



Site C Inquiry:

Submission #2 to the BC Utilities Commission

August 2017

Dr. Karen Bakker

Program on Water Governance, University of British Columbia

www.watergovernance.ca

This is the second submission, prepared in August 2017, by the University of British Columbia's Program on Water Governance for the BC Utilities Commission Inquiry Respecting Site C.

The Program on Water Governance (www.watergovernance.ca) is co-hosted by UBC's Department for Geography and Institute for Resources, Environment, and Sustainability. Dr. Karen Bakker, Professor and Canada Research Chair at the University of British Columbia, is the Co-Director of the Program.

The Program on Water Governance previously published five reports on Site C, which are available online (watergovernance.ca/projects/sitec/). Two of these reports were previously submitted to the BCUC Site C Inquiry ("*Reassessing the Need for Site C*" (April 2017) and "*Comparative Analysis of Greenhouse Gas Emissions of Site C versus Alternatives*" (July 2016)).

This submission includes an entirely new expert report that provides updated economic analysis designed to respond to the five questions raised by the BCUC:

- a. whether the project is on time and within budget;
- b. the cost to ratepayers of suspending the project, resuming construction by F2024;
- c. the cost to ratepayers of terminating the project;
- d. what portfolio of generating projects and demand-side management initiatives could provide similar benefits; and
- e. what are expected peak capacity demand and energy demand.

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The authors are solely responsible for the report's contents. The report does not reflect the views of the University of British Columbia or of the funder.

Sincerely,

Dr. Karen Bakker





Submission to the British Columbia Utilities Commission regarding the Site C Hydroelectric Project

Philip Raphals

Richard Hendriks

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EXECUTIVE SUMMARY

The purpose of this Report is to provide the BC Utilities Commission with information relevant to its Inquiry into the Site C Project.

This report updates the analysis provided in *Reassessing the Need for Site C*, a report on economic aspects of Site C, published in April 2017 by this report's authors together with Dr. Karen Bakker, of the Program on Water Governance at UBC.

Our analysis

We analyze whether it would be economically preferable to a) complete, b) cancel or c) suspend the Site C Project. We examine these three options in the context of mid-, high- and low-load forecasts of future electricity requirements based on BC Hydro's July 2016 forecast. We consider additional cost-effective demand-side management, including capacity-focused DSM, the use of energy and capacity from the Canadian Entitlement under the Columbia River Treaty, and the advancement of low-carbon energy storage to meet additional capacity requirements.

We examine energy and capacity balances for each year over a 20-year planning period and calculate the present value of the year-by-year costs for resources that are added to the base case, net of revenues from export of surplus energy and capacity. Our model operates under the constraints imposed by the *Clean Energy Act*, including those related to achieving self-sufficiency and to generating at least 93% of the electricity in British Columbia from clean or renewable resources. Our analysis treats as sunk all costs through December 31, 2017, and considers that cancelling or suspending the Site C Project will entail additional construction cancellation, demobilization, and suspension costs.

Our findings

1) In an appendix to its 2016 Revenue Requirements Application, BC Hydro presented a 10-Year Capital Forecast, dated July 2016, showing year-by-year capital expenditures for Site C through F2025 totalling \$7.618 billion, which when added to the \$593 million in the Site C deferral account at the end of F2024, totals \$8.211 billion. Adding financing costs at BC Hydro's nominal discount rate of 7% to the annual balances of the capital expenditures results in a capital cost of \$9.986 billion. Adding the deferral account (\$593 million by F2024) results in a total capital cost estimate of \$10.579 billion, which is greater than the \$8.335 billion announced at project launch.

2) Based on these same figures, we find the capital account at December 31, 2017 to be \$2.395 billion, and the amount required to complete the Site C Project from that date to be \$7.225 billion.

3) Our analysis indicates that cancelling the Site C Project as of December 31, 2017 compared to continuing to completion would save between \$269 and \$447 million, depending on future conditions. Suspending the Site C Project compared to continuing to completion would save between \$146 million and \$498 million. Suspending the Site C Project is preferable to cancelling it by \$188 million under the mid-load scenario and by

\$51 million under the high load scenario, but cancellation is preferable to suspension by \$220 million in the low load scenario.

3) Under a low load scenario, additional demand-side management, including capacity-focused demand-side management is adequate to meet energy and capacity needs to the end of the planning period. No additional supply-side resources are required.

The analysis summarized above was conducted without taking the Canadian Entitlement from the Columbia Treaty into account. Our report further analyzes the cost implications of the Canadian entitlement. Our finding in this regard is as follows:

4) Reliance on 50% of the annual energy and capacity from the Canadian Entitlement when Site C is cancelled would increase savings to \$610 million in the mid load scenario and \$790 million in the high load scenario. Similarly, if Site C is suspended, reliance on 50% of the Canadian Entitlement would reduce costs by \$400 million in the mid load scenario and \$880 million in the high load scenario.

Our recommendation

The findings of our analysis with respect to the value of the Canadian Entitlement under the Columbia River Treaty lead us to formulate an explicit recommendation: **that the Commission recommend that the Government enact a regulation allowing BC Hydro to take its entitlement under the Columbia River Treaty into account in its energy and capacity planning.** Doing so will result in much lower resource costs to ratepayers, in both a mid-load and high-load scenario.

ABOUT THE AUTHORS

Philip Raphals is cofounder and executive director of the Helios Centre, a non-profit energy research and consulting group based in Montreal. Over the last 25 years, he has written extensively on issues related to hydropower and competitive energy markets, and has appeared many times as an expert witness before energy and environmental regulators in several provinces. He appeared as an expert witness on behalf of the Treaty 8 Tribal Association before the Joint Review Panel charged with the environmental assessment of the Site C Hydroelectric Project in 2014.

Richard Hendriks is the director of Camerado Energy Consulting, an Ontario-based firm providing environmental assessment, energy planning, policy analysis, and research services to clients across Canada. For the past two decades, he has been engaged in the planning and assessment of several large-scale hydroelectric developments, and provided testimony before regulatory bodies concerning their economic viability, environmental effects, socio-economic impacts and implications for Indigenous rights.

Together with Prof. Karen Bakker of the University of British Columbia, MM. Raphals and Hendriks were the authors of “Reassessing the Need for Site C”, a study published by the UBC Programme on Water Governance in April 2017.

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1 Introduction and Summary

In April 2017, we published, together with Prof. Karen Bakker, a report on economic aspects of Site C (*Reassessing the Need for Site C*). The report (referred to herein as “Reassessing the Need”) was commissioned and published by the Program on Water Governance at the University of British Columbia.

The *Reassessing the Need* report considered the factors that led to the construction of the Site C Project, the factors that have changed since it was approved, and the relative costs to ratepayers of the following options:

- complete the Site C Project as scheduled;
- cancel the Site C Project and develop alternative resources as needed; or
- suspend the Site C Project and develop alternative resources as needed, leaving open the possibility of restarting construction if circumstances warrant.

These three options correspond with items b), c) and d) of the questions asked by the BCUC in its Site C Inquiry, namely:

- a. whether the project is on time and within budget;
- b. the cost to ratepayers of suspending the project, resuming construction by F2024;
- c. the cost to ratepayers of terminating the project;
- d. what portfolio of generating projects and demand-side management initiatives could provide similar benefits; and
- e. what are expected peak capacity demand and energy demand.¹

In order to conduct our analysis, we also engaged with questions a) and e), because the five questions noted above are all closely interrelated. Question e), regarding forecast capacity and energy demand over a 20-year horizon, defines the needs to be met by various portfolios of generating projects and demand-side management initiatives (Question d). The comparative costs of these portfolios — including those based on continuing, suspending or terminating the Site C project — determine the cost to ratepayers of each of these options (Questions b and c). And of course, the estimated final cost of the project (Question a) is a key input into that comparison.

Below, we respond to the five questions posed by the BCUC in an order that reflects the structure of our report. Unless otherwise stated, the data sources are from publicly available reports (including BC Hydro’s 2013 Integrated Resource Plan (IRP) as well as its 2016 Revenue Requirements Application (RRA)).

Question (a): Is the Project on time and within budget?

¹ BCUC. August 9, 2017. Order G-120-17.

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To the best of our knowledge, BC Hydro has not presented a detailed analysis of the capital cost of the Site C Project that includes financing costs during construction.

The RRA included a briefing document prepared by Corporate Finance for the Board of Directors dated July 2016, which shows year-by-year capital expenditures for Site C, through F2025.² The total capital costs add up to \$7.618 billion. When added to the \$593 million in the Site C deferral account at the end of F2024,³ equals a capital cost of \$8.211 billion.

If this interpretation is correct, it is necessary to add financing costs to determine the then-current estimate of the capital cost of the Site C Project. Applying BC Hydro's nominal discount rate of 7% to the annual balances of the capital expenditures account results in a capital cost of \$9.986 billion. This rate reflects the corporation's weighted average cost of capital (WACC), including both equity and debt components, as is standard practice for large capital projects. Adding the deferral account (\$593 million by F2024) results in a total capital cost estimate of \$10.6 billion, far more than the \$8.335 billion announced at project launch.

Table 1. Capital costs of the Site C Project

Fiscal	Capital	AFUDC	Cumulative	Deferral account	Total
Year	Expenditure	7%	Capital	Balance	Capital
			Cost		Cost
2015	25		25	419	863
2016	489	2	516	436	969
2017	743	36	1,295	453	1,765
2018	717	91	2,102	472	2,593
2019	829	147	3,079	491	3,589
2020	1,258	216	4,552	511	5,083
2021	1,136	319	6,007	531	6,558
2022	1,020	420	7,447	551	8,018
2023	833	521	8,802	572	9,395
2024	568	616	9,986	593	10,600

A similar calculation, including only amounts which will be spent after January 1, 2018 results in future costs of \$7.099 billion, as shown in Table 2.⁴

² BC Hydro. July 28, 2016. Fiscal 2017 – Fiscal 2019 Revenue Requirements Application ["RRA"] - 10 Year Capital Forecast.

³ RRA, p.7-6.

⁴ This calculation includes 25% of the capital expenditures scheduled for F2018.

Table 2. Capital expenditures required to complete Site C Project

Fiscal	Capital	AFUDC	Cumulative	Deferral account		Total
Year	Expenditures	7%	Capital	Incremental	Cumulative	Capital
			Cost			Cost
2018	179	0	179	5	5	184
2019	829	13	1,021	19	24	1,045
2020	1,258	71	2,350	20	44	2,394
2021	1,136	165	3,651	20	64	3,715
2022	1,020	256	4,926	20	84	5,010
2023	833	345	6,104	21	105	6,209
2024	568	427	7,099	21	126	7,225

Adding the additional costs of \$126 million that will accrue in the deferral account starting in 2018 results in a total of **\$7.225 billion** to complete the Site C Project. We will use this amount in the scenario analysis presented herein.

For its deferral accounts, the Commission applies a Weighted Average Cost of Debt, rather than a Weighted Average Cost of Capital (presumably equal to the discount rate). In recent years, the WACD has varied around 4%.⁵ Using a WACD would reduce the amounts required to complete the Site C Project to \$6.648 billion (including the deferral account). In our view, the WACC is a more appropriate rate for a major capital project like Site C, but if the Commission indicates otherwise in its Preliminary Report, we will update our analysis based on that determination.

It should also be noted that this briefing document mentions that it is issued annually, implying that there is a more recent version (July 2017) that, to the best of our knowledge, has not been made public.

Question (e): What are expected peak capacity demand and energy demand?

In *Reassessing the Need*, in section 3.2 (pages 14 to 27), we carried out a retrospective analysis of BC Hydro's past load forecasts. We found that, over the last 20 years, the utility has overestimated demand far more often than it has underestimated it.⁶ This suggests that BC Hydro's load forecasts should be regarded critically.

That said, critical review of a utility load forecast is a painstaking process, unlikely to be completed within the very short timeframe available for this Inquiry. As we are not aware of any reliable alternative to BC Hydro's most recent load forecasts, we have relied on

⁵ RRA, p.7-49

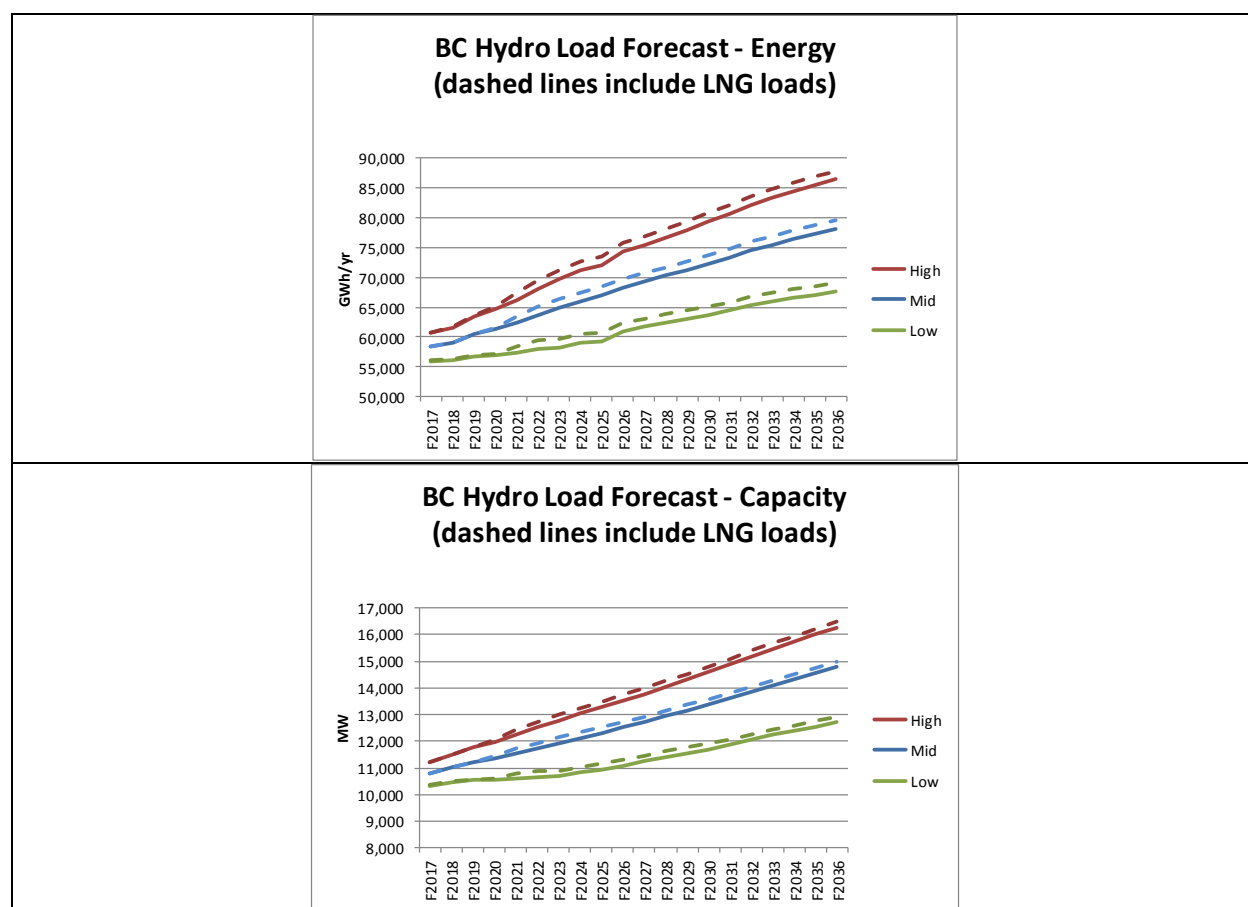
⁶ Since the release of *Reassessing the Need*, BC Hydro issued errata to its past load forecasts (see BC Hydro. April 28, 2017. Fiscal 2017 – Fiscal 2019 Revenue Requirements Application, Revision to Attachment 1 to CEC IR 2.135.1). These errata do not materially alter the findings of *Reassessing the Need*.

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the load forecasts found in Tables 3-8 and 3-9 of the RRA, with one specific adjustment based on new information since the time of the forecast.⁷

BC Hydro — like most North American energy utilities — circumscribes the uncertainty in load forecasting by generating low, mid, and high forecasts of future demand. These forecasts form the foundation for the resource portfolios required to meet each forecast level of demand. For the period 2017-2036, we have relied on the load forecast data provided in the RRA. As BC Hydro did not provide explicit high and low load forecasts, we have derived values for them from the “large gap” and “small gap” figures provided in the RRA, as described below. These three load forecasts are shown in Figure 1, below.

Figure 1: BC Hydro load forecasts from the RRA⁸



⁷ The most important adjustment occurs with respect to anticipated LNG-related electricity demand. As explained in s. 3.1.1 below, it is now clear that the ambitious plans to develop a major liquefied natural gas industry in British Columbia within the current decade are unlikely to be realized. The LNG-related loads in the load forecast must therefore be moderated.

⁸ High and low scenarios derived from forecasts for large and small gap, respectively.

Question (d): What portfolio[s] of generating projects and demand-side management initiatives could provide similar benefits?

We understand the question to mean: “What portfolio[s] of generating projects and demand-side management initiatives could meet forecast energy and capacity requirements without the Site C Project, at a present value cost equal to or lower than that of the reference case including Site C?”

The question is complex. First, the question must be answered separately for the mid, low and high scenarios. While BC Hydro’s planning, like that of most utilities, is based on its mid load forecast, other scenarios can also occur, leading to very different sets of portfolios for meeting energy and capacity requirements.

Second, in our view, BC Hydro’s set of potential resources is not entirely adequate with respect to four areas: traditional or “energy-focused” demand-side management (DSM), capacity-focused DSM, including “demand response”, the Canadian Entitlement under the Columbia River Treaty, and energy storage.

- **Energy-focused DSM:** Under BC Hydro’s current DSM plan, annual incremental savings decline drastically later in the planning period. As explained below, we propose an alternate DSM forecast, inspired by the language of the BC *Clean Energy Act*, whereby 50% of load growth from 2017 through 2036 would be met through demand-side measures.

The DSM plan in the RRA (Table 3-9) in fact does meet 52% of energy load growth and 48% of capacity load growth with DSM until F2024. However, this percentage falls to 29% of energy load growth and 22% of capacity load growth by F2036. In effect, our alternate DSM forecast simply extends current levels of DSM savings through the end of the planning period.

- **Capacity-focused DSM:** In its 2013 IRP, BC Hydro did not forecast any capacity savings from capacity-focused DSM, though it did identify a substantial potential and acknowledged that pilot programs were underway. BC Hydro now acknowledges that capacity-focused DSM constitutes: “a critical investment and part of a cost-effective portfolio”.⁹ As described below, we have conservatively included a gradually increasing amount of capacity-focused DSM in our scenarios.
- **The Canadian Entitlement:** Under the Columbia River Treaty (CRT), Canada receives around 1,300 MW and 4,000 GWh/year of energy (the “Canadian Entitlement”), which is generally sold directly into American power markets. Under the self-sufficiency requirement set out in s. 6(2) of the *Clean Energy Act*, which requires that BC Hydro plan to meet all energy needs with in-province generation, BC Hydro may not use the Canadian Entitlement in its long-term planning. However, the Lieutenant Governor in Council could authorize an exemption from this constraint.

A further concern is that discussions are underway with the United States

⁹ RRA. Final Submissions of BC Hydro, p.180.

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concerning the eventual modification of the CRT. It is very unlikely that the Treaty would be abrogated, but it is conceivable that the Canadian Entitlement could be materially reduced. Given these circumstances, we recommend including 50% of the current energy and capacity levels of the Canadian Entitlement in considering future resource needs. The scenario analysis presented herein includes scenarios both with and without the Canadian Entitlement.

- **Energy storage:** Electricity storage technologies are undergoing rapid technological improvements and declines in cost. Based on our review, of literature and discussions with industry participants, we believe it is reasonable to assume that non-hydro energy storage can make a significant contribution to meeting BC Hydro's future capacity needs.

Based on our modelling, described below, and these modifications to the universe of available resources, the portfolios required to meet energy and capacity needs without Site C under each load scenario are as follows.

Mid load scenario

Under the mid-load scenario, if the government authorizes reliance on the Canadian Entitlement for planning purposes, no capacity resources other than Revelstoke 6 are required (Scenario B1-CE).¹⁰ To meet energy requirements, about 1,000 GWh of additional wind energy (or other renewable resources) would be required starting in F2034.

If reliance on the Canadian Entitlement is not allowed (Scenario B1), then 110 MW of energy storage or other peaking resources would be required starting in F2027. In addition, 1,000 GWh of additional wind energy (or other renewable resources) would be required in F2030, increasing to 3,000 GWh by F2034.

High load scenario

Under the high load scenario, Revelstoke 6 should be advanced to F2022. If the government authorizes reliance on the Canadian Entitlement for planning purposes (Scenario B2-CE), no other capacity resources are required. To meet energy requirements, substantial amounts of additional wind energy (or other renewable resources) would be required, starting with 1400 GWh in F2026 and rising to 6,000 GWh by F2034.

