeyask G.S. offers significant advantages over gas; that the development of Keeyask G.S. is more advantageous with a new interconnection and firm sales than without; and that the Preferred Development Plan, which includes the development of Conawapa G.S. and a large new interconnection, is the best overall from a broad provincial perspective over the long term.

However, there is uncertainty in the reference scenario assumptions and therefore in the consequences of the different plans for Manitoba Hydro revenues and expenditures and customer rates. It is not just the consequences of the Preferred Development Plan, but rather of all the plans that are subject to considerable uncertainty. The question thus arises, does the uncertainty favour some plans over others – is there a risk trade-off that could change the relative advantage of the different plans based on the reference scenario analysis.

To address this question, the revenue and expenditure and consequent rate implications of the different plans were analyzed under a wide range of assumptions. With probabilities attached to the different underlying assumptions, probability distributions of the range of outcomes were calculated. In Figure 13.11 the probability distribution of the net present values of the preferred and alternative plans are shown. They are presented as “S-curves” which show the cumulative probability values. A given point on the curve indicates there is a percentage value (from the y-axis) chance that the net present value (calculated relative to the all gas reference scenario result) will be less than or equal to the corresponding amount of the x-axis.

Figure 13.11 MANITOBA HYDRO NET REVENUE S-CURVES



2014 PRESENT VALUE IN MILLIONS OF 2014$

The curves show that there is a wide range of outcomes for all of the plans. However there are differences. Manitoba Hydro's Preferred Development Plan would appear to offer the greatest upside potential. The all gas plan, on the other hand, exhibits the greatest downside risk. With respect to the Preferred Development Plan versus the alternative with the smaller interconnection there is a trade-off. There is a 50% chance the small-interconnection alternative would be better than the Preferred Development Plan and it generally has less downside risk. The Preferred Development Plan however has an equal chance of being better with greater upside potential.

The S-curves shown in Figure 13.11 are based on set development plans. In the all gas case, for example, the plan assumes a continuation of gas plant development even in scenarios where gas and energy prices rise above what is currently expected. In the Preferred Development Plan Conawapa G.S. is developed for 2025 even if low market prices or high interest rates would favour delaying the in-service date. As discussed in the next chapter, each development plan represents a pathway which preserves some flexibility to make changes depending on unfolding events. And that flexibility can serve to mitigate certain downside risks.

For example, some of the downside risk of the all gas plan can be mitigated by shifting back to hydro or other sources if fuel and carbon prices rise to the point where gas-fired thermal is clearly uneconomic. Similarly, up until the commitment date for Conawapa G.S., some of the downside risk of the Preferred Development Plan can be mitigated by deferring development expenditures should it become apparent that project development would not be economic with the currently planned early in-service date.

With these mitigation opportunities, the differences in the extent of the downside risk greatly diminish. The all gas plan could become gas followed by Keeyask G.S. or Conawapa G.S. as opposed to Keeyask G.S. followed by gas. The Preferred Development Plan could be Keeyask G.S. without Conawapa G.S. or Keeyask G.S. with Conawapa G.S. at a later date.

What differentiates the plans is not so much the extent of the downside risk due to unfolding future events, but what is retained or foregone by the initial decisions. The all gas alternative retains the opportunity to have a no hydro future, but it foregoes the benefit and upside potential with the early development of Keeyask G.S., and in particular the development of Keeyask G.S. with the current export and interconnection opportunity. As for Keeyask G.S.

without a new interconnection, it foregoes the expected benefit and potential upside from the current export and interconnection opportunity. And as for the Keeyask G.S. with a small tie, it foregoes the benefit and potential upside of the larger sales and early development of Conawapa G.S.

Overall, there is little reason to reconsider the broad conclusions concerning the relative long term (net present value) advantage of the different plans suggested by the reference scenario analysis. The plan with Keeyask G.S. is better from an expected and risk point of view to the all gas plan, and the plans with a new interconnection are better than the ones without.

As with the reference scenario findings, the rate implications in the short to medium term versus long term are a different matter. Figure 13.12 shows the probable range of the projected cumulative rate impacts of the different plans after 20 years; Figure 13.13 the probable range of the projected cumulative rate increases over 50 years.