If reliance on the Canadian Entitlement is not allowed (Scenario B2), then the requirements for new wind energy (or other renewables) start in F2023, reaching 3,300

¹⁰ Scenarios are named according to the resource strategy (A = Complete Site C by F2024; B = Cancel Site C Project; C = Suspend Site C Project until F2030) and the load scenario (1 = mid; 2 = high; 3 = low). The suffix "CE" refers to scenarios in which reliance on the Canadian Entitlement is permitted.

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GWh in F2026 and 5,400 GWh in F2030. In addition, 280 MW of energy storage or other peaking resources would be required starting in F2021.¹¹

Low load scenario

Under the low load scenario (Scenario B3), no additional capacity or energy resources would be required through F2036.

Question (b): What is the cost to ratepayers of suspending the project and resuming construction in F2024?

This question has two distinct aspects: the direct costs related to suspension, and the net costs and benefits resulting from such a suspension.

Direct costs

Based on the capital expenditure data presented in Table 1, we calculate that the expenditures through December 31, 2017, including financing costs (AFUDC), will amount to \$1.942 billion.

If construction were suspended from the end of this year until F2024, additional financing costs would be incurred on this amount, based on applying BC Hydro's nominal discount rate (WACC) of 7% for six years, or \$972 million.

In addition, there would be some demobilization costs, including:

- Removing equipment, personnel and materials from the site;
- Securing quarries and borrow areas and allowing them to flood in accordance with permit conditions;
- Stabilizing any rock or overburden stockpiles in accordance with permit conditions;
- Removing any fuels, chemicals and explosives from the site; and
- Securing mechanical, hydraulic and electrical systems.

We do not have detailed information concerning these costs, and anticipate that BC Hydro will provide the Commission with additional information in its evidentiary filing. For the analysis undertaken herein, we have included an amount of \$50 million, which is less than the costs of full demobilization (required under the cancellation scenario), plus \$200 million for remobilization.

There would also be ongoing costs to maintain the site in suspension, such as:

- Securing the site from visitors for protection of the public through the provision of fencing or other measures;
- Maintaining the site in a secure condition through provision of continuous security;

¹¹ We do not attempt to choose between the various storage technologies available (Li-ion batteries, flow batteries, pumped storage, etc.).

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- Periodically inspecting any rock or overburden stockpiles;
- Securing and maintaining all facilities to remain on-site during suspension; and
- Continuing with environmental monitoring programs in accordance with permit conditions.

There are not currently, nor have there been recently, any large-scale hydroelectric projects under suspension in Canada. We tentatively estimate these costs at around \$15 million a year, based on reported suspension costs of a large potash mine in New Brunswick.¹² Adding the financing costs, this suggests that the additional costs resulting from suspension would be on the order of \$120 to \$140 million per year, over seven (7) years. In our modelling of this option, we have assumed that these costs will be capitalized and recovered after commissioning. We anticipate that BC Hydro will provide the Commission with additional information concerning the costs of suspension in its evidentiary filing.

Net costs and benefits

To complete the analysis of the cost to ratepayers of suspending the project, we must also take into account the corresponding benefit to ratepayers, insofar as suspending the project would result in decreased cost of service to ratepayers. That is, if, despite these additional direct costs, suspension results in decreasing the present value of the resources required to meet energy and capacity demands over the long term, then suspension would result in a **net benefit to ratepayers**.

The scenarios described below take all these factors into account. As we shall see, in most cases, **project suspension compared to completion of the project as scheduled results in a net benefit to ratepayers**.

Question (c): What is the cost to ratepayers of cancelling the project?

Once again, there are two aspects to the question.

Direct costs

In addition to the sunk costs of \$2.395 billion as of December 31, 2017, project cancellation would also entail other costs and penalties, as well as complete demobilization and site restoration costs. In *Reassessing the Need*, we estimated these cancellation costs to be \$750 million, including complete demobilization and site regeneration. We anticipate that BC Hydro will provide the Commission with additional information concerning the costs of cancellation in its evidentiary filing.

Cancelling the project would result in writing off the sunk costs and incurring the cancellation costs, which would all ultimately have to be borne by ratepayers (or in part, under certain circumstances, by taxpayers).

Should the Commission conclude that this amount is to be recovered from ratepayers, it will then face the thorny question of the appropriate basis for that recovery. The sunk

¹² Potash Corp. January 19, 2016. News Release: PotashCorp to Suspend New Brunswick Potash Operations. "The Picadilly mine will be placed in care-and-maintenance mode at an estimated annual cost of \$20 million in 2016 and \$15 million in subsequent years." (Available at: <http://www.potashcorp.com/news/2112/>)

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costs would presumably be transferred to a deferral account, to be recovered over time. The shorter the recovery time period, the greater the annual cost to ratepayers.

We suggest that, for the purposes of this Inquiry, the deferral account be amortized on the same terms as the Site C Project (70 years). To do otherwise would in effect create an uneven playing field, artificially favouring project completion over cancellation. In our view, the economic aspects of this decision should be made without regard to the financing mechanisms that will eventually be put in place.

For our modelling, we treat the costs incurred to date as sunk, and have thus excluded them from the analysis, since they are common to all scenarios. For the scenarios based on completing Site C by F2024, we take into account only the cost of completing the project. For the scenarios based on suspending the Project, this amount is increased by the suspension costs described above. For cancellation, they are replaced by the cancellation costs, estimated at \$750 million.

Net costs and benefits

Again, to complete the analysis of the cost to ratepayers of cancelling the project, we must also take into account the corresponding benefit to ratepayers, insofar as cancelling the project results in decreased cost of service to ratepayers. That is, if, despite these additional direct costs, cancellation results in decreasing the present value of the resources required to meet energy and capacity demands over the long term, then cancellation would result in a net benefit to ratepayers.

The scenarios described below take all these factors into account. As we shall see, in most cases, **project cancellation compared to completion of the project as scheduled results in a net benefit to ratepayers.**

2 The Analytical Model

The model used to generate the results presented in this report grew out of a model developed as part of expert testimony provided in 2014 to the Joint Review Panel (JRP) for the Site C Project on behalf of the Treaty 8 Tribal Association.¹³ The model was refined in preparing *Reassessing the Need*, and has been further refined in preparing this report.

In each case, we followed the approach set out in BC Hydro's 2013 IRP for comparing resource portfolios, in which the present value costs (net of revenues) of different resource portfolios are compared, on an apples-to-apples basis.

An Excel-based model was developed to examine energy and capacity balances for each year over a 20-year planning period, designed to mimic to a certain extent the System Optimizer program used by BC Hydro, which is described in the 2013 IRP.¹⁴

For each year, the model's inputs include:

- available supply (energy and capacity) from existing resources;
- estimates of energy and capacity savings from energy- and capacity-focused DSM; and
- forecast requirements (energy and capacity), including capacity reserves.

Based on these inputs, amounts of additional energy and capacity required for each year are calculated.

Given these requirements, scenarios are prepared based on different resource strategies. For each resulting portfolio — again following the method used in the IRP — the annual costs of the additional resources required ("incremental resources") are determined in constant 2016 Canadian dollars. These costs are broken down into capacity costs (including fixed costs of new capital resources), energy costs (including costs of new clean resources purchased under a PPA, market purchases, natural gas costs for incremental gas resources (if included), export revenues and additional DSM costs above the base case. The present value of this stream of annual costs and revenues is calculated, and the resource choices are optimized to meet requirements (within the selected resource strategy) at the lowest present value cost.

The model also operates under the constraints imposed by the *Clean Energy Act*, including those related to achieving self-sufficiency and to generating at least 93% of the electricity in British Columbia from clean or renewable resources.¹⁵ The analyses are conducted in real 2016 Canadian dollars for the period F2017 through F2036.

Thus, the model calculates the present value of the year-by-year costs for resources that are added to the base case, net of revenues from export of surplus energy and capacity. Costs of elements that remain unchanged from the base case scenario are not

¹³ Raphals, P. November 25, 2013. Need for, Purpose of, and Alternatives to the Site C Hydroelectric Project. (Available at: <http://www.ceaa-acee.gc.ca/050/documents/p63919/96613E.pdf>)

¹⁴ BC Hydro. November 2013. Integrated Resource Plan ["IRP"]. Chapter 4 – Resource Planning Analysis Framework, p. 4-60

¹⁵ The *Clean Energy Act* obligation to meet 66% of load growth through DSM is of little relevance, since it is inoperative after 2020. However, the variant described below has a similar, though smaller, effect.

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included in the analysis. Thus, the costs reported below in relation to the various scenarios are only meaningful in comparison to one another, not in absolute terms.

2.1 Approach

Carrying out a study of the comparative costs of different resource portfolios involves several steps. First, a reference case is developed for each load scenario. Then, alternate resource portfolios are prepared to meet each of those load scenarios. Finally, the incremental costs of the alternate portfolios are compared on a present value basis.

These steps are described in greater detail in the following subsections. The following table summarises the assumptions used in our modelling.

Table 3. Modeling assumptions

Variable	Alternatives	Description
Load forecast	<ul style="list-style-type: none">MidHighLow	Mid load forecast from RRA. Low and high load forecasts derived from the small gap ¹⁶ and large gap ¹⁷ scenarios in the RRA. The high-load forecast scenario encompasses the potential for additional electricity requirements resulting from low-carbon electrification. ¹⁸
Energy-focused DSM	<ul style="list-style-type: none">2016 RRA DSM Plan50% of load growth	Scenarios including the Site C Project in F2024 reflect BC Hydro's DSM Plan as stated in the RRA. Other scenarios assume that 50% of load growth from 2017 on will be met through DSM.
Capacity-focused DSM	<ul style="list-style-type: none">Starting in F2024Starting in F2018	Following the recent Climate Leadership Plan, moderate capacity-focused DSM (30 MW in F2018, increasing by 30 MW/year to 570 MW in F2036) at a cost of \$50/kW-year, is included in all scenarios, except the reference scenario, where it starts in F2024
Site C Project	<ul style="list-style-type: none">Complete by F2024Suspend to F2030Cancel	Complete by F2024: cost to complete, ignoring sunk costs of \$2.395 billion Suspend to F2030: cost to complete, plus financing costs for six years, plus demobilization costs of \$50 million, site maintenance costs of \$15 million per year, and remobilization costs of \$200 million Cancel: cancellation costs of \$750 million
Revelstoke 6	<ul style="list-style-type: none">All scenarios	Commissioned in order to minimize net present value costs of each scenario, but not prior to F2022.
Storage	<ul style="list-style-type: none">None in reference scenario	When required to meet capacity shortfalls after F2024.
Simple cycle gas turbines	<ul style="list-style-type: none">Only in the reference scenario	In the reference scenario, capacity factor of 18% as per IRP.

¹⁶ RRA, p. 3-37. The Small Gap Scenario is one with the least need for new resources. It reflects a low-load forecast combined with low DSM delivery.

¹⁷ RRA, p. 3-37. The Large Gap Scenario is the one with the greatest need for new resources reflecting a high-load forecast also combined with lower DSM delivery.

¹⁸ The high load scenario reflects additional electricity requirements comparable to the electrification scenario based on medium GHG prices and medium natural gas prices, as set out in the IRP.

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Market reliance	▪ All scenarios	Short-term reliance of up to 400 MW of capacity and 500 GWh/year of energy, consistent with the approach taken by BC Hydro in the 2013 IRP.
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2.1.1 Reference case

The first step is to prepare a detailed reference case (“business as usual”) scenario. Generally, this is based on the mid load forecast, in accordance with regulation under the *Clean Energy Act*.¹⁹ In the present situation, the reference case also includes completing the Site C Project by F2024, as well as BC Hydro’s current and planned IPP commitments, its Standing Offer Program and its currently planned DSM programs.

This reference case details energy and capacity requirements and available resources for each year in the 20-year planning period. Any deficits will be met by imports (to the extent feasible and allowed by law), and any surpluses are presumed to be exported at forecast market prices.

Since the reference case will ultimately be compared to other portfolios on an economic basis, it is also necessary to define the costs of the various resources to be added during the planning period, as well as the value of exported capacity and energy. Following BC Hydro’s practice in the IRP,²⁰ costs that are common among all portfolios are ignored.

A reference case also needs to be prepared for the high load and the low load scenarios. If future load growth follows a different trajectory, requirements will change and the utility’s resource options and choices over the next 20 years will change as well. A given strategy might be optimal for the high scenario and uneconomic for the low scenario, or vice versa.

The complexities of planning under uncertainty have been explored in great detail by the Northwest Power Planning Council (NPPC), most recently in its 7th Power Plan.²¹ Like many utilities, BC Hydro plans primarily for the mid load scenario, but also addresses the high load scenario as part of its contingency resource plan.²²

While the IRP does include low load scenarios in Appendix 6A,²³ they are not explicitly detailed in the Plan itself. This is a significant oversight, as BC Hydro’s analysis in the IRP demonstrated a substantial cost disadvantage for portfolios based on the low load forecast which included the Site C Project.²⁴

2.1.2 Alternate resource portfolios

¹⁹ *Electricity Self-Sufficiency Regulation*, BC Reg 315/2010.

²⁰ IRP, Chapter 6 – Resource Planning Analysis, p. 6-149.

²¹ Northwest Power and Conservation Council. February 2016. Seventh Northwest Conservation and Electric Power Plan, Chapter 3 Resource Strategy.

²² IRP, Chapter 6 – Resource Planning Analysis, p. 6-139.

²³ IRP, Appendix 6A – Portfolio Results.

²⁴ IRP, Appendix 6A – Portfolio Results, p. 6-37.

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Once the fully worked-out reference case has been defined for a given load growth scenario, alternate resource plans must be defined. Each of these alternate resource plans must of course provide “similar benefits” (as per the language of the Order-in-Council); that is, each one must provide for meeting BC Hydro’s energy and capacity requirements in each year, while respecting reliability standards as well as regulatory requirements and policy objectives, including those related to greenhouse gas emissions.

The choice of comparative resource portfolios should take several factors into account. Given the context in which the study is being carried out, it must include the three scenarios for the Site C Project: completion as scheduled, suspension, or cancellation. Comparative resource portfolios may also include other modifications, based on perceived shortcomings in the reference scenario.

To develop resource portfolios, BC Hydro relies on a software package called System Optimizer to choose the least-cost combination of resources for each load forecast scenario. As seen in the detailed results provided in Appendix 6A of the IRP, these include individual clean energy projects, as well as generic thermal projects (when allowed under the portfolio definitions), which together meet the scenario requirements at least cost. An example of the resource stack for one scenario from Appendix 6A is provided below.

Figure 2: Sample resource stack from a portfolio from Appendix 6A of the IRP

Resources Selected								
Year	Zone	Resource	Capacity - MW		Energy - GWh		UEC / UCC	
			Installed	Dependable	Firm	Total	\$/MWh or \$/kW-year	
2025	BCH_PR	Site C	1100	1,100	5,100	5,100	79	
2029	BCH_PR	GMS Units 1-5 Cap Increase	220	220			35	
2030	BCH_REV	Revelstoke Unit 6	500	488	26	26	50	
2032	BCH_LM	Pumped_Storage_LM	1000	1,000			126	
2034	BCH_PR	Wind_PC28	153	40	591	591	111	
2034	BCH_LM	MSW2_LM	25	24	208	208	92	
2035	BCH_PR	Wind_PC19	117	30	441	441	113	
2035	BCH_PR	Wind_PC21	99	26	371	371	112	
2036	BCH_PR	Wind_PC16	99	26	377	377	116	
2037	BCH_PR	Wind_PC13	135	35	541	541	113	
2037	BCH_VI	MSW1_VI	12	12	100	100	127	
2038	BCH_VI	Biomass_VI	30	30	239	239	142	
2038	BCH_LM	Biomass_LM	30	30	239	239	143	
2039	BCH_PR	Wind_PC14	144	37	527	527	117	
2040	BCH_PR	Wind_PC10	297	77	1,023	1,023	118	
2040	BCH_PR	Wind_PC41	45	12	155	155	122	

Our model is unable to duplicate this degree of sophistication. Instead, we have assumed that each type of resource is available, based on an average energy (and, when appropriate, capacity) cost. For non-hydro resources, these are assumed to be modular, and hence available in the required amounts. In those scenarios where the Canadian Entitlement has been included, it has been treated as a block of energy and capacity. A combination of algorithms and manual fine-tuning is used to ensure that resources are selected for each scenario that meet energy and capacity needs for each year, and at least cost.

2.1.3 Comparison of present value costs

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Using the processes described above, our model describes, for each year under each portfolio, the combination of supply- and demand-side resources that contribute to meeting energy and capacity requirements, and the incremental cost (compared to the reference case) of doing so. In years when surplus power and energy is produced, its value on the export market is netted against these costs.

Thus, each portfolio includes a 20-year stream of incremental costs and revenues. The present value of that stream is calculated, using BC Hydro's discount rate. The present value costs of alternate resource strategies can thus be compared, on an apples-to-apples basis.

Such a comparison is of course only valid for portfolios responding to the same conditions, including forecasts of load growth, market prices, exchange rates, etc.

2.1.4 Recent developments

One important factor has changed since the *Reassessing the Need* report was completed in April 2017: the prospect for LNG-related loads.

Most notably, the Petronas LNG Project has been cancelled because of changes in LNG market conditions. These changed market conditions also have implications for development of other LNG export facilities.

In our view, the most likely scenario is that no LNG facilities other than expansion at the Tilbury LNG plant and the Woodfibre plant will be developed in the foreseeable future. As a result, LNG loads in the load forecast should be scaled back from the level found in the RRA (360 MW and 2848 GWh/yr) to the requirements of these two plants (203 MW and 1439 GWh/yr). The expected load from LNG is discussed further below in section 3.1.1.

Furthermore, we presume that this BCUC Inquiry will result in more reliable data with respect to certain costs and resources that we could only estimate here. Insofar as additional information becomes available during this process, we intend to update our findings in our final submission in October.

2.2 Challenges

Carrying out this type of exercise involves many challenges. When a utility makes a comparison of this type, as BC Hydro did in its IRP,²⁵ it has access to its full data library as well as to sophisticated computational tools. In our case, we have worked with data that has been made public by the utility and our own Excel-based model.

2.2.1 BC Hydro's data

For the first iteration of this work, during the environmental assessment process, we relied on the draft and final versions of BC Hydro's 2013 IRP.

As time has passed, these data have become progressively more outdated. In *Reassessing the Need*, we relied on the updated data released during the 2016 RRA

²⁵ The method is described in the IRP, specifically in Chapter 4 – Resource Planning Analysis Framework. The detailed results are found in Appendix 6A.

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process before the BCUC. This has to a certain extent been a moving target, as each round of responses to Information Requests has included relevant new data.

This approach has a second difficulty as well. The data in the IRP were presented over a 20-year planning horizon, and our model is also based on a 20-year horizon. However, the RRA proceeding is focussed on the near term, and many of the data presented therein only covered shorter periods. In some cases, we therefore had to find a way to extend these data to the full 2017-2036 planning period. In some cases, we relied on the original IRP data, modified according to a trendline derived from the RRA. Our solutions to these specific challenges are described below in Appendix A.

Given that the BCUC enjoys the cooperation of BC Hydro in this Inquiry, we presume that it can request the data updates it requires. In order to assist in this process, we have formulated a number of recommended Information Requests, in order to assemble the data required for a full analysis.

2.2.2 Resource characteristics and costs

As noted above, it is not feasible, without access to dedicated software tools like System Optimizer, to develop an optimized list of specific resources and commissioning dates for each scenario. Instead, we used generic resources and generic costs.²⁶

Thus, for incremental clean resources, we have made the simplifying assumption that they will all be wind projects, and that they can be sized to meet energy requirements. We have determined a levelized unit energy cost for on-shore wind of \$80/MWh, as discussed in *Reassessing the Need*,²⁷ and have utilized BC Hydro's average capacity factor of 32.75%,²⁸ and effective load carrying capability of 26% of installed capacity.²⁹

Energy costs for gas used by SCGTs is calculated based on the natural gas price forecasts in the 2013 IRP. The model relies on the levelized resource unit capacity costs (UCCs) determined by BC Hydro for capacity resources (\$84/kW-year for SCGTs plus energy costs).³⁰

Energy and capacity from the Canadian Entitlement under the Columbia River Treaty, discussed further below in section 3.3, is assumed to be available at the energy export price.

Energy export prices are based on BC Hydro's Mid-C forecast, exchange rates and methodology.³¹ BC Hydro uses a value of \$100/kW-year for capacity market purchases, and attributes capacity sales revenues of \$37/kW-year for surplus capacity, based on

²⁶ There is one exception: hydropower projects identified in the IRP were modelled as discrete projects, each with its own cost.

²⁷ *Reassessing the Need*, pp. 91-94

²⁸ IRP, Table 3-1.

²⁹ Ibid.

³⁰ RRA to Information Request BCSEA 1.15.1. \$79/kW-year adjusted for delivery to the Lower Mainland, presuming 6% losses, with energy costs added separately to reflect actual energy production.