The rate impact ranges in these figures reinforce the short to medium term rate versus long term trade-off identified in the reference scenario analysis. Over the long term (by year 50) the rate impact with the Preferred Development Plan is lower with a narrower band of uncertainty than the others, but the opposite is true in the short to medium term. The rate impact with the Preferred Development Plan is cumulatively greater and more uncertain than the others.

These projected rate impact figures are based on the set development plans as opposed to the pathways they represent. Cumulative rates with the pathways would show narrower ranges for all of the plans. However, the general pattern and short to medium term versus long-term trade-off would remain much the same.

Figure 13.12 **PROJECTED MANITOBA HYDRO CUMULATIVE NOMINAL RATE INCREASES TO 2031/32**

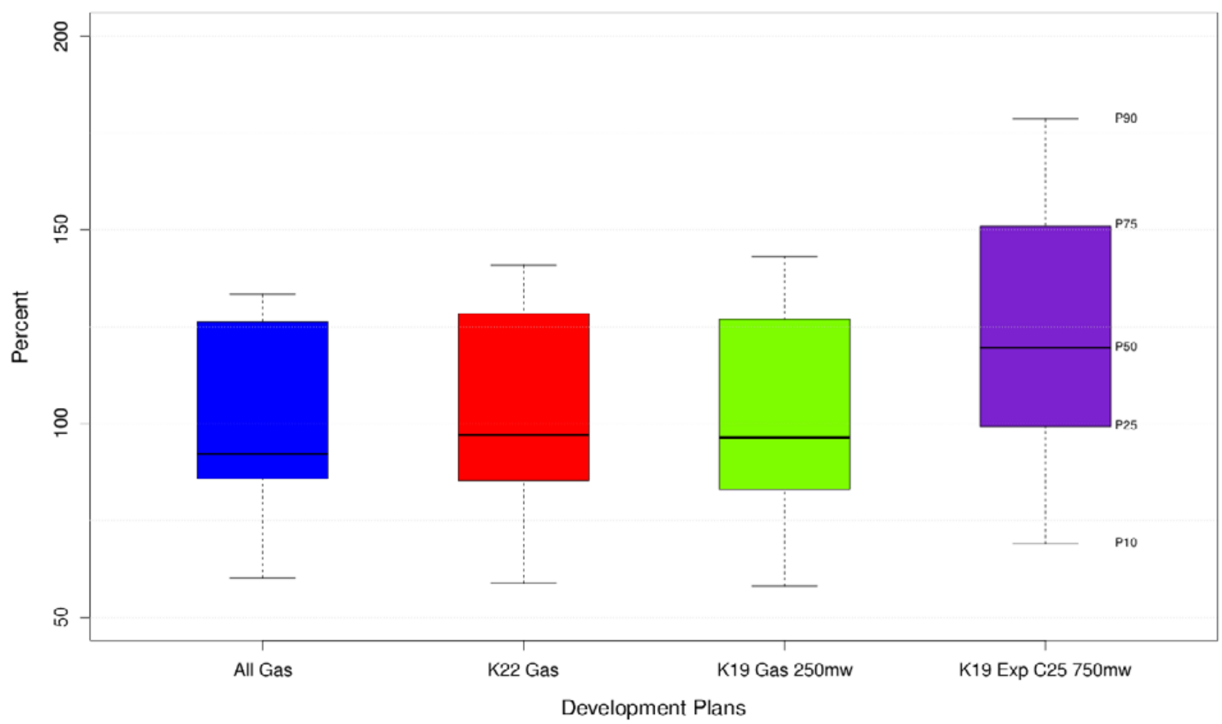
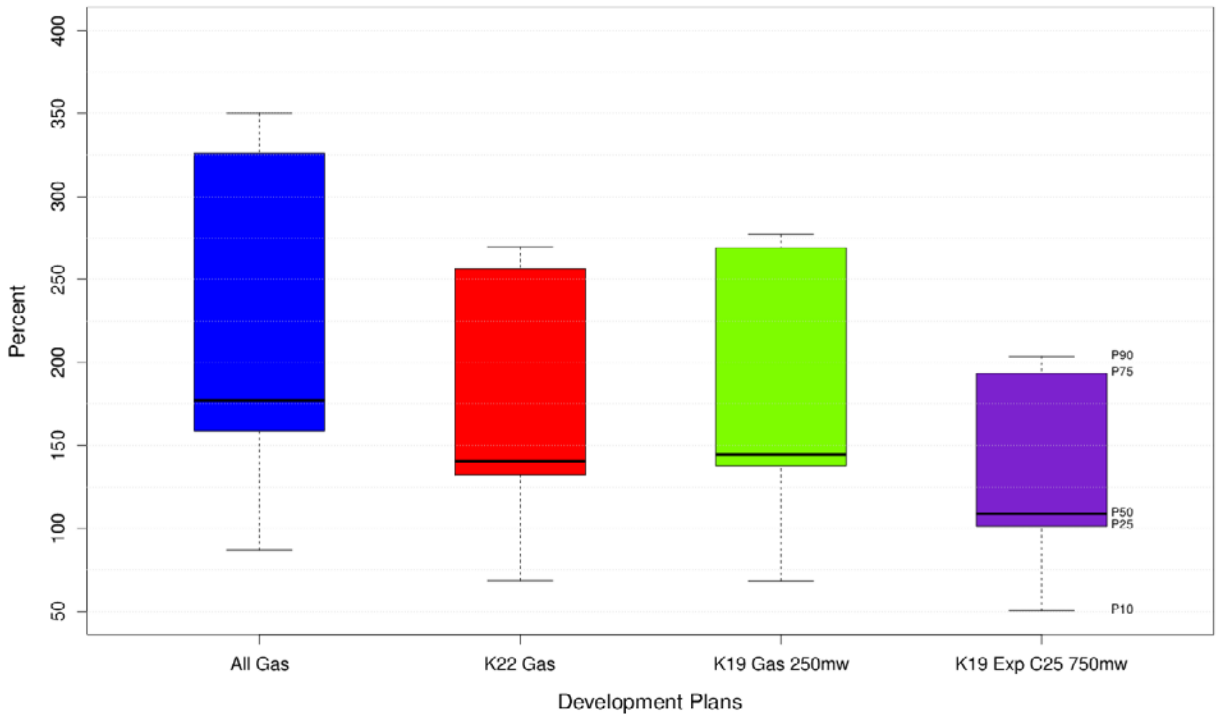