³¹ RRA, Response to Information Request BCUC 2.310.1. See also Appendix A to this report.

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market research from 2012.³² However we do not find this value to be credible at this time, given the very large reserve margins currently observed in the Pacific Northwest.

Figure 3: Northwest Power Pool Capacity Reserves

NWPP: Case 1 – Existing/Class 1 Resources Summer	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Internal Demand	68,126	69,111	70,193	71,090	71,771	72,399	73,041	73,928	74,805	74,957
Anticipated Internal Capacity	87,000	87,422	90,083	90,890	90,846	90,796	91,114	90,808	89,776	89,128
Wind Expected On-Peak MW	3,435	3,724	4,445	4,446	4,447	4,448	4,449	4,479	4,480	4,481
Percentage of Capacity	25.2%	25.1%	25.9%	25.9%	25.9%	25.9%	25.9%	25.9%	25.9%	25.9%
Solar Expected On-Peak MW	540	547	554	555	557	558	560	562	563	565
Percentage of Capacity	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.9%	19.9%	19.9%
Hydro Expected On-Peak MW	35,251	35,278	35,329	35,379	35,284	35,288	35,293	36,197	36,610	36,614
Percentage of Capacity	66.9%	66.7%	66.4%	66.4%	66.2%	66.2%	66.1%	66.4%	66.5%	66.5%
Imports	7,340	7,665	7,893	8,149	8,435	8,700	8,854	9,102	9,516	9,177
Exports	3,673	2,159	1,522	995	949	897	729	1,287	2,521	2,490
Anticipated Resource Reserve Margin MW	8,519	7,806	9,220	8,994	8,165	7,392	6,970	5,642	3,600	2,777
Anticipated Resource Reserve Margin %	27.7%	26.5%	28.3%	27.9%	26.6%	25.4%	24.7%	22.8%	20.0%	18.9%

NWPP: Case 1 – Existing/Class 1 Resources Winter	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Internal Demand	71,071	71,945	72,844	73,504	74,122	75,069	75,722	76,308	76,994	77,374
Anticipated Internal Capacity	88,752	89,866	90,412	90,470	90,753	91,065	91,475	91,471	90,634	90,575
Wind Expected On-Peak MW	3,006	3,515	3,865	3,867	3,869	3,870	3,872	3,881	3,882	3,884
Percentage of Capacity	21.5%	23.4%	22.5%	22.5%	22.5%	22.5%	22.5%	22.4%	22.4%	22.4%
Solar Expected On-Peak MW	0	0	0	0	0	0	0	0	0	0
Percentage of Capacity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydro Expected On-Peak MW	34,358	34,379	34,400	34,488	34,382	34,386	34,392	35,385	35,838	35,841
Percentage of Capacity	65.1%	64.8%	64.6%	64.7%	64.5%	64.4%	64.4%	64.9%	65.1%	65.1%
Imports	6,760	6,700	6,800	6,766	7,517	8,188	8,598	8,694	8,966	9,419
Exports	1,700	0	0	0	0	0	0	100	993	1,161
Anticipated Resource Reserve Margin MW	5,812	5,906	5,403	4,690	4,252	3,459	3,107	2,419	782	279
Anticipated Resource Reserve Margin %	24.9%	24.9%	24.1%	23.1%	22.4%	21.3%	20.8%	19.9%	17.7%	17.1%

For purposes of this modelling exercise, we have used a value of \$10/kW-year for sales of surplus capacity.

2.2.3 Site C Project characteristics and costs

Capital costs

The budgeted capital cost of the Site C Project stands at \$8.335 billion, not including a \$440 million Treasury reserve.³³

As noted above, assuming financing costs during construction (AFUDC) at BC Hydro's WACC of 7% (nominal), we estimate the Project's total capital costs to be the much higher figure of \$10.6 billion.

Based on these figures, we calculate that the amount spent by December 31, 2017 will be approximately \$2.395 billion, including financing costs. As noted above, in this

³² RRA, Response to Information Request BCSEA 1.15.1.

³³ RRA, p. 6-120.

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analysis we have excluded sunk costs from the comparative cost calculations. Treating this amount as sunk, the remaining cost to complete the Project would be \$7.225 billion.

Thus, for the scenarios based on completing the Site C Project by F2024, we have calculated an annual payment based on the \$7.225 billion remaining to be spent, amortized over 70 years at a 7% nominal discount rate. This results in annual payments of \$510 million nominal dollars, starting with commissioning in F2024.

For scenarios based on suspending the Site C Project until F2024, implying a commissioning date of F2030, we have used the same approach, but increased the capital cost by the carrying costs over six years for the \$2.395 billion spent to date, again calculated at a nominal interest rate of 7%.

For scenarios based on cancelling the Site C Project, we have assumed that the cancellation costs, estimated at \$750 million, would be recovered in the same way, but with the payments of \$53 million per year (in nominal dollars) beginning immediately.

Greenhouse gas costs

In a previous study, we explored in detail the expected GHG emissions of the Site C Project.³⁴ Figure 4 presents BC Hydro's "likely" and "conservative" estimates of annual greenhouse gas emissions that the Site C Project would produce, where emissions prior to F2024 reflect construction-related emissions and emissions following F2024 indicate operating emissions. Figure 5 presents the cumulative GHG emissions of the Site C Project over the first forty years of operations.

Figure 4: Annual GHG emissions of the Site C Project³⁵

³⁴ Hendriks, R.M. July 2016. Comparative Analysis of Greenhouse Gas Emissions of Site C versus Alternatives. (Available at: <http://watergovernance.ca/projects/sitec/>)

³⁵ BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Volume 2 Appendix S: Site C Clean Energy Project: Greenhouse Gases Technical Report. Prepared for BC Hydro by Stantec Consulting Ltd., Table C-4 and Table C-6. (Available at: <http://www.ceaa-acee.gc.ca/050/document-eng.cfm?document=85328>)

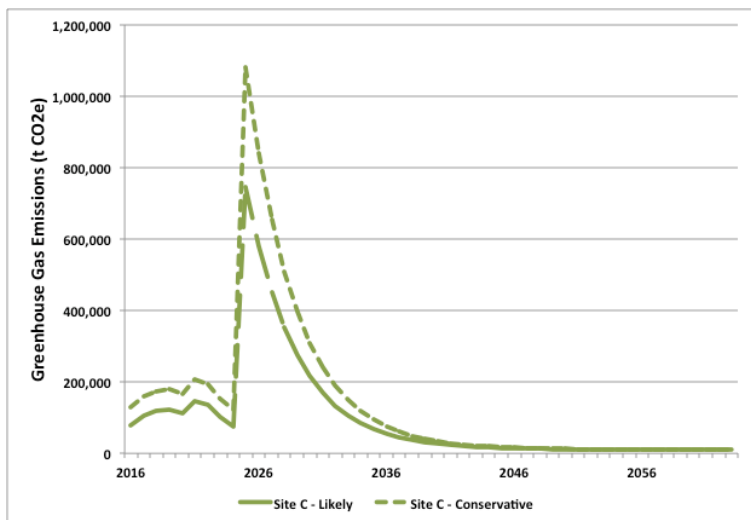
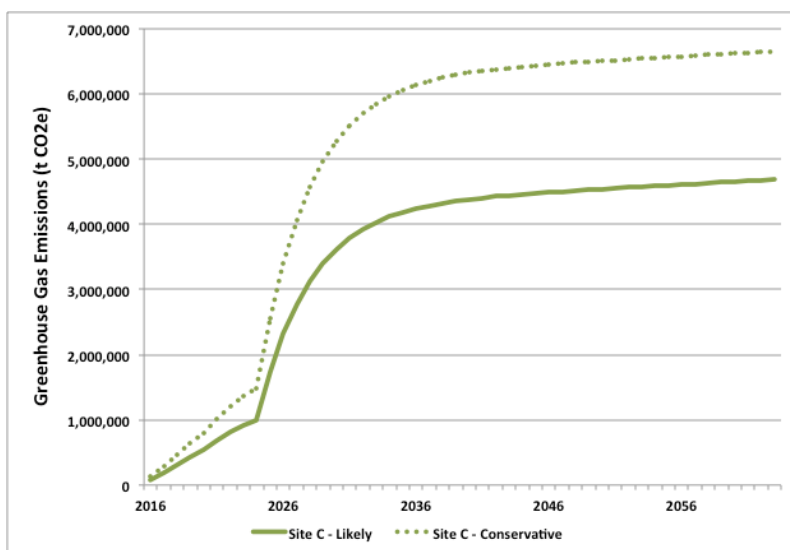


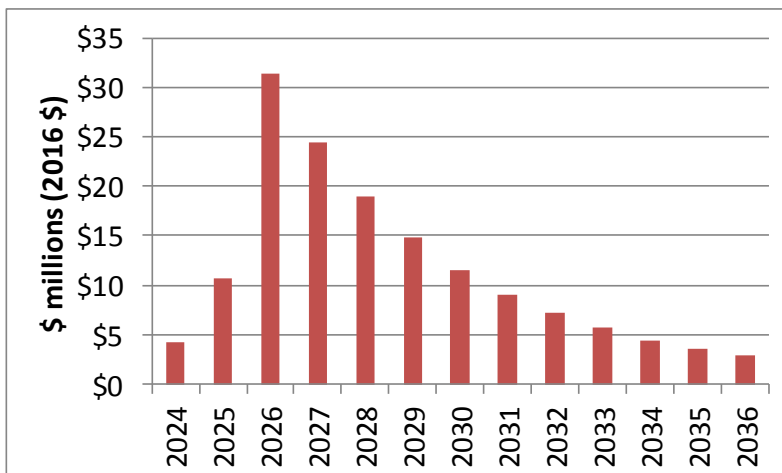
Figure 5: Cumulative GHG emissions of the Site C Project³⁶



The cost of construction phase GHG emissions are implicitly included in the construction costs of the Site C Project to the extent that the existing carbon tax of \$30/tonne of GHG emissions applies to fuel, materials and equipment. However, GHG emissions from the operations phase were not included in the cost estimate. Using this same price of \$30/tonne (2016 \$), we estimate the cost associated with GHG emissions from the Site C reservoir to be as indicated in Figure 6. These costs are included in the scenarios described below.

Figure 6: Costs associated with GHG emissions of the Site C Project

³⁶ *Ibid.*



2.2.4 Energy and capacity availability

The energy from the Site C Project is presumed to be available in accordance with the load resource balance presented in the RRA,³⁷ with 550 MW of capacity available in F2025 and the full 1100 MW by F2026. A small amount of energy (388 GWh) from Site C is available in F2024, 87% of full output in F2025, and full output starting in F2026.

³⁷ RRA, Table 3-8.

3 Current Issues

In this section, we explore in greater depth the modifications we have proposed to the resource strategy found in BC Hydro's reference case (RRA).

3.1 Future electricity needs

3.1.1 Liquefied natural gas

The Terms of Reference for the Site C Inquiry require that:

the commission must use the forecast of peak capacity demand and energy demand submitted in July 2016 as part of the authority's Revenue Requirements Application, and must require the authority to report on

- (i) developments since that forecast was prepared that will impact demand in the short, medium and longer terms, and
- (ii) other factors that could reasonably be expected to influence demand from the expected case toward the high load or the low load case; [emphasis added]

A critical review of BC Hydro's load forecast cannot be completed within the very short timeframe available for this Inquiry. In our modelling, we have relied on the load forecasts found in Tables 3-8 and 3-9 of the RRA, with one noted exception: LNG loads.

The RRA states:

The LNG sector faces uncertainty with regard to possible future load. FortisBC Energy Inc. is currently constructing an expansion of its all-electric Tilbury Island LNG facility. Further expansion at Tilbury is possible, but will depend on market conditions. Two other potential LNG projects, LNG Canada and Woodfibre LNG, are currently expected to take service from BC Hydro. If all of these three LNG developments move forward, the resulting demand will be close to the 3,000 GWh/year of expected total LNG demand included in the 2013 Integrated Resource Plan and the 2013 10 Year Rates Plan. However, as timelines for LNG final investment decisions have been delayed, BC Hydro expects less revenue from LNG customers during the 2013 10 Year Rates Plan period. BC Hydro's load forecast includes the announced loads and in-service dates for these three developments.³⁸

BC Hydro's approach is to include in the load forecast those facilities that have requested an electricity service agreement,³⁹ but this approach overlooks the possibility

³⁸ RRA, p.1-9

³⁹ RRA, p. 3-5.

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that not all of these LNG projects will necessarily be developed. Of these three potential LNG export projects, only Woodfibre LNG has made a final investment decision,⁴⁰ and even it has not yet executed an electricity supply agreement,⁴¹ nor secured binding LNG supply contracts.⁴² The potential energy and capacity requirements of these three LNG facilities are summarized in the table below.

Table 4: Potential LNG energy and capacity requirements

	Woodfibre LNG ⁴³	LNG Canada ⁴⁴	Tilbury Island LNG ⁴⁵
Non-compression load	Grid	Grid	Grid
Compression load	Grid	Self	Grid
Electricity service request	Yes	Yes	Yes
Capacity (MW)	185	150	18
Energy (GWh/year)	1,300	1,400	139
Final investment decision	Yes	No	No

There have been several material developments related to the potential for LNG exports since the load forecast included in the RRA. In a footnote to the above quotation, BC Hydro notes that on July 11, 2016 LNG Canada announced a delay in its final investment decision beyond December 2017, a consideration that has not been reflected in the load forecast since the impact is not yet known. This news was followed in March 2017 by Shell's cancellation of the Prince Rupert LNG Project.⁴⁶ Finally, on July 25, 2017, Petronas announced that it was cancelling its Pacific Northwest LNG project citing "changes in market conditions" and "the extremely challenging environment brought about by the prolonged depressed prices and shifts in the energy industry".⁴⁷

⁴⁰ Woodfibre LNG. November 2016. Parent Company Authorizes Woodfibre LNG to Proceed with Project. (Available at: <http://www.woodfibrelng.ca/parent-company-authorizes-woodfibre-lng-to-proceed-with-project/>)

⁴¹ RRA, Response to Information Request BCUC 1.73.

⁴² "Woodfibre announces major supply agreement with Chinese Gas Company" in Business in Vancouver, May 12, 2016. (Available at: <https://www.biv.com/article/2016/5/woodfibre-announces-major-supply-agreement-chinese/>.)

⁴³ Woodfibre LNG. 2015. Application for an Environmental Assessment Certificate, Comments #1401 – 1500, Table 15 of 17, p.59. (Available at <https://www.woodfibrelng.ca/wp-content/uploads/2017/02/Application-for-an-Amendment-to-Environmental-Assessment-Certificate-January-2017.pdf>). Energy estimated from reported "140-150MW of power under normal operating conditions and up to 185MW under peak loading".

⁴⁴ LNG Canada. 2013. Project Description: LNG Canada Project, p.18. (Available at: <http://www.ceaa.gc.ca/050/document-eng.cfm?document=87575>). Energy estimated from reported capacity.

⁴⁵ RRA, Response to BCUC IR No. 1.7.2. Capacity estimated from reported annual energy.

⁴⁶ "Shell ends development of Prince Rupert LNG project". (Available at: <http://www.cbc.ca/news/canada/british-columbia/shell-ends-development-of-prince-rupert-lng-project-1.4020820>.)

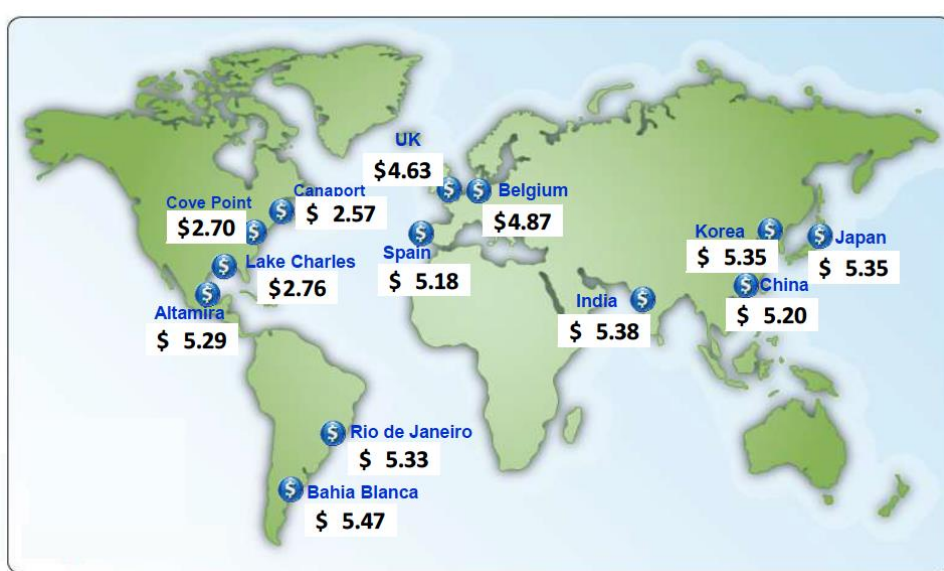
⁴⁷ Pacific Northwest LNG. July 25, 2017. "Pacific Northwest LNG Not Proceeding", available at: <http://www.pacificnorthwestlng.com/media/NewsRelease-Backgrounder-PNWLNG-July25-2017.pdf>.

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In July 2017, the National Energy Board released an updated assessment of the potential for future LNG exports from Canada.⁴⁸ The report does not assess individual projects currently proposed in BC, but addresses matters of global LNG supply, demand, pricing and trends, noting the advantages, challenges and uncertainties inherent to Canada's LNG industry. The key uncertainties include: future global natural gas and LNG contracting and pricing, the role of LNG in addressing global climate concerns in the coming decades, and the potential for cost overruns observed in other projects.⁴⁹

With respect to LNG pricing, the Federal Energy Regulatory Commission regularly issues world LNG estimated landed prices, as shown below.

Figure 7: World LNG estimated landed prices (US\$/MMBtu): July 2017⁵⁰



Several analyses have indicated that “break-even” natural gas prices for LNG exports from BC are in the range of US\$10/MMBtu to US\$12/MMBtu, ranging as low as US\$8/MMBtu to as high as \$16/MMBtu.^{51,52,53} Current global natural gas prices remain well below profitable levels for the development of LNG export projects in BC. A recent

⁴⁸ National Energy Board. July 2017. Canada's Role in the Global Energy Market.

⁴⁹ *Ibid.*, p.19.

⁵⁰ Federal Energy Regulatory Commission. August 2017. World LNG Estimated Landed Prices: July 2017. Available at: <https://www.ferc.gov/market-oversight/mkt-gas/overview/ngas-ovr-lng-wld-pr-est.pdf>.

⁵¹ Oxford Institute for Energy Studies. May 2015. Natural Gas in Canada: what are the options going forward? Available at: <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2015/05/NG-98.pdf>.

⁵² TD Economics. May 2014. Liquefied Natural Gas: The Next Leg of Canada's Energy Boom? Available at: <https://www.td.com/document/PDF/economics/special/LiquefiedNaturalGas.pdf>.

⁵³ Cedigaz. March 2015. Waiting for the Next Train? An Assessment of the Emerging Canadian LNG Industry. Available at: <http://www.cedigaz.org/documents/2015/Canada%20LNG%20%20Final.pdf>.

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analysis by Moody's Investor Service⁵⁴ suggests that LNG demand and prices will remain low until at least the early 2020s, suggesting the possibility (though not the certainty) of another opportunity in the middle of the next decade for the development of LNG export projects in BC. In addition, the current government of British Columbia has announced that development of LNG for export would come with four new "conditions."⁵⁵

For these reasons, BC Hydro's decision to include in its load forecast the demand of every proposed LNG export project that has requested electricity service does not properly reflect the many uncertainties facing the LNG industry in BC. The load forecast should be a reflection of expected future conditions, acknowledging the probabilities that projects may or may not proceed as planned, if at all.

For the purposes of our analysis, we have presumed that, for each of these three projects, there is about a 50% probability that it will proceed. As such, instead of BC Hydro's projections of 361 MW of capacity and 2,848 GWh/year of energy by F2024, we have assumed 203 MW of capacity and 1439 GWh/year of energy.

3.2 Alternative demand-side resources

3.2.1 Energy-focused DSM

In the event of suspension or cancellation of the Site C Project, it would be necessary to advance other resources in order to meet future requirements for energy or capacity. Additional investment in demand-side measures beyond that currently contemplated by BC Hydro could defer investment in higher-cost supply-side resources.

BC Hydro selected Option 2 as its DSM Target for use in the 2013 IRP, despite the fact that Option 3 represented (at that time) the "greatest level of DSM program savings currently considered deliverable".⁵⁶ The decision not to proceed with DSM Option 3 was the result of BC Hydro's ongoing energy surplus, and the utility's desire to reduce near-term costs. Indeed, BC Hydro recommended in the 2013 IRP to moderate (i.e. reduce) program spending for DSM Option 2 in the near term (F2014 through F2016), while maintaining (in BC Hydro's view) the ability to ramp up to the DSM Target seven years later, in F2021.⁵⁷

⁵⁴ Moody's Investor Service. February 2017. Global LNG prices to remain capped beyond 2020 on supply/demand imbalance. Available at https://www.moodys.com/research/Moodys-Global-LNG-prices-to-remain-capped-beyond-2020-on--PR_362435.

⁵⁵ Government of BC. July 18, 2017. Mandate letter to Michelle Mungall, Minister of Energy, Mines and Petroleum Resources. Available at: <http://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet/mlas/minister-letter/mungall-mandate.pdf> 1) provide express guarantees of jobs and training opportunities for British Columbians; 2) provide a fair return for our resource; 3) respect and make partners of First Nations; and 4) protect our air, land and water, including living up to our climate commitments.

⁵⁶ IRP, Chapter 4 Resource Planning Analysis Framework, p. 4-18.

⁵⁷ *Ibid.*, p. 4-22.

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In the RRA, BC Hydro confirmed that it is proposing to further extend the “moderation” of DSM program spending through F2017 – F2019,⁵⁸ with this moderation strategy extended as an assumption for F2020 and beyond, pending review as part of the 2018 IRP.⁵⁹ The effect of this moderation strategy is presented in the RRA in Table 3-8 (for energy) and Table 3-9 (for capacity) where incremental savings from planned DSM decline to zero by the end of the planning period.

Initially selecting DSM Option 3 would have provided more than 10,000 GWh/year of energy and more than 1,800 MW of capacity savings by F2024.⁶⁰ The decision in the 2013 IRP to proceed with DSM Option 2 reduced those savings to under 9000 GWh/year and 1600 MW.⁶¹ The decision to moderate DSM Option 2 during the F2014 to F2016 period reduced those savings further to 8400 GWh/year and less than 1500 MW,⁶² and now the proposal in the 2016 RRA to further moderate DSM would reduce those savings to about 6700 GWh/year and 1200 MW.⁶³

The cumulative effect of BC Hydro’s decisions to forego Option 3 and to moderate DSM during and following the 2013 IRP is more than 3,000 GWh/year and 600 MW by F2024. This represents more than 50% of the energy and capacity of the Site C Project.

In evaluating the long-term utility of its DSM programs, BC Hydro assumes that average DSM persistence is about 19 years,⁶⁴ depending on the program and the technology employed. At the end of this period, since the savings are no longer incremental to what would have otherwise occurred, they are removed from the DSM plan. However, following F2021, no new additional demand-side measures are contemplated to replace and improve upon existing measures. This situation is illustrated in

⁵⁸ RRA, p.3-34.

⁵⁹ *Ibid.*

⁶⁰ IRP, Figure 3-1 and Figure 3-2.

⁶¹ RRA, Response to Information Request BCUC 1.168.1.

⁶² RRA, Response to Information Request BCSEA 1.2.9.

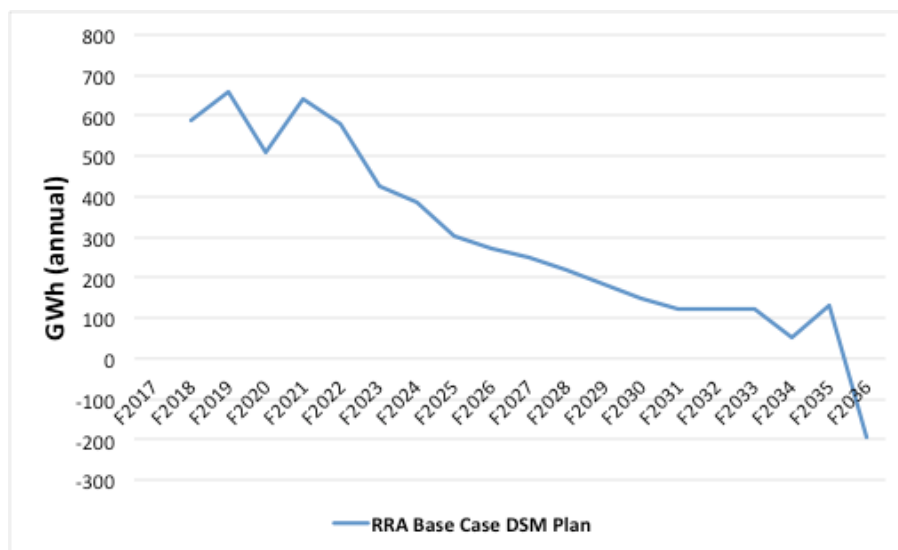
⁶³ RRA, Response to Information Request BCUC 1.168.1.

⁶⁴ RRA, Response to Information Request BCUC 1.170.1.

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Figure 8 derived from the RRA, where new DSM measures cease after F2021 and the additional energy savings from DSM decline by more than 40% by F2024 and to zero by F2036.

Figure 8: 2016 RRA DSM Plan – annual incremental energy⁶⁵



In our opinion, BC Hydro’s position that no new additional demand-side measures will be developed following F2021 to replace and improve upon existing measures is not credible. LED lights, time-of-use prices, load curtailment, programmable thermostats, community energy planning, micro-grids, real-time data analytics, smart meters, and direct load control are just a few of the many electricity management innovations of recent years. There is no reason to believe that the pace of innovation will slow down or cease following 2020. The following expert testimony before the Manitoba Public Utilities Board speaks to this issue:

The challenge of DSM for planning purposes, then, becomes the challenge of predicting innovations: we know they will happen, but we don’t know exactly how or how much. Yet the reverse is true too: we know that a static view – one in which future DSM savings are limited to the savings opportunities available today – is wholly inappropriate for a long-term planning horizon, much less one covering the coming 20 years.⁶⁶

The conclusion in the 2016 RRA that DSM will cease to make any new contributions to meeting BC Hydro’s needs beyond F2021, and any contributions at all beyond F2036, implies abandoning the *Clean Energy Act* Objective 2(b) without any public policy acknowledgement or debate.

⁶⁵ Derived from RRA, Table 3-8. Surprisingly, the table shows cumulative DSM declining from F2035 to F2036, implying negative incremental gains.

⁶⁶ Dunskey, P. et al. February 3, 2014. The Role and Value of Demand-side Management in Manitoba Hydro’s Resource Planning Process. Submitted to the Manitoba Public Utilities Board at the request of Consumers Association of Canada (Manitoba) and Green Action Centre, at p.35. (Accessed 17 April 2017 at: http://www.pubmanitoba.ca/v1/nfat/pdf/demand_side_management_dunskey.pdf)

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The *Clean Energy Act*, in section 2(b), sets what appeared at the time to be an ambitious objective of meeting 66% of BC Hydro's demand growth with DSM, until the year 2020 – but was silent about the longer-term future.

In its Reply Argument filed in response to the final arguments of interveners during the RRA, BC Hydro recognizes the benefits of a higher-level of DSM, including: increased bill savings, lowering BC Hydro's revenue requirement, increasing participation in DSM, and increased support for policy initiatives, including low-carbon electrification.⁶⁷

Despite these numerous and substantial benefits, BC Hydro determined that higher spending on additional DSM was “not in the interests of ratepayers” due to two factors:

- changing system needs (BC Hydro's Load Resource Balance showed a reduced need for additional resources than what was forecast in the 2013 Integrated Resource Plan); and
- the impact to the 2013 10 Year Rates Plan (pursuing the 2013 Integrated Resource Plan Alternative would result in a cumulative rate increase of approximately 2.7 per cent by the end of the fiscal 2024 period relative to the proposed DSM Plan).

Neither of these two factors constrains the Commission from determining during the Site C Inquiry that a higher level of DSM would be “in the interests of ratepayers”.

In the first instance, higher spending on additional DSM, despite the ongoing energy surplus, may be beneficial in the long-term despite the additional short-term costs. Specifically, this would be the case if such DSM spending defers or averts spending on higher cost supply-side resources, including Site C. It is worth recalling that the utility cost of DSM programs under BC Hydro's proposed revised DSM Plan is \$22/MWh.⁶⁸ These costs reflect the weighted average of many demand-side measures. They compare to the levelized cost of energy from the Site C Project of \$85 to \$88/MWh,⁶⁹ and BC Hydro's most recent estimate of the long-run marginal cost of energy from clean resources (i.e. wind) of \$100/MWh.⁷⁰

Secondly, the 10 Year Rates Plan is apparently no longer government policy. This was made clear in the mandate letter to the new Minister of Energy, Mines and Petroleum Resources, which directed the Minister to “[f]reeze B.C. Hydro rates while conducting a comprehensive review of the Crown corporation.”⁷¹ The Terms of Reference for the Site C Inquiry also make no mention of the 10 Year Rates Plan, indicating that it is no longer an active policy consideration.

In our modelling, we used the RRA data as the base case. However, this forecast implies that incremental DSM (additional savings from one year to the next) will

⁶⁷ RRA, Reply Submissions of BC Hydro, p.102.

⁶⁸ RRA, Response to Information Request BCSEA 1.25.4.

⁶⁹ Government of British Columbia and BC Hydro. “Site C to provide more than 100 years of affordable, reliable clean power”. Backgrounder: Comparing the Options. (Available at: <https://news.gov.bc.ca/stories/site-c-to-provide-more-than-100-years-of-affordable-reliable-clean-power>)

⁷⁰ RRA, p.3-46.

⁷¹ Government of BC. July 18, 2017. Mandate letter to Michelle Mungall, Minister of Energy, Mines and Petroleum Resources. (Available at: <http://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/mungall-mandate.pdf>)

plummet, reaching zero in 2035. For the alternative portfolios, we utilize an alternate DSM plan, inspired by the language of the *Clean Energy Act*, whereby 50% of energy load growth from 2017 through 2036 would be met through demand-side measures. Under the low load scenario, this would result in DSM savings similar to those in the reference case. Under the mid and high load scenarios, DSM savings would be substantially greater.

The DSM plan in the RRA in fact does meet 52% of energy load growth and 48% of capacity load growth with DSM until F2024; however, this percentage falls to 29% for energy and 22% for capacity by F2036.⁷² In effect, our alternate DSM forecast simply extends current levels of incremental DSM through the end of the planning period.

In the absence of a specific analysis of additional DSM costs, it is reasonable to conclude that the utility cost of a DSM plan that meets 50% of energy load growth to 2036 would be higher than BC Hydro's DSM plan, which meets only 29% of energy load growth. For modelling purposes, we have assumed that additional DSM bears a cost of \$33/MWh, or 50% higher than the average cost in the RRA's DSM Plan.

The additional energy savings through 2036 achieved by our alternate DSM plan under the mid load scenario amounts to 4,083 GWh/year.⁷³ Presuming the same ratio of capacity savings to energy savings as BC Hydro's DSM plan, additional capacity savings of 656 MW would result.

3.2.2 Capacity-focused DSM

Capacity-focused DSM refers to measures specifically designed to induce consumers to shift their electricity consumption away from peak periods. As a result of a forecast need for capacity resources in advance of energy resources, BC Hydro has paid increasing attention to DSM measures designed specifically to reduce capacity needs. Although the utility did not forecast any capacity savings from capacity-focused DSM in its 2013 IRP, BC Hydro identified two types of capacity-focused DSM (industrial load curtailment and capacity-focused programs, include demand response) with substantial potential, totalling 575 MW.⁷⁴

In its 2013 IRP, BC Hydro acknowledged that pilot programs were underway but did not forecast any capacity savings from capacity-focused DSM. Thus, the decision to launch the Site C Project was made based on a planning scenario that did not include any forecast reduction in capacity requirements due to capacity-focused DSM.

Since then, BC Hydro has revised its approach. In its closing comments to the 2016 RRA, BC Hydro acknowledges the numerous benefits of capacity-focused DSM, including smaller quantities with shorter lead times, deferring high cost supply-side resources, and benefits to customers in terms of reduced overall costs. However, there is still no capacity-focused DSM in the resource plan presented in the RRA. In all

⁷² RRA, Table 3-8.

⁷³ RRA, Reply Submissions of BC Hydro, p.102.

⁷⁴ IRP, Chapter 3 – Resource Options, p.3-22.

scenarios, we have assumed modest increases of 30 MW/year beginning in F2024 in the reference scenarios and beginning in F2018 in all other scenarios.

3.3 Alternative supply-side resources

3.3.1 Canadian Entitlement

BC Hydro's import capacity is 2000 MW from the US, and imports of 2000 MW are not uncommon.⁷⁵ In fact, in the past, BC Hydro has imported as much as 8,400 GWh in a single year, implying average imports of just under 1000 MW.⁷⁶ There is thus no technical obstacle to importing large amounts of power.

However, BC Hydro cannot plan on using these resources because of the self-sufficiency requirement set out in s. 6(2) of the *Clean Energy Act*, which requires that BC Hydro plan to meet all energy needs with in-province generation. This excludes not only energy purchases from the wholesale market, but also the Canadian Entitlement under the Columbia River Treaty.

The Canadian Entitlement varies from year to year. In F2014, it consisted of 1,330 MW of hydroelectric capacity and 4,425 GWh of energy. These amounts represent "half of the extra power capability at generation facilities in the U.S. that results from the improved water regulation made available by the Columbia River Treaty."⁷⁷ The Canadian Entitlement is owned by the Province of B.C. and is marketed on its behalf by Powerex at market prices. However, because the turbines generating the electricity are located in the United States, this energy is not produced by "generating facilities within the Province," as required under the *Clean Energy Act* self-sufficiency requirement. As a result, this hydropower, which reflects the contribution of reservoirs located in British Columbia to the hydropower produced on the Columbia River system, cannot be relied upon by BC Hydro for long-term planning purposes.

It should be noted that ss. 35(i) and 6(3) of *Clean Energy Act* do allow the government to authorize BC Hydro by regulation to enter into electricity import contracts otherwise barred under s. 6(2). Under Subsection 6(3), BC Hydro may be authorized by regulation to enter into contracts that do not meet this requirement.⁷⁸

In fact, in its 2013 IRP, BC Hydro announced that it would seek such a regulation to allow it to rely on market purchases of capacity from F2019 to F2023.⁷⁹

In its IRP process, BC Hydro assumed that the self-sufficiency criterion would remain unchanged throughout its planning period. The Site C environmental assessment Joint

⁷⁵ BC Hydro. Undated. Open Access Transmission Tariff Business Practice: TTC/ATC. (Available at: <https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/suppliers/transmission-scheduling/bulletins/2010/TTCATCFFebruary12011.pdf>)

⁷⁶ Government of British Columbia. June 2011. Review of BC Hydro, at p. 93. <https://news.gov.bc.ca/files/Newsroom/downloads/bchydroreview.pdf>

⁷⁷ BC Hydro. 2014. BC Hydro Annual Report 2014, p. 8. (Available at: <https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/accountability-reports/financial-reports/annual-reports/bc-hydro-annual-report-2014.pdf>)

⁷⁸ IRP, Chapter 9 – Recommended Actions, p. 9-39.

⁷⁹ *Ibid.*

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Review Panel faced a similar constraint. The Government of British Columbia, however, is not so constrained, given its executive power to allow exemptions to the self-sufficiency requirement.

The Joint Review Panel spoke only briefly of the self-sufficiency requirement. However, its comments raise questions as to whether or not this criterion is in the public interest of British Columbians:

Taken literally, this [self-sufficiency requirement of the CEA] means a B.C. disconnected to the outside world, a vision of autarchy truly strange for a province that relies on trade, and a long way from its recent history. (It could also explain the neglect of geothermal opportunities.)

Minor relaxations could mean being connected for reliability or for diversity exchange, which are current practices apparently not condoned by the regulation, or for multi-year balance, all of which seem consistent with the intent if not the drafting of the regulation. ...⁸⁰

In practice and in economic terms, the restriction **requires** BC Hydro to sell the power to which it is entitled, at market prices. This is **not** disconnection from the outside world, but rather a forced connection, requiring BC Hydro to sell off this power at rates far below its value were it used in British Columbia. Either way, the power is being generated on BC's behalf, in the US. The only question is what flows north: power or money.

The Industrial Energy Policy Review panel established in January 2013 raised the same issue in its Final Report:

As BC Hydro's surplus diminishes, Government should consider whether a requirement for self-sufficiency is consistent with a long-run approach to least cost electricity prices.⁸¹

The Government's formal response suggested that it is open to reviewing this restraint in the future:

BC Hydro is currently in surplus. While not under consideration at this time, this recommendation could be considered as energy forecasts change.⁸²

The self-sufficiency requirement was apparently designed in large part to make it impossible to circumvent BC's clean energy legislation by importing high-GHG power. The Canadian Entitlement, however, consists of hydropower, the environmental costs of

⁸⁰ Site C Joint Review Panel. May 2014. Report of the Joint Review Panel Site C Clean Energy Project BC Hydro, at pp. 304-305. In the same section, the JRP also questioned the current treatment of the Columbia River Treaty and the natural gas "headroom" policy, both of which constrain rational planning options.

⁸¹ IEPR Task Force. October 31, 2013. IEPR Task Force Final Report, at p.18. (Available at: http://www.newsroom.gov.bc.ca/downloads/Industrial_Electricity_Policy_Review_Task_Force_Final_Report.pdf)

⁸² Government of British Columbia. November 2013. Backgrounder: Industrial Electricity Policy Review Background Report. (Available at: http://www.newsroom.gov.bc.ca/downloads/Backgrounder_Industrial_Electricity_Policy_Review_Report.pdf)

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which are already borne by British Columbians. Adopting a regulation allowing the import of the Canadian Entitlement could not be seen as compromising BC's climate policies or its goal of energy self-sufficiency.

The consequences of the self-sufficiency criterion were evaluated in the Review of BC Hydro in 2011:

The panel recognizes that the economic and energy situations have changed, and that the existing self-sufficiency definition may be overly conservative and place an undue burden on ratepayers. The panel recommends that BC Hydro and the province evaluate alternative definitions and timelines for self-sufficiency that meet the needs of the province and ratepayers in a way that is sustainable for the long term.⁸³

To cast more light on this issue, we have prepared scenarios that assume that the Canadian Entitlement is exempted by regulation under the *Clean Energy Act* s. 6(3) from application of the self-sufficiency requirement. Given the uncertainties surrounding the renegotiation of the Columbia River Treaty, we have limited the Downstream Benefits in these scenarios to 50% of the energy and capacity currently available.⁸⁴

3.3.2 Storage

Due to recent advances in energy storage technologies, wide-scale energy storage deployment is taking place in numerous jurisdictions. This expansion is occurring at the utility, commercial and residential scales, as can be seen in Figure 9. The extent of future deployment will depend in part on policy and technology improvements, which will ultimately lead to lower costs and further deployments. The “experience rates” of new storage technologies continues on a downward cost trajectory with additional deployment.⁸⁵

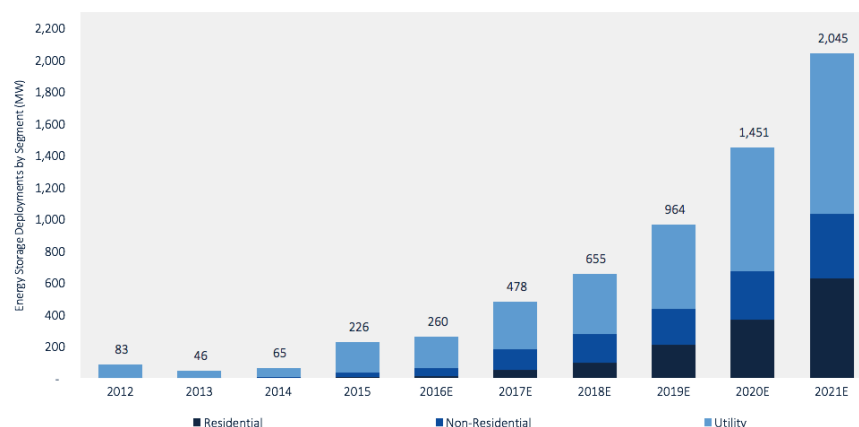
Figure 9: U.S. annual energy storage deployment to 2021⁸⁶

⁸³ Government of British Columbia. June 2011. Review of BC Hydro, at p.10.

⁸⁴ Given the importance of the Treaty to US system operations, it seems implausible that the Americans would simply abrogate the treaty. However, it is possible that the Downstream Benefits will be reduced. (See: U.S. Benefits from the Columbia River Treaty – Past, Present and Future: A Province of British Columbia Perspective, BC Ministry of Energy and Mines, June 25, 2013. <http://blog.gov.bc.ca/columbiarivertreaty/files/2012/07/US-Benefits-from-CRT-June-25-132.pdf>)

⁸⁵ O.Schmidt, A. Hawkes, A. Gambhir & I. Staffell. “The future cost of electrical energy storage based on experience rates” in *Nature Energy*. Article number: 17110 (2017).

⁸⁶ GTM Research. March 2017. U.S. Energy Storage Monitor. (Available at: <https://www.greentechmedia.com/research/report/us-energy-storage-monitor-q1-2017>)



This value proposition stems from the variety and scope of the services energy storage can provide to the transmission and distribution system and to customers (i.e. behind the meter). Here, we focused on the use of storage to meet capacity requirements of several hundred megawatts for at least 4 hours' duration. Specifically, we investigated the current and future evolution of lithium-ion batteries as a source of dependable low-carbon capacity for use by BC Hydro.