Figure 13.13 PROJECTED MANITOBA CONSUMERS CUMULATIVE NOMINAL RATE INCREASES TO 2061/62



13.4 Conclusions

The purpose of a multiple account benefit-cost assessment is not so much to determine which of a set of alternatives is best, but rather to identify their advantages or disadvantages and the key trade-offs from a broad social or public interest perspective.

This multiple account benefit-cost assessment of Manitoba Hydro's Preferred Development Plan and alternative plans with and without Keeyask G.S. and with and without a new interconnection and firm sales with the U.S. indicate that there are key trade-offs that require careful consideration, most notably between a strictly Manitoba Hydro and broader social perspective and between customers in the short to medium versus long term.

The main findings are as follows:

- Developing Keeyask G.S. to meet domestic load offers significant net benefits relative to the all gas plan not only for Manitoba Hydro but also more broadly to society as a whole; developing Keeyask G.S. offers significant tax, employment, GHG and social benefits that go beyond the benefits to Manitoba Hydro and its partners.
- Plans that include a new interconnection offer significant net benefits compared to those that do not include a new interconnection. These plans significantly enhance the net benefits for Manitoba Hydro and its partners.
- The alternative with the 250 MW interconnection and the development of Keeyask G.S. but not Conawapa G.S. offers similar expected net benefit to Manitoba Hydro and its partners as the Preferred Development Plan, without the short to medium term rate trade-off that the Preferred Development Plan gives rise to. At the same time this alternative with a smaller interconnection and Keeyask G.S. only does not offer the same long-term legacy value or upside potential as the Preferred Development Plan. Nor does it offer the same long term rate, customer reliability, tax, employment, GHG and social benefits as the Preferred Development Plan.
- The Preferred Development Plan offers the lowest projected rate impacts for the long term and significantly greater benefits to society as a whole than the smaller interconnection alternative. It does, however, require higher projected rate increases in the short to medium term than the other plans. The more weight one places on the broader public interest consequences and the longer-term effects, the more one would favour this plan.