Lithium-ion batteries

Used first primarily in consumer products, lithium-ion batteries have been scaled up for use in electric vehicles and energy storage applications, at the utility, industrial and residential scales. Lithium-ion systems have relatively high energy density, low self-discharge and high charging efficiency, with an expected useful life of up to 10 years.⁸⁷

The benefits of lithium ion batteries as a peaking resource include the following:

- dispatchability – capable of dispatching and curtailing electricity production within seconds, providing reliability benefits while storing energy for future use
- dependability – capable of generating electricity on the grid during peak seasonal or daytime periods
- multiplicity – in addition to capacity, can support arbitrage, provide spinning reserve and non-spinning reserve
- integration – can improve grid performance and assist in the integration of renewables (e.g. wind and solar)
- modularity – can be developed on an as-required basis without the need to create large and costly capacity surpluses
- locationality – can be easily sited compared to other forms of generation, and located to provide additional benefits to the grid, including deferral of system investments
- constructability – can be developed from conception to operations in less than two years, and often less than a year
- affordability – due to a rapidly expanding manufacturing base, the cost of lithium-

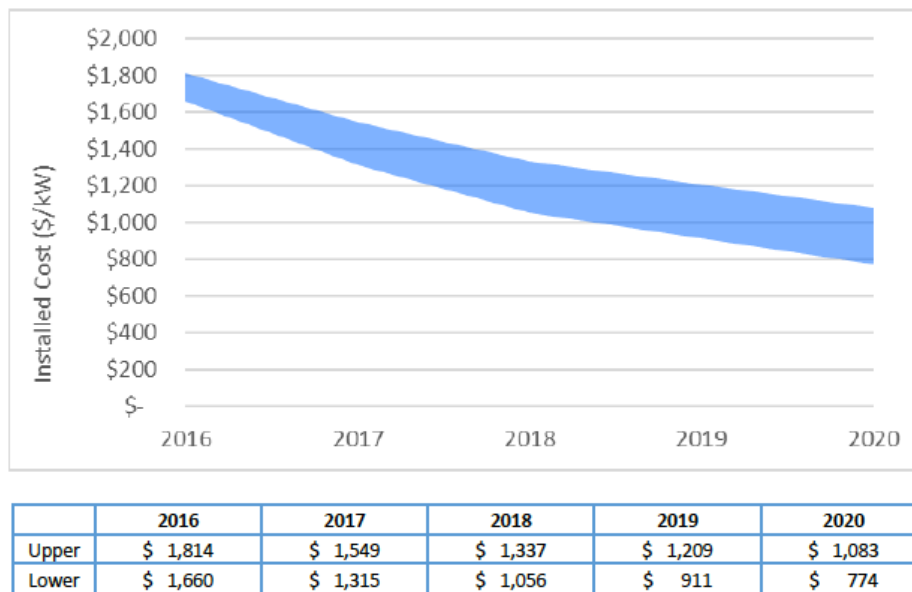
⁸⁷ Lazard. December 2016. Lazard's Levelized Cost of Storage – Version 2.0, p.9.

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ion batteries continues to decline and is expected to decline into the foreseeable future.

The costs of lithium-ion battery storage have declined substantially in recent years with increased manufacturing, deployment and technological advances.⁸⁸ While the rate of change is expected to decrease, an overall decline in cost is anticipated to continue into the foreseeable future, as illustrated in Figure 10. These installed costs are inclusive of batteries, balance of system costs, financing, and O&M.⁸⁹

Figure 10: Forecast installed cost, 100 MW / 4-hour lithium-ion storage⁹⁰



Upper: GTM install costs, BNEF experience curve (low end, 14%), Navigant global installs
Lower: IHS install costs, BNEF experience curve (high end, 19%), Navigant global installs

The ESA projection of future declining capital costs for lithium-ion battery storage on the order of 40% from 2016 to 2020 (to US\$774-1083/kW, installed) is consistent with findings in the literature.⁹¹

Evaluating energy storage in resource planning

Most resources considered in electricity resource planning, including BC Hydro's integrated resource planning process, are evaluated primarily in terms of their ability to

⁸⁸ O.Schmidt, A. Hawkes, A. Gambhir & I. Staffell. op cit.

⁸⁹ Energy Storage Association. November 2016. Including Advanced Energy Storage in Integrated Resource Planning: Cost Inputs and Modeling Approaches ["ESA"], p.5. (Available at: http://energystorage.org/system/files/attachments/irp_primer_002_0.pdf)

⁹⁰ *Ibid.*

⁹¹ O.Schmidt, A. Hawkes, A. Gambhir & I. Staffell. op cit.; Lazard. December 2016. Lazard's Levelized Cost of Storage – Version 2.0, p.32.

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meet energy and capacity needs, with additional consideration at the portfolio level to matters such as reliability and dispatchable.

Energy storage systems, however, are unique in the range of system benefits they can provide.

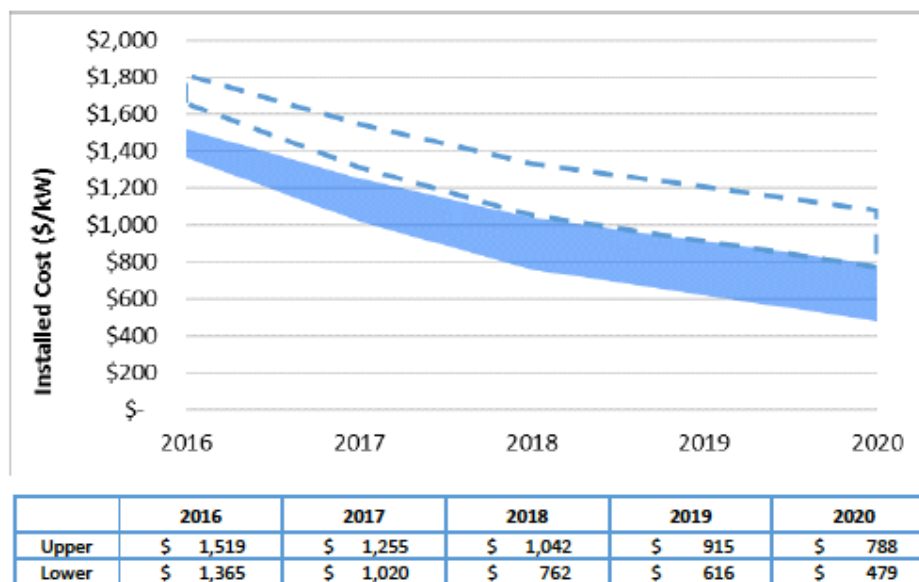
In contrast, current-day advanced energy storage provides high value flexibility services, like frequency regulation or ramping support, in addition to capacity. A large-scale energy storage resource dedicated to providing peak capacity when needed – typically a four-hour period in afternoon and early evening – can also provide grid services for the many hours when that peak capacity is not needed. Storage resources can do this because they are “always on” and available for service, in contrast to traditional generation units that need to be started up and shut

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down to provide services to provide peak capacity and other services. As a result, planners do not have the right tools to estimate the net cost of storage capacity.⁹²

Taking these other benefits into account significantly reduces the net cost of capacity. According to the ESA study, the net cost of storage is expected to fall by 2020 to US\$479-788 (roughly CAD\$800, on average) per installed kW.

Figure 11: Forecast net cost, 100 MW / 4-hour lithium-ion storage⁹³



Upper: GTM install costs, BNEF experience curve (low end, 14%), Navigant global installs
Lower: IHS install costs, BNEF experience curve (high end, 19%), Navigant global installs

For our modeling analysis presented below, we used a conservative estimate of \$1000/kW in 2020 for lithium-ion storage, with a subsequent decline of 2%/year in real costs.

4 Results

4.1 Additional required resources

Using the model described above, we developed resource portfolios to meet energy and capacity needs under the mid, high and low load forecasts (Scenarios 1, 2 and 3) for each of the following three resource strategies:

- Strategy A: Complete the Site C project by F2024
- Strategy B: Cancel the Site C project
- Strategy C: Suspend the Site C project until 2024, and complete it by F2030

⁹² ESA, p.5

⁹³ *Ibid.*

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Scenarios were also prepared, when appropriate, in which reliance on the Canadian Entitlement is allowed.

In this section, we present tables summarizing the additional required resources for each strategy, under each load scenario. Detailed energy and capacity load resource balance tables describing each of the scenarios discussed below are presented in Appendix B.

Strategy A: Complete Site C by F2024

Strategy A, the reference strategy, is based on BC Hydro's assumptions drawn from the RRA proceeding and on resource strategies set out in the 2013 IRP. These include:

- Load forecasts and DSM scenarios from the RRA, and
- In the high load scenario, additional capacity requirements to be met by single cycle gas turbines, as seen in the Contingency Resource Plan.⁹⁴

We have also assumed, based on the tenor of the utility's responses in the RRA, that BC Hydro would undertake to develop capacity-focused DSM, adding 30 MW per year beginning in F2024.

Strategy A, like strategies B and C, is examined separately under the mid, high and low load forecasts.

Strategy B: Cancel Site C

In Strategy B, the Site C Project is cancelled outright. In this scenario, we call upon — as needed — certain alternate resources described elsewhere in this report. These include:

- A modified DSM Plan whereby 50% of load growth beyond 2017 is met by DSM;
- Capacity-focused DSM, adding 30 MW per year beginning in F2018; and
- Energy storage when required to meet capacity needs.

Strategy C: Suspend construction of Site C

Under Strategy C, construction of Site C would be suspended until F2024, implying an in-service date of F2030. The same alternate resources used for Strategy B are also available to respond to energy and capacity needs under Strategy C.

In the following sections, we compare the resource additions required according to each of these three resource strategies in order to meet energy and capacity needs, for the mid, high and low load forecasts.

4.1.1 Mid Load Scenarios (Scenarios A1, B1 and C1)

The mid load scenario produces significant capacity surpluses in the near term, diminishing until F2023. Completing Site C in F2024 (Scenario A1) would result in extending the capacity surplus for several years, but this capacity surplus is absorbed in

⁹⁴ BC Hydro. November 2013. Integrated Resource Plan, Chapter 9 – Recommended Actions, section 9.4.6.

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part by using this period for the Mica refurbishment. All three scenarios maintain capacity balance throughout the planning period.

With respect to energy, Scenario A1 (Site C in F2024) continues to show a substantial energy surplus through F2030; Scenario C1 (Site C in F2030) shows a similar surplus from F2031 through F2035.

Table 5: Additional resources – Mid-load scenarios

Scenario	Load Forecast	Capacity resources	Energy resources
A1	Mid	<ul style="list-style-type: none"> Site C in F2024 Capacity DSM starting in F2024 Mica off-line F2026 through F2030 Revelstoke 6 in-service in F2027 90 MW of SCGTs in F2026 Market purchases of up to 400 MW of capacity 	<ul style="list-style-type: none"> Site C in F2024 1500 GWh of wind energy (523 MW installed) added in F2036
B1	Mid	<ul style="list-style-type: none"> Capacity DSM starting in F2018 Mica off-line F2023 through F2027 Revelstoke 6 in-service in F2030 110 MW of storage in F2027 Market purchases of up to 400 MW of capacity 	<ul style="list-style-type: none"> Addl DSM F2026-F2036 1000 GWh of wind energy (349 MW installed) added in F2030, increasing to: <ul style="list-style-type: none"> 2000 GWh (697 MW installed) in F2032; and 3000 GWh (1046 MW installed) in 2034. Energy market purchases of up to 350 GWh/yr in F2029, F2030 and F2036
C1	Mid	<ul style="list-style-type: none"> Capacity DSM starting in F2018 Revelstoke 6 in F2028; Mica offline starting in F2031 (if technically feasible); Market purchases of up to 150 MW of capacity 	<ul style="list-style-type: none"> Addl DSM F2026-F2036 Energy market purchases of up to 500 GWh/yr in F2029 and F2030;

Table 6 explores the same three scenarios, but with the added condition that the Canadian Entitlement is available as a resource for planning purposes. As a result, significantly fewer additional capacity and energy resources are required.

Table 6: Additional resources – Mid-load scenarios (with Canadian Entitlement)

Scenario	Load Forecast	Capacity resources	Energy resources
A1-CE	Mid (with Canadian Entitlement)	<ul style="list-style-type: none"> Canadian Entitlement 650 MW Site C in F2024 Mica off-line F2026 through F2030 Capacity DSM starting in F2024 	<ul style="list-style-type: none"> Canadian Entitlement 1970 GWh Site C in F2024
B1-CE	Mid (with Canadian Entitlement)	<ul style="list-style-type: none"> Canadian Entitlement 650 MW Capacity DSM starting in F2018 Mica off-line F2023 through F2027 Revelstoke 6 in-service in F2030 Market purchases of up to 100 MW of capacity in F2036 only 	<ul style="list-style-type: none"> Canadian Entitlement 1970 GWh Addl DSM F2026-F2036 1000 GWh of wind energy (91 MW installed) added in F2034

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			<ul style="list-style-type: none"> Market purchases of up to 500 GWh of energy in F2036 only
C1-CE	Medium (with Canadian Entitlement)	<ul style="list-style-type: none"> Canadian Entitlement 650 MW Capacity DSM starting in F2018 Revelstoke 6 in F2028; Site C in F2030 Mica offline starting in F2031 (if technically feasible); 	<ul style="list-style-type: none"> Canadian Entitlement 1970 GWh Addl DSM F2026-F2036 Site C in F2030

4.1.2 High Load Scenarios (Scenarios A2, B2 and C2)

In the high load scenarios, the current capacity surplus disappears by F2020. Scenario A2 (Site C in F2024) adds 80 MW of simple cycle gas turbines (SCGTs) as early as F2021; from F2030 to F2036, this increases to 1,300 MW. At the same time, significant quantities of wind energy are added as well.

In Scenario B2 (Cancel Site C), 280 MW of energy storage is required for capacity purposes starting in F2021, increasing to 670 MW by F2034. Additional DSM and substantial amounts of wind energy are also required.

In Scenario C2 (Suspend Site C), no additional energy storage is required after the 280 MW installed in F2021. The need for additional wind energy is eliminated, once Site C comes on-line in F2030.

Table 7: Additional resources – High-load scenarios

Scenario	Load Forecast	Capacity resources	Energy resources
A2	High	<ul style="list-style-type: none"> Revelstoke 6 in-service in F2022; Capacity DSM starting in F2024 Site C in F2024 Mica off-line F2026 through F2030; 80 MW of SCGTs added in F2021, increasing to <ul style="list-style-type: none"> 1020 MW in F2030; and 1300 MW in F2036; Market purchases of up to 400 MW of capacity 	<ul style="list-style-type: none"> Site C in F2024 1400 GWh of wind energy (488 MW installed) added in F2023, increasing to: <ul style="list-style-type: none"> 4200 GWh (1464 MW installed) in F2032; 5500 GWh (1917 MW installed) by F2033; and 7300 GWh (2545 MW installed) by F2035 Market purchases of up to 500 GWh of energy.
B2	High	<ul style="list-style-type: none"> Capacity DSM starting in F2018 Mica off-line as early as possible (preferably in F2018); Revelstoke 6 in-service in F2022 Energy storage of 280 MW in F2021, increasing to 670 MW in F2034. Market purchases of up to 400 MW of capacity 	<ul style="list-style-type: none"> Addl DSM F2026-F2036 1000 GWh of wind energy (349 MW installed) added in F2023, increasing to: <ul style="list-style-type: none"> 3300 GWh (1150 MW installed) in F2026; 5400 GWh (1882 MW installed) by F2030; 7400 GWh (2579 MW installed) by F2033; and 8400 GWh (2928 MW installed) by F2035;

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			<ul style="list-style-type: none"> Market purchases of up to 500 GWh of energy.
C2	High	<ul style="list-style-type: none"> Capacity DSM starting in F2018 Mica offline starting as early as possible (preferably in F2018); Revelstoke 6 in F2022; 280 MW of energy storage in F2021; Site C in F2030 Market purchases of up to 400 MW of capacity; 	<ul style="list-style-type: none"> Addl DSM F2026-F2036 Wind energy purchases of 1000 GWh/yr (91 MW installed) starting in F2023, increasing to: <ul style="list-style-type: none"> 2000 GWh/yr (181 MW installed) in F2024, 3300 GWh/yr (299 MW installed) in F2026, and 5400 GWh/yr (489 MW installed) in F2030; Site C in F2030 Market purchases of up to 500 GWh of energy.

Table 8 explores the same three scenarios, but with the added condition that the Canadian Entitlement is available as a resource for planning purposes. As a result, significantly fewer additional capacity and energy resources are required.

Table 8: Additional resources – High-load scenarios (with Canadian Entitlement)

Scenario	Load Forecast	Capacity resources	Energy resources
A2-CE	High (with Canadian Entitlement)	<ul style="list-style-type: none"> Canadian Entitlement 650 MW Capacity DSM starting in F2024 Revelstoke 6 in-service in F2022; Site C in F2024 Mica off-line F2026 through F2030; Market purchases of up to 400 MW of capacity from F2028 	<ul style="list-style-type: none"> Canadian Entitlement 1970 GWh 1300 GWh of wind energy (453 MW installed) added in F2025, increasing to: <ul style="list-style-type: none"> 2800 GWh (976 MW installed) by F2030; 6100 GWh (2126 MW installed) by F2035; 7200 GWh (2510 MW installed) in F2036 Market purchases of up to 500 GWh of energy in F2024 and F2030 to F2036
B2-CE	High (with Canadian Entitlement)	<ul style="list-style-type: none"> Canadian Entitlement 650 MW Capacity DSM starting in F2018 Mica off-line as early as possible (preferably in F2018); Revelstoke 6 in-service in F2022 Market purchases of up to 400 MW of capacity in F2029 to F2036 	<ul style="list-style-type: none"> Canadian Entitlement 1970 GWh Addl DSM F2026-F2036 1400 GWh of wind energy (662 MW installed) added in F2027, increasing to: <ul style="list-style-type: none"> 2800 GWh (976 MW installed) by F2029; 5000 GWh (1473 MW installed) by F2032; and 6000 GWh (2091 MW installed) by F2034; Market purchases of up to 500 GWh of energy F2025 to F2036

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C2-CE	High (with Canadian Entitlement)	<ul style="list-style-type: none"> • Canadian Entitlement 650 MW • Capacity DSM starting in F2018 • Mica offline starting as early as possible (preferably in F2018); • Revelstoke 6 in F2022; • Site C in F2030 • Market purchases of up to 200 MW of capacity; • 	<ul style="list-style-type: none"> • Canadian Entitlement 1970 GWh • Addl DSM F2026-F2036 • Wind energy purchases of 1400 GWh/yr (127 MW installed) starting in F2026, increasing to: <ul style="list-style-type: none"> ◦ 2800 GWh/yr (254 MW installed) in F2030, • Market purchases of up to 500 GWh of energy in F2025 to F2030
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4.1.3 Low Load Scenarios (Scenarios A3, B3 and C3)

In the low load scenario, no additional resources are required, even with the cancellation of the Site C Project. This is the result of the advancing of additional energy focused DSM to that currently contemplated by BC Hydro, and capacity-focused DSM starting in F2018. While our scenarios include additional DSM and capacity-focused DSM in Scenarios B3 and C3, these are in fact unnecessary and could be eliminated, reducing the resource costs of these two scenarios even further.

Table 9: Additional resources – Low-load scenarios

Scenario	Load Forecast	Capacity resources	Energy resources
A3	Low	<ul style="list-style-type: none"> • Site C in F2024 • Capacity DSM starting in F2024 • No additional resources required. 	<ul style="list-style-type: none"> • Site C in F2024 • No additional resources required.
B3	Low	<ul style="list-style-type: none"> • Capacity DSM starting in F2018 • Mica offline F2024 to F2028 • No additional resources required. 	<ul style="list-style-type: none"> • Reduced DSM
C3	Low	<ul style="list-style-type: none"> • Capacity DSM starting in F2018 • Mica offline F2024 to F2028 • No additional resources required. 	<ul style="list-style-type: none"> • Reduced DSM

4.2 Present Value Costs

For each one of the scenarios described in section 4.1, we have carried out an analysis of the annual and present value costs of incremental resources.

4.2.1 Mid Load Scenarios (Scenarios A1, B1 and C1)

Table 10 shows the present value of each incremental cost category for the three scenarios under the medium load forecast, without the Canadian Entitlement:

- Scenario A1: Complete the Site C Project by F2024
- Scenario B1: Cancel the Site C Project
- Scenario C1: Suspend the Site C Project and recommence construction in

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F2024, for an in-service date of F2030

Table 10: Present value costs – Low load forecast

	PV (\$ millions)		
SCENARIO	A1	B1	C1
Load forecast	medium	medium	medium
Site C Strategy	Complete	Cancel	Suspend
Canadian Entitlement			
ADDL CAPACITY COSTS			
Site C Capital Cost	2,293	557	1,328
Site C GHG cost	153	0	89
Revelstoke Unit 6	134	87	118
Canadian Entitlement	0	0	0
Market reliance	53	216	24
Clean Resources	0	0	0
SCGT	3	0	0
Storage	0	60	0
CCGT	0	0	0
Subtotal	2,483	920	1,470
ADDL ENERGY COSTS			
Addl Gas costs	4	0	0
Addl Wind costs	45	507	0
Canadian Entitlement	0	0	0
Storage losses	0	2	0
Market Purchases	52	25	21
Subtotal	101	534	21
ADDL TRADE REVENUE			
Surplus sales revenues (\$M)	-1,412	-757	-1,069
Surplus capacity revenues	-23	-15	-17
Subtotal	-1,434	-771	-1,086
ADDL DSM COSTS			
Addl DSM	0	268	268
Capacity-focussed DSM	63	148	148
Subtotal	63	416	416
TOTAL INCREMENTAL COSTS	1,367	1,098	910

As seen in Table 10, for the mid load forecast, Scenario A1 (Complete by F2024) shows the highest present value costs, some \$270 million more than those for cancelling the Site C Project. The costs of the Suspend scenario are marginally lower than those of the Cancel scenario.

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Table 11 shows the same mid load scenarios, but assuming that the government has adopted a regulation allowing reliance on the Canadian Entitlement (CE) for planning purposes. While the costs of Scenarios A1 (Complete) and C1 (Suspend) fall only slightly, reliance on the Canadian Entitlement reduces costs in Scenario B1 (Cancel) by almost \$400 million. This amount represents the savings from relying on the Canadian Entitlement instead of acquiring new and more expensive resources. As a result, the cost savings resulting from cancelling the Project increase to over \$600 million.

Table 11: Present value costs – Mid load forecast (with Canadian Entitlement)

SCENARIO	PV (\$ millions)		
	A1-CE	B1-CE	C1-CE
Load forecast	medium	medium	medium
Site C Strategy	Complete	Cancel	Suspend
Canadian Entitlement	included	included	included
ADDL CAPACITY COSTS			
Site C Capital Cost	2,293	557	1,328
Site C GHG cost	153	0	89
Revelstoke Unit 6	134	87	118
Canadian Entitlement	81	81	81
Market reliance	2	4	0
Clean Resources	0	0	0
SCGT	0	0	0
Storage	0	0	0
CCGT	0	0	0
Subtotal	2,511	728	1,527
ADDL ENERGY COSTS			
Addl Gas costs	0	0	0
Addl Wind costs	0	95	0
Canadian Entitlement	873	873	873
Storage losses	0	0	0
Market Purchases	9	10	0
Subtotal	882	979	873
ADDL TRADE REVENUE			
Surplus sales revenues (\$M)	-2,219	-1,376	-1,927
Surplus capacity revenues	-83	-48	-79
Subtotal	-2,298	-1,422	-2,002
ADDL DSM COSTS			
Addl DSM	0	268	268
Capacity-focussed DSM	63	148	148
Subtotal	63	416	416
TOTAL INCREMENTAL COSTS	1,311	701	903

4.2.2 High load scenario

Table 12 shows the present value of each incremental cost category for the same three scenarios under the high load forecast.

Table 12: Present value costs – high load forecast

SCENARIO	PV (\$ millions)		
	A2 high Complete	B2 high Cancel	C2 high Suspend
Load forecast			
Site C Strategy			
Canadian Entitlement			
ADDL CAPACITY COSTS			
Site C Capital Cost	2,293	557	1,328
Site C GHG cost	153	0	89
Revelstoke Unit 6	231	231	231
Canadian Entitlement	0	0	0
Market reliance	216	320	266
Clean Resources	0	0	0
SCGT	319	0	0
Storage	0	376	307
CCGT	0	0	0
Subtotal	3,059	1,484	2,132
ADDL ENERGY COSTS			
Addl Gas costs	415	0	0
Addl Wind costs	1,941	2,681	2,284
Canadian Entitlement	0	0	0
Storage losses	0	11	9
Market Purchases	235	96	75
Subtotal	2,592	2,789	2,368
ADDL TRADE REVENUE			
Surplus sales revenues (\$M)	-370	-215	-577
Surplus capacity revenues	1	-6	-13
Subtotal	-369	-222	-590
ADDL DSM COSTS			
Addl DSM	0	852	852
Capacity-focussed DSM	63	148	148
Subtotal	63	1,000	1,000
TOTAL INCREMENTAL COSTS	5,498	5,051	5,000

Under the high scenario, we see once again that the “Complete Site C” scenario A2 results in the highest present value costs, some \$450 million more than those for

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cancelling the project. The costs of the Suspend scenario are only \$50 million lower than under the Cancel scenario.

In Table 13, we again see the high load forecast, but assuming that the Canadian Entitlement can be relied on for planning purposes. Here, costs for all three scenarios fall dramatically compared to the corresponding scenarios without the CE (\$764 million for the Complete scenario, and \$1.1 billion for each of the other two). This is because, even with Site C, a significant amount of additional resources would be required under the high load forecast. Since the effective cost of the Canadian Entitlement (equal to the price at which it is exported) is far lower than the cost of these new resources, relying on it results in dramatic cost savings for ratepayers.

Table 13: Present value costs – High load forecast (with Canadian Entitlement)

SCENARIO	PV (\$ millions)		
	A2-CE	B2-CE	C2-CE
Load forecast	high	high	high
Site C Strategy	Complete	Cancel	Suspend
Canadian Entitlement	included	included	included
ADDL CAPACITY COSTS			
Site C Capital Cost	2,293	557	1,328
Site C GHG cost	153	0	89
Revelstoke Unit 6	231	231	231
Canadian Entitlement	81	81	81
Market reliance	123	108	20
Clean Resources	0	0	0
SCGT	73	0	0
Storage	0	31	0
CCGT	0	0	0
Subtotal	2,800	1,008	1,660
ADDL ENERGY COSTS			
Addl Gas costs	100	0	0
Addl Wind costs	1,316	1,511	1,003
Canadian Entitlement	873	873	873
Storage losses	0	1	0
Market Purchases	165	106	73
Subtotal	2,454	2,491	1,949
ADDL TRADE REVENUE			
Surplus sales revenues (\$M)	-661	-485	-772
Surplus capacity revenues	-20	-14	-19
Subtotal	-679	-498	-789
ADDL DSM COSTS			
Addl DSM	0	852	852
Capacity-focussed DSM	63	148	148
Subtotal	63	1,000	1,000
TOTAL INCREMENTAL COSTS	4,791	4,000	3,909

4.2.3 Low load scenario

Table 14 shows the present value of incremental costs each resource strategy under the low load forecast.

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Table 14: Present value costs – Low load forecast

SCENARIO	PV (\$ millions)		
	A3	B3	C3
	low Complete	low Cancel	low Suspend
Load forecast			
Site C Strategy			
Canadian Entitlement			
ADDL CAPACITY COSTS			
Site C Capital Cost	2,293	557	1,328
Site C GHG cost	153	0	89
Revelstoke Unit 6	0	0	0
Canadian Entitlement	0	0	0
Market reliance	0	0	0
Clean Resources	0	0	0
SCGT	0	0	0
Storage	0	0	0
CCGT	0	0	0
Subtotal	2,293	557	1,328
ADDL ENERGY COSTS			
Addl Gas costs	0	0	0
Addl Wind costs	0	0	0
Canadian Entitlement	0	0	0
Storage losses	0	0	0
Market Purchases	0	0	0
Subtotal	0	0	0
ADDL TRADE REVENUE			
Surplus sales revenues (\$M)	-4,484	-2,532	-3,150
Surplus capacity revenues	-150	-79	-103
Subtotal	-4,626	-2,608	-3,248
ADDL DSM COSTS			
Addl DSM	0	-580	-580
Capacity-focussed DSM	63	148	148
Subtotal	63	-432	-432
TOTAL INCREMENTAL COSTS	-2,117	-2,483	-2,263

Under the low load forecast, once again, we see a present value benefit of over \$350 million for the Cancel scenario, as compared to Complete. In this case, the costs of the Suspend scenario are just \$146 million less than those of the “Complete Site C” scenario.

As no new resources are required in any of these scenarios, there is no need to review Canadian Entitlement scenarios.

5 Discussion, conclusions and recommendations

5.1 Discussion

The central finding of the modelling exercise presented above is that, under every load scenario, **cancelling the Site C Project or suspending it will result in substantially lower costs to ratepayers than completing it by F2024**. Under the low load scenario, cancellation is also substantially superior to suspension.

The present value costs for each strategy under each load scenario are summarized in Table 15.

Table 15: Present value costs (\$ millions)

<u>Site C Strategy</u>	Complete	Cancel	Suspend
<u>load forecast</u>			
mid	1,367	1,098	910
high	5,498	5,051	5,000
low	-2,117	-2,483	-2,263

Table 16 shows the differentials between the Cancel and Suspend scenarios and the reference case (Complete Site C by F2024). It shows that Cancelling the Site C Project results in resource cost savings of between \$269 and \$447 million dollars. Savings are even greater for the Suspend strategy under the mid and high load forecasts.

Table 16: Differential present value costs (\$ millions)

<u>Site C Strategy</u>	Cancel	Suspend
<u>load forecast</u>		
mid	-269	-457
high	-447	-498
low	-366	-146

Furthermore, in the high and medium load scenarios, allowing reliance on 50% of the energy and capacity of the Canadian Entitlement reduces present value costs by a substantial margin. The differential costs are shown in Table 17, which shows that, if reliance on the Canadian Entitlement were to be allowed, cancelling the Site C Project would save ratepayers \$610 million under the mid load scenario, or \$791 million under the high load scenario, compared to completing the project by F2024. Again, the differential costs are even higher for the Suspend strategy under the high load forecast.

Table 17: Differential present value costs (\$ millions), with Canadian Entitlement

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<u>Site C Strategy</u>	Cancel	Suspend
<u>load forecast</u>		
mid	-610	-408
high	-791	-881

As we have seen, these conclusions are dependent upon a large number of inputs and assumptions. We have endeavoured to make assumptions that are reasonable and conservative. In most cases, we have followed BC Hydro's assumptions; when we have not, we have explained our reasoning.

Assuming that the Commission takes a position in its Preliminary Report with respect to project cost, load forecasts, and other key parameters, we present updated results in a supplementary submission.

The parameters with the most significant effects are undoubtedly capital costs (including both capital expenditures and financing costs), cancellation and suspension costs, and resource costs.

Capital costs

As noted in Section 2.2.3, we were unable to reconcile the annual capital expenditures set out in the 2016 Ten Year Capital Forecast⁹⁵ with the announced project cost of \$8.335 billion. Applying BC Hydro's Weighted Average Cost of Capital (WACC) —5% in real dollars, or 7% in nominal dollars — to the annual balances results in a capital cost of \$10.6 billion (including financing costs). It is worth noting that, in September 2014, Synapse Energy Economics Inc. performed a review of BC Hydro's alternatives assessment methodology for the utility, and concluded that these rates are reasonable.⁹⁶

Aside from financing costs, we have relied on BC Hydro's 2016 estimation of capital expenditures for the Site C Project. This is probably a conservative assumption, given BC Hydro's record of substantial cost overruns, particularly for large projects, as discussed in section 4.3.1 of *Reassessing the Need*.

Cancellation and suspension costs

We have used the best estimates available to us, as discussed in detail in *Reassessing the Need*. We hope that the Commission will be able to obtain sufficient information from BC Hydro to make a determination as to the appropriate amounts.

Load forecast

The load forecast is another critical input. Aside from an adjustment in the forecast of LNG loads, explained in Section 3.1.1, we have used BC Hydro's mid load forecast and,

⁹⁵ RRA, Appendix G – 10 Year Capital Forecast.

⁹⁶ Synapse Energy Economics. 2014. Review of BC Hydro's Alternatives Assessment Methodology (Available at: <https://www.sitecproject.com/document-library/due-diligence-reviews>)

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in the absence of precise figures, have derived low and high load forecasts from the large gap and small gap scenarios presented in the RRA.

Resource costs

The long-term trend of wind power costs is another important assumption, given the substantial amounts of new wind power that are required in some scenarios.⁹⁷ We refer the Commission to the discussion in section 5.4.1 of *Reassessing the Need*, for the justification for our estimate of CA\$80/MWh (in 2016\$) as the long-term adjusted unit energy cost of this resource.

Comparison to findings of Reassessing the Need

The current report builds upon the analysis undertaken in *Reassessing the Need*. Both studies compared the costs of continuing Site C to completion as scheduled, cancelling the Project, or suspending the Project. Notwithstanding similarities between the analyses, there are several key differences that limit the utility of direct comparisons. These include the following:

- In evaluating the costs to suspend the Site C Project, the current report considers only one date for restarting the Project, namely 2024, whereas *Reassessing the Need* allowed for an optimal date to be chosen. This has the tendency to lower the potential benefits of suspension.
- In light of the Climate Leadership Plan policy respecting 100% low-carbon electricity, the current analysis advances battery storage in lieu of simple cycle gas turbines for capacity. This makes the alternative portfolios more expensive.
- The current analysis considers cancellation as of December 31, 2017, as opposed to June 30, 2017 in *Reassessing the Need*. This adds to the costs of cancelling Site C.
- *Reassessing the Need* evaluated cost overruns in the Site C Project and changes in export market prices, which were not considered in this report. This has the tendency to reduce the range of findings since fewer scenarios were considered in the current report
- The current analysis evaluates the potential effects of reliance on the Canadian Entitlement, which was not considered in *Reassessing the Need*.

Considering that most of the above differences result in declines in the benefits to cancelling or suspending the Site C Project, the findings summarized below in Table 18

⁹⁷ Lacking access to sophisticated planning tools such as System Optimizer, we have used wind power as a generic renewable resource.

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are not surprising. The benefits of cancelling or suspending the Site C Project have declined in each of the scenarios common to the two reports.

Table 18: Comparison of findings to Reassessing the Need (\$million)

	Reassessing the Need		Current Report	
Load Forecast	Cancel Site C	Suspend Site C	Cancel Site C	Suspend Site C
Low	-794	-794	-366	-146
Mid	-622	-867	-269	-457
High	-518	-865	-447	-498

Supplementary submission

We look forward to updating these findings, based on the determinations found in the Commission's Preliminary Report. We would be pleased to share our models with the Commission staff, upon request.

5.2 Conclusions and Recommendations

5.2.1 Canadian Entitlement under the Columbia River Treaty

As noted above, this modelling exercise has also demonstrated that, in the high and medium load scenarios, **allowing reliance on 50% of the energy and capacity of the Canadian Entitlement reduces present value costs by a substantial margin**. This conclusion is in fact very robust, and remains valid under a very broad range of input assumptions. The reason is that the effective cost of this resource — BC Hydro's export price for energy and, perhaps, capacity — is so much lower than any other resources available to meet future needs.

Given these findings, **we urge the Commission recommend that the Government enact a regulation allowing BC Hydro to take its entitlement under the Columbia River Treaty into account in its energy and capacity planning**. Doing so will result in far lower resource costs to ratepayers, especially in a high load environment, without any corresponding harm (except perhaps to American consumers, who will lose a low-cost energy supply). Furthermore, because the Canadian Entitlement consists of hydroelectric energy from existing reservoirs in Canada, there would be no recognizable impact on greenhouse gas emissions.

5.2.2 Additional Information

Recommended IR #1: Please present the most up-to-date reference case planning scenario in the format used in Tables 3 and 4 of Appendix 9A to the 2013 IRP, including:

- The breakdown of existing and committed heritage resources, excluding Site C;
- The breakdown of existing and committed IPP resources;
- The breakdown of planned future supply-side resources;

Please provide separate lines for:

- The Site C project;
- Mid-load forecast before DSM;
- LNG;
- Individual DSM programs such as SMI Theft Reduction and Voltage and VAR Optimization;
- Additional planned DSM savings.

Recommended IR #2: Please provide alternate year-by-year values for:

- High and low load forecasts before DSM;
- Alternate scenarios for energy and capacity savings from DSM programs;
- Additional capacity savings from capacity-focused DSM programs.

Recommended IR #3: Please provide year-by-year estimate of all capital costs pertaining to the Site C Project, from inception to commissioning, distinguishing between capital expenditures, regulatory costs and financing costs (AFUDC).

Recommended IR #4: Please provide BC Hydro's a) most likely, and b) optimistic estimate of capacity savings from demand response and capacity-focused demand-side management.

Recommended IR #5: For each year from 2010 through 2017, inclusive, please provide :

- The amount of energy and capacity provided to British Columbia as the Canadian Entitlement under the Columbia River Treaty, and
- The total amount received for the sale of this power and energy.

7 Appendix A: Additional Data Sources

The primary data sources used in this modelling exercise are BC Hydro's 2013 IRP ("IRP") and its 2016 Revenue Requirements Application ("RRA"). Generally speaking, the data presentations are more consistent and complete in the IRP, and thus we have endeavoured to use these presentations throughout. However, because the RRA data are more up-to-date but less complete, we have at times had to extrapolate or otherwise replace missing data, as described below.

In the following sections, we will identify the primary data issues that have arisen in preparing this model and the solutions we have used. Issues concerning energy balance data are addressed in section A.7.1.

We also used updated economic parameters, such as export market price and exchange rate forecasts. These issues are addressed in section A.7.2.

7.1 Energy and capacity balances

7.1.1 *Energy and capacity balances in the IRP*

The most complete data in the IRP are found in the Base Resource Plans (BRPs) and the Contingency Resource Plans (CRPs), found in Appendix 9A of the IRP. Each of these BRPs consists of a table with a column for each year of the 20-year planning horizon, with a separate table for energy and for capacity. The BRP is divided into five groups:

- Existing and Committed Heritage Resources
- Existing and Committed IPP Resources
- Future Supply-Side Resources
- Demand – Integrated System Gross Requirements, and
- Future DSM and Other Measures

A "Total Supply" line sums the first three groups, and a "surplus/deficit" line, at the end, represents the sum of all five groups, for each year.

The first group, "Existing and Committed Heritage Resources", provides nine (9) lines of annual supply data, including both categories (e.g., "Heritage hydroelectric") and specific resources (e.g., Ruskin, John Hart, etc.), with a sub-total (line a).

The second group, "Existing and Committed IPP Resources", provides ten (10) lines of annual supply data, including both categories (e.g., "F2006 Call") and specific resources (e.g., Waneta Expansion), with a sub-total (line b).

The third group, "Future Supply-Side Resources", provides eight (8) lines of annual supply data, including both categories (e.g., "IPP renewals") and specific resources (e.g., Site C), with a sub-total (line c).

Total Supply is simply the sum of lines a, b and c.

The fourth category, "Demand – Integrated System Gross Requirements", is composed of the 2012 Mid-Level Load Forecast Before DSM (line e), and forecast LNG load. The sum of the two (both negative numbers) is line f, representing total demand.

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The fifth category, “Future DSM and Other Measures”, includes lines for two specific programs (“SMI Theft Reduction” and “Voltage and VAR Optimization”, as well as a much larger line representing the annual savings forecast under “DSM Option 2/DSM Target”, the particular scenario of future DSM programs recommended in the IRP. The subtotal of these three lines is described as line g.

Finally, the surplus or deficit for each year is presented as line h. For each year, it represents the sum of all available energy resources (positive numbers), plus the forecast total demand (negative numbers). Thus, a positive number represents a surplus to be sold on the export market, and a negative number represents a deficit.

Similar tables are presented for the capacity balance.

The row headings of these two tables — BRP with LNG, for energy and capacity (Tables 5 and 6, respectively) — are reproduced below in Figure Figure 12.

Figure 12: 2013 IRP – Energy and Capacity Balances

Table 5		BRP with LNG – Energy									
		Operating			Planning						
(GWh)		F2014	F2015	F2016	F2017	F2018	F2019	F2020	F2021	F2022	
Existing and Committed Heritage Resources											
Heritage Hydroelectric		44,962	44,884	45,737	42,425	42,048	42,048	42,048	42,048	42,048	
Heritage Hydroelectric Non-Firm / Market Allowance		0	0	0	4,100	4,100	4,100	4,100	4,100	4,100	
Heritage Thermal		31	31	31	180	180	180	180	180	180	
Resource Smart		60	86	113	133	133	133	133	133	133	
Waneta Transaction		1,003	874	885	885	885	885	885	885	885	
Mica 5		0	73	145	145	145	145	145	145	145	
Mica 6		0	0	28	56	56	56	56	56	56	
Ruskin		0	0	30	221	319	338	338	338	338	
John Hart		0	0	0	300	806	806	806	806	806	
Sub-total	(a)	46,057	45,947	46,949	48,425	48,653	48,671	48,671	48,671	48,671	
Existing and Committed IPP Resources											
Pre-F06 Call EPAs (incl. Rio Tinto Alcan)		7,078	6,865	4,309	5,936	5,786	5,135	4,977	4,869	4,869	
F2006 Call		2,158	2,603	2,603	2,328	2,328	2,328	2,328	2,328	2,328	
Standing Offer Program (signed EPAs)		214	228	228	201	201	201	201	201	201	
Bioenergy Call Phase I		569	569	569	582	582	582	515	342	221	
Clean Power Call		786	1,369	1,629	1,768	2,124	2,253	2,253	2,253	2,253	
AltaGas Power (NTL)		0	593	873	947	947	947	947	947	947	
Waneta Expansion		0	0	567	306	306	306	306	306	306	
Integrated Power Offer		926	1,055	1,092	1,139	1,139	1,139	1,139	1,139	673	
Bioenergy Call Phase II		0	109	380	565	565	565	565	565	565	
Conifex		0	94	188	180	180	180	180	180	180	
Sub-total	(b)	11,731	13,483	12,418	13,952	14,158	13,637	13,412	13,130	12,543	
Future Supply-Side Resources											
IPP Renewals		88	654	1,096	1,147	1,245	1,570	1,683	1,824	2,117	
Standing Offer Program		0	0	80	159	239	318	398	477	557	
IBAs		0	0	0	0	0	0	167	167	167	
Site C		0	0	0	0	0	0	0	0	0	
Revelstoke Unit 6		0	0	0	0	0	0	0	0	0	
Gas Capacity		0	0	0	0	0	0	600	600	600	
Clean Resources		0	0	0	0	0	0	0	0	0	
Market Purchases		0	0	0	0	0	0	0	0	245	
Sub-total	(c)	88	654	1,176	1,306	1,484	1,888	2,848	3,068	3,686	
Total Supply	(d) = a + b + c	57,876	60,084	60,543	63,683	64,294	64,196	64,931	64,869	64,900	
Demand - Integrated System Total Gross Requirements											
2012 Mid Load Forecast Before DSM	(e)	-58,714	-60,378	-61,855	-63,238	-65,769	-67,545	-69,111	-70,207	-70,811	
Expected LNG Load		0	0	0	0	0	0	-1,000	-2,000	-3,000	
2012 Mid Load Forecast Before DSM with LNG	(f)	-58,714	-60,378	-61,855	-63,238	-65,769	-67,545	-70,111	-72,207	-73,811	
Future Demand Side Management & Other Measures											
SMI Theft Reduction		0	0	0	65	129	193	256	318	380	
Voltage and VAR Optimization		38	162	229	273	288	304	314	326	328	
DSM Option 2 / DSM Target		1,919	2,666	3,564	4,364	4,942	5,893	6,842	7,790	8,202	
Sub-total	(g)	1,957	2,828	3,793	4,702	5,359	6,389	7,412	8,435	8,911	
Surplus / Deficit with LNG	(h) = d + f + g	1,119	2,533	2,480	5,147	3,884	3,040	2,231	1,097	0	

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Table 6 BRP with LNG – Capacity

			Operating/Planning								
(MW)			F2014	F2015	F2016	F2017	F2018	F2019	F2020	F2021	F2022
Existing and Committed Heritage Resources											
Heritage Hydroelectric			10,182	10,182	10,077	9,956	9,956	9,956	9,956	9,956	9,956
Heritage Thermal			946	496	46	46	46	46	46	46	46
Resource Smart			51	51	51	51	51	51	51	51	51
Waneta Transaction			256	249	249	249	249	249	249	249	249
Mica 5			0	465	465	465	465	465	465	465	465
Mica 6			0	0	460	460	460	460	460	460	460
Ruskin			0	0	73	76	114	114	114	114	114
John Hart			0	0	0	127	127	127	127	127	127
Sub-total	(a)		11,435	11,443	11,421	11,429	11,468	11,468	11,468	11,468	11,468
Existing and Committed IPP Resources											
Pre-F06 Call EPAs (excl. Rio Tinto Alcan)			667	557	553	547	523	462	426	426	426
F2006 Call			85	86	86	86	86	86	86	86	86
Standing Offer Program (signed EPAs)			10	11	11	11	11	11	11	11	11
Bioenergy Call Phase I			67	67	67	67	67	67	54	29	29
Clean Power Call			86	112	128	141	159	162	162	162	162
AltaGas Power (NTL)			0	26	31	31	31	31	31	31	31
Waneta Expansion			0	0	10	10	10	10	10	10	10
Integrated Power Offer			128	152	165	165	165	165	165	165	82
Bioenergy Call Phase II			0	15	65	65	65	65	65	65	65
Conifex			0	21	21	21	21	21	21	21	21
Sub-total	(b)		1,044	1,047	1,137	1,144	1,138	1,080	1,031	1,005	922
Future Supply-Side Resources											
IPP Renewals			16	126	129	133	146	177	202	214	256
Standing Offer Program			0	0	6	13	19	25	32	38	44
IBAs			0	0	0	0	0	0	24	24	24
Site C			0	0	0	0	0	0	0	0	0
Revelstoke Unit 6			0	0	0	0	0	0	0	0	0
GMS Units 1 - 5 Capacity Increase			0	0	0	0	0	0	0	0	0
Gas Capacity			0	0	0	0	0	0	392	392	392
Clean Resources			0	0	0	0	0	0	0	0	0
Sub-total	(c)		16	126	135	146	165	202	649	668	716
Total Supply Requiring Reserves	(d) = a + b + c		12,495	12,615	12,693	12,719	12,771	12,750	13,147	13,141	13,106
Reserves											
14% of Supply Requiring Reserves	-14% *d		-1,749	-1,766	-1,777	-1,781	-1,788	-1,785	-1,841	-1,840	-1,835
400 MW market reliance			400	400	0	0	0	0	0	0	0
Sub-total	(e)		-1,349	-1,366	-1,777	-1,781	-1,788	-1,785	-1,841	-1,840	-1,835
Supply Not Requiring Reserves											
Alcan 2007 EPA			419	419	153	153	153	153	153	153	153
Market Purchases			0	0	0	0	0	8	0	0	168
Sub-total	(f)		419	419	153	153	153	162	153	153	321
Effective Load Carrying Capability	(g) = d + e + f		11,565	11,668	11,069	11,092	11,137	11,126	11,460	11,454	11,592
Demand - Integrated System Peak											
2012 Mid Load Forecast Before DSM	(h)		-11,011	-11,222	-11,451	-11,681	-11,971	-12,230	-12,443	-12,613	-12,743
Expected LNG Load			0	0	0	0	0	0	-120	-240	-360
2012 Mid Load Forecast Before DSM with LNG	(i)		-11,011	-11,222	-11,451	-11,681	-11,971	-12,230	-12,563	-12,853	-13,104
Future Demand Side Management & Other Measures											
SMI Theft Reduction			0	0	0	9	17	26	35	43	52
Voltage and VAR Optimization			0	0	0	0	0	0	0	0	0
DSM Option 2 / DSM Target			304	439	638	820	932	1,078	1,224	1,371	1,480
Sub-total	(j)		304	439	638	829	949	1,104	1,259	1,414	1,511
Surplus / Deficit with LNG	(k) = g + i + j		858	885	256	239	115	0	156	15	0

7.1.2 Energy and capacity balances in the RRA

The IRP data are updated in the RRA, but the presentation is very different.

Table 3-8 of the RRA presents a load resource balance (LRB) similar to that shown above from the IRP. However:

- Existing and committed heritage resources are grouped into single line, which also includes Site C. In most but not all years, this figure reflects the sum of the relevant figures found in the IRP LRB;

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- Existing and committed IPP resources are also grouped into single line;
- Future supply-side resources are limited to IPP Renewals, the Standing Offer Program, and Revelstoke 6; and
- DSM savings are broken down into “2016 DSM Plan F16 savings” (included in “Existing and Committed DSM and Other Measures”) and “2016 DSM Plan F17 to F19 savings” and “2016 DSM Plan F20+ savings”, both of which are included in “Planned DSM and Other Measures”.

Figure 13: 2016 RRA – Energy and Capacity Balances

(GWh)		F2017	F2018	F2019	F2020	F2021
<u>Existing and Committed Heritage Resources</u>						
Heritage Resources (including Site C)	(a)	48,445	46,895	46,014	48,491	48,491
<u>Existing and Committed IPP Resources</u>						
	(b)	13,252	14,681	14,457	14,456	14,188
<u>Future Supply-Side Resources</u>						
IPP Renewals		61	234	569	647	779
Standing Offer Program		62	87	173	284	394
Revelstoke 6						
Sub-total	(c)	123	321	742	931	1,173
Total Supply (Operational View) **	(d) = a + b + c	61,820	61,897	61,213	63,879	63,853
<u>Demand - Integrated System Total Gross Requirements</u>						
2016 May Mid Load Forecast Before DSM*		-58,334	-59,013	-60,413	-61,371	-62,309
Expected LNG Load		-61	-148	-148	-252	-1,265
Sub-total	(e)	-58,395	-59,162	-60,561	-61,624	-63,574
<u>Existing and Committed Demand Side Management & Others Measures</u>						
SMI Theft Reduction		83	83	83	83	83
Voltage and VAR Optimization		67	152	171	188	219
2016 DSM Plan F16 savings		982	970	939	940	935
<u>Planned Demand Side Management Measures</u>						
2016 DSM Plan F17 to F19 savings		389	988	1,679	1,896	1,931
2016 DSM Plan F20+ savings		0	0	0	292	904
Sub-total	(f)	1,521	2,192	2,873	3,399	4,072
Surplus / (Deficit) (Operational View) **		(g) = d + e + f	4,945	4,928	3,524	5,654
Surplus / Deficit as % of Net Load (Planning View) **			113%	115%	115%	114%
Small Gap Surplus/(Deficit) (Operational View) **			7,266	7,487	6,536	9,044
Large Gap Surplus/(Deficit) (Operational View) **			2,559	2,036	(70)	(661)
* 2016 Integrated System Load Forecast with losses						
** See section 3.4.2 for description of Operational versus Planning view						

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(MW)		F2017	F2018	F2019	F2020	F2021	F2022
<u>Existing and Committed Heritage Resources</u>							
Heritage Resources (including Site C)	(a)	11,372	11,410	11,416	11,416	11,416	11,480
<u>Existing and Committed IPP Resources</u>							
	(b)	1,593	1,685	1,633	1,583	1,502	1,473
14% of Supply Requiring Reserves***	(c)	-1,787	-1,805	-1,798	-1,792	-1,780	-1,785
Effective Load Carrying Capability	(d) = a + b + c	11,178	11,290	11,250	11,208	11,138	11,168
<u>Demand - Integrated System Peak</u>							
2016 May Mid Load Forecast Before DSM*		-10,776	-11,021	-11,209	-11,374	-11,541	-11,737
Expected LNG Load		-19	-19	-19	-72	-222	-329
Sub-total	(e)	-10,795	-11,039	-11,228	-11,447	-11,763	-12,066
<u>Existing and Committed Demand Side Management & Others Measures</u>							
SMI Theft Reduction		11	11	11	11	11	11
Voltage and VAR Optimization		0	0	0	0	0	0
2016 DSM Plan F16 savings		216	214	210	211	210	207
Sub-total	(f)	227	226	222	222	221	218
		F2017	F2018	F2019	F2020	F2021	F2022
Surplus / (Deficit) **	(g) = d + e + f	610	476	244	(17)	(404)	(680)
Low Load Forecast Surplus / (Deficit) **		1,030	944	792	600	297	110
High Load Forecast Surplus / (Deficit) **		160	(74)	(434)	(845)	(1,348)	(1,758)
* 2016 Integrated System Load Forecast with losses							
** Planning View is shown in this table. Capacity load resource balances are only shown in Planning View. See section 3.4.2.							
*** This is also referred to as the Planning Reserve - the system generating capacity beyond that required to meet peak demand t							

In our model, we have moved Site C from the Existing and Committed Heritage Resources to Future Resources.

It is important to note that no load forecast data are provided for either the high or the low forecast. Instead, the surplus/deficit line is restated for “small gap” and “large gap” scenarios. It is explained in the IRP that, for BC Hydro, the “small gap” represents a possible future where load growth is low, DSM performance is high and IPP renewals are high; “large gap” refers to the opposite. In our modelling, we used these values to estimate low and high load growth scenarios, in effect attributing the entire difference between the reference, small gap and large gap scenarios to load variations.

7.2 Market price and exchange rate forecasts

Another important data category is that of economic parameters, including market price forecasts and exchange rate forecasts.

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Appendix 5A of the IRP presented detailed market price forecasts. Tables 6 and 7 presented forecast buy and sell prices (respectively) over a 25-year period (through 2040) under five (5) scenarios, as shown in Figure 14.

Figure 14: Market price forecasts from the IRP

Table 6 B.C. Buy Electricity Market Price Forecasts by Market Scenario (Real 2012 US\$/MWh at B.C. Border)¹					
Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas
2014	29.8	26.6	36.0	29.8	36.0
2015	30.3	26.5	36.9	30.3	36.9
2016	30.6	25.9	36.9	30.6	36.9
2017	31.9	26.8	38.4	31.9	38.4
2018	31.9	26.4	38.8	31.9	38.8
2019	32.9	26.8	40.5	32.9	40.5
2020	32.9	26.6	41.0	32.9	41.0
2021	34.2	27.2	42.4	34.2	42.4
2022	35.0	27.5	43.8	35.9	46.4
2023	36.7	28.0	46.8	40.5	57.4

Table 7 B.C. Sell Electricity Market Price Forecasts by Market Scenario (Real 2012 US\$/MWh at B.C. Border)²					
Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas
2014	20.2	17.1	26.2	20.2	26.2
2015	20.7	17.0	27.0	20.7	27.0
2016	21.0	16.4	27.0	21.0	27.0
2017	22.2	17.3	28.5	22.2	28.5
2018	22.2	16.9	28.9	22.2	28.9
2019	23.2	17.3	30.4	23.2	30.4
2020	23.2	17.1	31.0	23.2	31.0
2021	24.4	17.7	32.3	24.4	32.3
2022	25.1	17.9	33.7	26.0	36.2
2023	26.8	18.5	36.6	30.5	46.8

The original RRA filing did not present a detailed market price forecast. However, in response to an IR from the BCUC, BC Hydro provided a Mid-C price forecast through

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2033, along with a forecast of USD/CAD exchange rates and a methodology for deriving buy and sell prices therefrom.⁹⁸

This method produces the market price forecasts (sell) shown in Figure 15.⁹⁹

Figure 15: Market price forecasts – sell

Year	Mid-C Market Prices ¹⁰⁰	Exchange rate	Mid-C Market Prices	Wheeling/loss Adjuster	B.C. Border Sell Price - Calendar Year	B.C. Border Sell Price - Fiscal Year
	\$2016 USD/MWh	(USD/CAD)	\$2016 CAD/MWh	\$2016 CAD/MWh	\$2016 CAD/MWh	\$2016 CAD/MWh
2017	23.2	0.78	29.74	6.3	23.44	
2018	24.1	0.8	30.13	6.3	23.83	23.54
2019	27.2	0.82	33.17	6.3	26.87	24.59
2020	30.2	0.82	36.83	6.3	30.53	27.79
2021	32.5	0.82	39.63	6.3	33.33	31.23
2022	33.7	0.82	41.10	6.3	34.80	33.70
2023	35.0	0.82	42.68	6.3	36.38	35.19
2024	35.4	0.82	43.17	6.3	36.87	36.50
2025	36.2	0.82	44.15	6.3	37.85	37.11
2026	37.2	0.82	45.37	6.3	39.07	38.15
2027	38.1	0.82	46.46	6.3	40.16	39.34
2028	38.6	0.82	47.07	6.3	40.77	40.32
2029	39.9	0.82	48.66	6.3	42.36	41.17
2030	41.4	0.82	50.49	6.3	44.19	42.82
2031	43.0	0.82	52.44	6.3	46.14	44.68
2032	43.8	0.82	53.41	6.3	47.11	46.38
2033	44.7	0.82	54.51	6.3	48.21	47.39
2034	45.6	0.82	55.63	6.3	49.33	48.49
2035	46.6	0.82	56.78	6.3	50.48	49.62
2036	47.5	0.82	57.94	6.3	51.64	50.77
2037	48.5	0.82	59.13	6.3	52.83	51.94

The prices in this table reflect a single price forecast. In reality, there is considerable uncertainty respecting the potential value of surplus energy sales from the Site C Project. Specifically, these forecasts are very sensitive to the future evolution of the USD/CAD exchange rate, to electricity prices, to natural gas prices, and to carbon

⁹⁸ RRA, Response to Information Request BCUC 2.310.1.

⁹⁹ This table is similar to Table 1 of BCUC 2.310.1, but corrects calculation errors found in that table.

¹⁰⁰“Mid-C” refers to the Mid-Columbia electricity hub, a reference location for electricity prices in the United States Northwest, the market region into which electricity from the Site C Project would be exported.

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prices, among other factors. This exchange rate forecast is considerably lower the one found in the 2013 IRP, which used a fixed exchange rate of 0.9693 USD/CAD.

Over the last 20 years, the USD/CAD exchange rate has fluctuated within a range of some 20% above and below the current rate. It is thus highly unlikely that the exchange rate will in fact remain flat, as presumed by both of these forecasts. Ideally, a Monte Carlo simulation approach should be used to ensure that this risk is captured, both for exchange rates and for electricity and gas prices. Failing to capture the uncertainty associated with future exchange rate variations, natural gas prices and other variables understates the financial risks associated with the Project. However, time and resource constraints have not allowed us to implement this type of analysis.

8 Appendix B: Scenario results: Energy and Capacity Balances

Load Resource Balance including Planned Resources

CAPACITY

Scenario: A1
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	13,119	13,114	13,607	13,798	14,293	14,279	14,273	14,282	14,703	14,709	14,717	14,695	14,843	15,060
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,808	-1,807	-1,875	-1,902	-1,970	-1,968	-1,967	-1,968	-2,026	-2,027	-2,028	-2,025	-2,046
Capacity market reliance	0	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0	133	338	371	400
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,311	11,354	11,800	11,923	12,391	12,309	12,305	12,315	12,735	12,683	12,823	13,005	13,189	13,414
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity focused DSM	0	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360	390
Total DSM	293	392	494	578	706	818	884	968	1,037	1,103	1,165	1,222	1,275	1,324	1,368	1,412	1,454	1,501	1,556	1,566
Surplus / Deficit 2016 (capacity)	688	688	574	422	222	199	62	0	321	308	645	385	222	50	286	52	0	0	0	3

Load Resource Balance including Planned Resources

ENERGY

Scenario: A1
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,500
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	430	500	500
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	64,345	67,881	69,326	69,453	69,448	69,453	69,545	69,672	69,783	69,906	70,463	70,648	72,018
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total DSM	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
DSM as % of load growth		99%	65%	62%	64%	59%	55%	52%	49%	46%	44%	42%	41%	39%	37%	35%	34%	32%	32%	29%
Surplus / Deficit (GWh) 2016	4,946	4,918	3,533	5,706	4,537	3,441	2,791	2,402	5,145	5,667	5,103	4,334	3,563	2,737	1,915	992	315	0	-501	-194

Scenario: A1
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	371	419	410	402	394	387	379	372	364	357	350	343	2,293
Site C GHG cost	0	0	0	0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	18.4	15.7	13.4	11.4	9.7	8.3	153
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	134
Market reliance	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	13	34	37	40	53
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	5	6	6	10	386	464	477	463	449	437	426	416	419	431	425	427	2,483
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	45
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	62	44	52
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	62	174	101
TRADE REVENUE																					
Surplus sales revenues (\$M)	-103	-116	-87	-159	-142	-116	-98	-88	-191	-216	-201	-175	-147	-117	-86	-46	-15	0	0	0	-1,412
Surplus capacity revenues		-6	-5	-3	-1	-1	0	0	-2	-2	-5	-3	-1	1	-2	0	0	0	0	1	-23
Subtotal	-103	-122	-92	-162	-143	-117	-98	-88	-193	-218	-206	-178	-148	-117	-87	-46	-15	0	0	1	-1,434
ADDL DSM COSTS																					
Addl DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity-focussed DSM	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
Subtotal	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
TOTAL INCREMENTAL COSTS	-103	-122	-92	-162	-138	-110	-92	-76	196	250	277	292	310	331	350	384	420	474	506	622	1,367

Load Resource Balance including Planned Resources
CAPACITY

Scenario: B1
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	91	91	181	181	272	272	272
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	110	110	110	110	110	110	110	110	110	120
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	12,705	12,700	12,653	12,698	12,815	13,215	13,209	13,797	13,804	13,900	13,908	13,977	14,125	14,126
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,751	-1,750	-1,744	-1,750	-1,766	-1,821	-1,820	-1,901	-1,902	-1,916	-1,917	-1,926	-1,947
Capacity market reliance	0	0	0	0	0	0	231	250	380	400	400	258	400	0	159	175	322	369	370	400
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,128	11,199	11,283	11,354	11,465	11,707	11,788	11,976	12,062	12,173	12,315	12,429	12,568	12,579
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-59	-53	-62	-97	-85	-59	-25	17	70	105	148	193	254	317	389	438	506	551	656
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	363	500	607	728	884	1,005	1,123	1,233	1,353	1,449	1,549	1,648	1,757	1,865	1,980	2,072	2,187	2,287	2,402
Surplus / Deficit 2016 (capacity)	688	659	581	451	244	265	0	0	0	-11	3	110	78	145	110	110	110	110	110	4

Load Resource Balance including Planned Resources

ENERGY

Scenario: B1
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	1,000	2,000	2,000	3,000	3,000	3,000
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	343	0	188	0	0	0	0	354
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	63,957	63,446	64,226	64,348	64,343	64,691	65,440	65,755	66,678	66,801	67,928	68,043	68,124
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-333	-312	-360	-564	-481	-341	-146	97	419	632	901	1,194	1,575	1,985	2,439	2,775	3,182	3,457	4,083
total DSM	1,521	1,861	2,561	3,040	3,509	4,192	4,772	5,358	5,909	6,509	6,988	7,482	7,965	8,502	9,041	9,622	10,085	10,551	10,962	11,399
DSM as % of load growth		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Surplus / Deficit (GWh) 2016	4,946	4,586	3,222	5,347	3,974	2,961	2,450	1,868	807	986	630	130	-5	207	-17	326	-15	647	351	-5

Scenario: B1
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	87
Market reliance	0	0	0	0	0	0	23	25	38	40	40	26	40	0	16	18	32	37	37	40	216
Storage	0	0	0	0	0	0	0	0	0	0	14	13	13	13	13	12	12	12	12	12	60
Subtotal	52	51	50	49	48	47	69	70	82	83	96	81	94	81	96	97	110	114	113	116	920
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	80	80	160	160	240	240	240	507
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	19	0	12	0	1	0	0	23	25
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	19	80	92	160	161	240	240	534
TRADE REVENUE																					
Surplus sales revenues (\$M)	-103	-108	-79	-149	-124	-100	-86	-68	-30	-38	-25	-5	0	-9	0	-15	0	-31	-17	0	-757
Surplus capacity revenues		-6	-5	-4	-1	-2	0	0	0	0	1	0	0	0	0	0	0	0	0	1	-15
Subtotal	-103	-114	-84	-152	-126	-101	-86	-68	-30	-38	-24	-5	0	-9	0	-15	0	-31	-18	1	-771
ADDL DSM COSTS																					
Addl DSM	0	-11	-10	-12	-19	-16	-11	-5	3	14	21	30	39	52	66	80	92	105	114	135	268
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-9	-7	-7	-13	-8	-2	6	15	27	36	46	57	71	87	103	116	130	141	163	416
TOTAL INCREMENTAL COSTS	-51	-72	-41	-110	-90	-63	-19	8	68	73	109	122	171	224	275	345	387	454	477	544	1,098

Load Resource Balance including Planned Resources

CAPACITY

Scenario: C1
 Resource strategy: Suspend Site C
 Load Forecast: medium
 Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	13,119	13,114	13,067	13,112	13,119	13,593	13,587	13,596	13,729	14,295	14,303	14,281	14,429	14,834
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,808	-1,807	-1,801	-1,807	-1,808	-1,873	-1,872	-1,874	-1,892	-1,970	-1,971	-1,968	-1,989
Capacity market reliance	0	0	0	0	0	0	0	0	23	54	150	0	0	108	96	0	0	10	0	0
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,311	11,306	11,283	11,365	11,462	11,785	11,714	11,832	11,952	12,403	12,333	12,319	12,461	12,845
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-59	-53	-62	-97	-85	-59	-25	17	70	105	148	193	254	317	389	438	506	551	656
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	363	500	607	728	884	1,005	1,123	1,233	1,353	1,449	1,549	1,648	1,757	1,865	1,980	2,072	2,187	2,287	2,402
Surplus / Deficit 2016 (capacity)	688	659	581	451	244	265	183	107	0	0	0	188	4	0	0	340	128	0	3	271

Load Resource Balance including Planned Resources

ENERGY

Scenario: C1
Resource strategy: Suspend Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	343	400	0	0	0	0	0	0
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	63,957	63,446	64,226	64,353	64,348	64,696	65,233	69,007	69,783	69,906	70,033	70,148	69,876
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-333	-312	-360	-564	-481	-341	-146	97	419	632	901	1,194	1,575	1,985	2,439	2,775	3,182	3,457	4,083
total DSM	1,521	1,861	2,561	3,040	3,509	4,192	4,772	5,358	5,909	6,509	6,988	7,482	7,965	8,502	9,041	9,622	10,085	10,551	10,962	11,399
DSM as % of load growth		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Surplus / Deficit (GWh) 2016	4,946	4,586	3,222	5,347	3,974	2,961	2,450	1,868	807	986	635	135	0	0	3,235	3,431	3,090	2,752	2,456	1,747

Scenario: C1
Resource strategy: Suspend Site C
Load Forecast: medium
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	457	448	439	431	422	414	406	1,328
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	89
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	28	28	118
Market reliance	0	0	0	0	0	0	0	0	2	5	15	0	0	11	10	0	0	1	0	0	24
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	2	5	20	35	35	502	501	513	497	484	469	456	1,470
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	18	22	0	0	0	0	0	0	21
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	18	22	0	0	0	0	0	0	21
TRADE REVENUE																					
Surplus sales revenues (\$M)	-103	-108	-79	-149	-124	-100	-86	-68	-30	-38	-25	-5	0	0	-145	-159	-146	-133	-122	-89	-1,069
Surplus capacity revenues		-6	-5	-4	-1	-2	-1	0	0	0	0	-1	1	0	0	-2	0	0	1	-2	-17
Subtotal	-103	-114	-84	-152	-126	-101	-87	-68	-30	-38	-25	-6	1	0	-145	-162	-147	-133	-121	-90	-1,086
ADDL DSM COSTS																					
Addl DSM	0	-11	-10	-12	-19	-16	-11	-5	3	14	21	30	39	52	66	80	92	105	114	135	268
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-9	-7	-7	-13	-8	-2	6	15	27	36	46	57	71	87	103	116	130	141	163	416
TOTAL INCREMENTAL COSTS	-103	-123	-91	-159	-138	-110	-89	-63	-12	-5	31	75	111	595	443	455	466	481	489	529	910

Load Resource Balance including Planned Resources

CAPACITY

Scenario: A1-CE
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	13,628	13,774	13,766	13,747	13,715	13,772	13,769	13,764	14,257	14,448	14,943	14,929	14,923	14,932	15,353	15,359	15,367	15,345	15,493	15,484
Required reserves	-1,878	-1,878	-1,898	-1,897	-1,895	-1,890	-1,898	-1,898	-1,897	-1,965	-1,991	-2,059	-2,057	-2,057	-2,058	-2,116	-2,117	-2,118	-2,115	-2,135
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
Effective Load Carrying Capability	11,750	11,896	11,868	11,850	11,820	11,882	11,871	11,866	12,360	12,483	12,952	12,870	12,866	12,875	13,295	13,243	13,250	13,227	13,378	13,411
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity focused DSM	0	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360	390
Total DSM	293	392	494	578	706	818	884	968	1,037	1,103	1,165	1,222	1,275	1,324	1,368	1,412	1,454	1,501	1,556	1,566
Surplus / Deficit 2016 (capacity)	1,249	1,249	1,135	983	782	760	622	512	881	868	1,206	946	783	610	846	612	427	222	189	0

Load Resource Balance including Planned Resources

ENERGY

Scenario: A1-CE
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	1970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	366
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	65,923	66,315	69,851	71,296	71,423	71,418	71,423	71,515	71,642	71,753	71,876	72,003	72,118	72,212
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total DSM	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
DSM as % of load growth		99%	65%	62%	64%	59%	55%	52%	49%	46%	44%	42%	41%	39%	37%	35%	34%	32%	32%	29%
Surplus / Deficit (GWh) 2016	6,916	6,888	5,503	7,676	6,507	5,411	4,761	4,372	7,115	7,637	7,073	6,304	5,533	4,707	3,885	2,962	2,285	1,540	969	0

Scenario: A1-CE
Resource strategy: Complete Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	371	419	410	402	394	387	379	372	364	357	350	343	2,293
Site C GHG cost	0	0	0	0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	18.4	15.7	13.4	11.4	9.7	8.3	153
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	134
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	7	7	7	7	11	13	13	12	393	471	483	469	456	444	432	422	413	403	395	393	2,511
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	9
Subtotal	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	123	882
TRADE REVENUE																					
Surplus sales revenues (\$M)	-145	-162	-135	-213	-203	-182	-168	-160	-264	-291	-278	-254	-228	-202	-174	-137	-108	-75	-48	0	-2,219
Surplus capacity revenues		-11	-10	-9	-7	-7	-5	-4	-8	-8	-11	-8	-7	-5	-7	-5	-3	-1	-1	0	-83
Subtotal	-145	-174	-146	-222	-210	-189	-173	-164	-272	-299	-289	-263	-235	-207	-181	-143	-112	-76	-49	0	-2,298
ADDL DSM COSTS																					
Addl DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity-focussed DSM	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
Subtotal	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
TOTAL INCREMENTAL COSTS	-97	-121	-91	-161	-137	-110	-91	-79	197	251	278	293	311	332	351	385	409	440	462	535	1,311

Load Resource Balance including Planned Resources

CAPACITY

Scenario: B1-CE
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	91	91
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	13,628	13,774	13,766	13,747	13,715	13,772	13,355	13,350	13,303	13,348	13,355	13,755	13,749	14,246	14,253	14,259	14,267	14,336	14,484	14,475
Required reserves	-1,878	-1,878	-1,898	-1,897	-1,895	-1,890	-1,898	-1,841	-1,840	-1,833	-1,840	-1,841	-1,896	-1,895	-1,963	-1,964	-1,965	-1,966	-1,976	-1,996
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
Effective Load Carrying Capability	11,750	11,896	11,868	11,850	11,820	11,882	11,457	11,509	11,463	11,515	11,515	11,914	11,853	12,351	12,290	12,295	12,302	12,369	12,508	12,575
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-59	-53	-62	-97	-85	-59	-25	17	70	105	148	193	254	317	389	438	506	551	656
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	363	500	607	728	884	1,005	1,123	1,233	1,353	1,449	1,549	1,648	1,757	1,865	1,980	2,072	2,187	2,287	2,402
Surplus / Deficit 2016 (capacity)	1,249	1,219	1,141	1,012	805	826	329	311	180	149	53	317	143	519	338	231	97	50	50	0

Load Resource Balance including Planned Resources

ENERGY

Scenario: B1-CE
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	1,000	1,000
Canadian Entitlement	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	384
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	65,923	65,927	65,416	66,196	66,323	66,318	66,323	66,415	66,542	66,653	66,791	67,903	68,018	68,130
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-333	-312	-360	-564	-481	-341	-146	97	419	632	901	1,194	1,575	1,985	2,439	2,775	3,182	3,457	4,083
total DSM	1,521	1,861	2,561	3,040	3,509	4,192	4,772	5,358	5,909	6,509	6,988	7,482	7,965	8,502	9,041	9,622	10,085	10,551	10,962	11,399
DSM as % of load growth		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Surplus / Deficit (GWh) 2016	6,916	6,556	5,192	7,317	5,944	4,931	4,420	3,838	2,777	2,956	2,605	2,105	1,627	1,182	770	301	-25	622	326	0

Scenario: B1-CE
Resource strategy: Cancel Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	87
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	58	57	56	55	54	54	53	52	51	50	49	48	47	75	74	73	73	72	71	80	728
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	80	80	95
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	24	10
Subtotal	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	96	176	178	204	979
TRADE REVENUE																					
Surplus sales revenues (\$M)	-145	-154	-128	-203	-186	-166	-156	-140	-103	-113	-102	-85	-67	-51	-34	-14	0	-30	-16	0	-1,376
Surplus capacity revenues		-11	-10	-9	-7	-7	-2	-2	-1	0	0	-2	0	-4	-2	-1	0	1	1	0	-48
Subtotal	-145	-166	-138	-212	-193	-173	-158	-142	-104	-113	-102	-87	-67	-55	-37	-15	0	-30	-16	0	-1,422
ADDL DSM COSTS																					
Addl DSM	0	-11	-10	-12	-19	-16	-11	-5	3	14	21	30	39	52	66	80	92	105	114	135	268
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-9	-7	-7	-13	-8	-2	6	15	27	36	46	57	71	87	103	116	130	141	163	416
TOTAL INCREMENTAL COSTS	-45	-71	-40	-110	-89	-62	-38	-13	35	39	60	87	119	176	212	253	284	348	374	448	701

Load Resource Balance including Planned Resources

CAPACITY

Scenario: C1-CE
Resource strategy: Suspend Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	13,628	13,774	13,766	13,747	13,715	13,772	13,769	13,764	13,717	13,762	13,769	14,243	14,237	14,246	14,379	14,945	14,953	14,931	15,079	15,484
Required reserves	-1,878	-1,878	-1,898	-1,897	-1,895	-1,890	-1,898	-1,898	-1,897	-1,890	-1,897	-1,898	-1,963	-1,962	-1,963	-1,982	-2,060	-2,061	-2,058	-2,078
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Effective Load Carrying Capability	11,750	11,896	11,868	11,850	11,820	11,882	11,871	11,866	11,820	11,872	11,872	12,345	12,274	12,284	12,416	12,963	12,893	12,870	13,021	13,406
Peak Demand																				
Capacity Load Forecast before DSM	10,776	11,021	11,209	11,374	11,541	11,737	11,930	12,119	12,313	12,515	12,708	12,943	13,155	13,386	13,614	13,840	14,074	14,303	14,542	14,774
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,794	11,039	11,227	11,445	11,744	11,940	12,133	12,322	12,516	12,718	12,911	13,146	13,358	13,589	13,817	14,043	14,277	14,506	14,745	14,977
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-59	-53	-62	-97	-85	-59	-25	17	70	105	148	193	254	317	389	438	506	551	656
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	363	500	607	728	884	1,005	1,123	1,233	1,353	1,449	1,549	1,648	1,757	1,865	1,980	2,072	2,187	2,287	2,402
Surplus / Deficit 2016 (capacity)	1,249	1,219	1,141	1,012	805	826	743	668	537	506	410	748	564	452	464	900	688	551	563	831

Load Resource Balance including Planned Resources

ENERGY

Scenario:
Resource strategy:
Load Forecast:
Canadian Entitlement:

C1-CE
Suspend Site C
medium
yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	1970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	65,923	65,927	65,416	66,196	66,323	66,318	66,323	66,803	70,977	71,753	71,876	72,003	72,118	71,846
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	58,395	59,152	60,552	61,614	63,448	65,114	66,275	67,447	68,548	69,749	70,706	71,695	72,661	73,735	74,813	75,974	76,901	77,832	78,654	79,528
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-333	-312	-360	-564	-481	-341	-146	97	419	632	901	1,194	1,575	1,985	2,439	2,775	3,182	3,457	4,083
total DSM	1,521	1,861	2,561	3,040	3,509	4,192	4,772	5,358	5,909	6,509	6,988	7,482	7,965	8,502	9,041	9,622	10,085	10,551	10,962	11,399
DSM as % of load growth		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Surplus / Deficit (GWh) 2016	6,916	6,556	5,192	7,317	5,944	4,931	4,420	3,838	2,777	2,956	2,605	2,105	1,627	1,570	5,205	5,401	5,060	4,722	4,426	3,717

Scenario: C1-CE
Resource strategy: Suspend Site C
Load Forecast: medium
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	457	448	439	431	422	414	406	1,328
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	89
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	28	28	118
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	7	7	7	7	7	7	7	7	7	7	11	41	41	497	498	520	504	489	475	463	1,527
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
TRADE REVENUE																					
Surplus sales revenues (\$M)	-145	-154	-128	-203	-186	-166	-156	-140	-103	-113	-102	-85	-67	-67	-233	-250	-240	-229	-220	-189	-1,927
Surplus capacity revenues		-11	-10	-9	-7	-7	-6	-6	-4	-4	-3	-6	-5	-4	-4	-8	-6	-5	-5	-7	-79
Subtotal	-145	-166	-138	-212	-193	-173	-162	-146	-107	-117	-106	-91	-72	-71	-236	-258	-246	-233	-224	-196	-2,002
ADDL DSM COSTS																					
Addl DSM	0	-11	-10	-12	-19	-16	-11	-5	3	14	21	30	39	52	66	80	92	105	114	135	268
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-9	-7	-7	-13	-8	-2	6	15	27	36	46	57	71	87	103	116	130	141	163	416
TOTAL INCREMENTAL COSTS	-97	-122	-90	-159	-137	-109	-88	-62	-13	-8	19	76	108	582	437	456	467	482	490	530	903

Load Resource Balance including Planned Resources

CAPACITY

Scenario: A2
 Resource strategy: Complete Site C
 Load Forecast: high
 Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	127	218	218	218	218	218	218	218	218	381	498	498	662	662
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	80	80	80	80	80	80	80	160	380	1,020	1,020	1,020	1,020	1,090	1,090	1,300
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,145	13,690	13,814	13,900	14,393	14,584	14,591	14,657	14,871	15,520	15,941	16,110	16,235	16,283	16,595	16,796
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,812	-1,887	-1,904	-1,916	-1,984	-2,010	-2,011	-2,020	-2,049	-2,139	-2,197	-2,220	-2,237	-2,244	-2,287
Capacity market reliance	0	0	0	195	400	35	183	269	0	38	230	400	400	400	0	60	207	400	296	400
Effective Load Carrying Capability	11,189	11,335	11,307	11,484	11,740	11,913	12,110	12,265	12,477	12,638	12,811	13,046	13,251	13,870	13,802	13,973	14,222	14,446	14,646	14,909
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity focused DSM	0	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360	390
Total DSM	293	392	494	578	706	818	884	968	1,037	1,103	1,165	1,222	1,275	1,324	1,368	1,412	1,454	1,501	1,556	1,566
Surplus / Deficit 2016 (capacity)	268	220	26	0	0	0	0	0	30	0	0	4	-4	378	78	0	0	4	0	1

Load Resource Balance including Planned Resources

ENERGY

Scenario: A2
Resource strategy: Complete Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	1,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	4,200	5,500	5,500	7,300	7,300
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	126	126	126	126	126	126	126	252	599	1,608	1,608	1,608	1,608	1,719	1,719	2,050
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	500	500	324	0	0	0	0	500	500	500	500	500	500	500	500
Total Supply	61,820	61,877	61,213	63,921	64,039	64,509	65,979	67,195	70,407	71,852	71,979	72,100	72,952	74,053	74,180	76,091	77,514	77,752	79,667	79,726
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total DSM	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
DSM as % of load growth		99%	65%	62%	64%	59%	55%	52%	49%	46%	44%	42%	41%	39%	37%	35%	34%	32%	32%	29%
Surplus / Deficit (GWh) 2016	2,606	2,360	521	2,273	734	-396	-42	126	2,747	2,228	1,436	530	330	228	-823	-288	60	-795	366	-785

Scenario: A2
Resource strategy: Complete Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	371	419	410	402	394	387	379	372	364	357	350	343	2,293
Site C GHG cost	0	0	0	0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	18.4	15.7	13.4	11.4	9.7	8.3	153
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	0	0	19	40	3	18	27	0	4	23	40	40	40	0	6	21	40	30	40	216
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	19	51	45	59	67	421	503	506	515	520	559	508	504	509	525	506	525	3,059
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	112	192	192	192	192	192	192	192	192	336	440	440	584	584	1,941
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	41	26	16	0	0	0	0	27	28	76	46	30	79	31	81	235
Subtotal	0	0	0	0	7	48	145	215	200	200	200	208	257	321	371	488	579	638	738	815	2,592
TRADE REVENUE																					
Surplus sales revenues (\$M)	-54	-56	-13	-63	-23	0	0	-5	-102	-85	-56	-21	-14	-10	0	0	-3	0	-18	0	-370
Surplus capacity revenues		-1	1	0	1	0	0	0	1	0	0	1	0	-3	0	0	1	1	0	1	1
Subtotal	-54	-57	-12	-63	-22	0	0	-5	-101	-85	-56	-20	-14	-13	0	0	-2	1	-18	1	-369
ADDL DSM COSTS																					
Addl DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity-focussed DSM	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
Subtotal	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
TOTAL INCREMENTAL COSTS	-54	-57	-12	-44	36	93	204	279	522	622	656	710	772	879	892	1,005	1,102	1,180	1,244	1,360	5,498

Load Resource Balance including Planned Resources

CAPACITY

Scenario: B2
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	91	181	181	299	299	390	390	489	580	580	671	671	761	761
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	280	280	280	280	280	280	280	280	280	280	280	390	490	670	670	790
Total Supply	12,978	12,710	12,702	12,683	12,931	13,476	13,978	14,063	14,016	14,179	14,186	14,263	14,257	14,365	14,463	14,579	14,778	14,936	15,174	15,285
Required reserves	-1,789	-1,789	-1,752	-1,751	-1,748	-1,782	-1,857	-1,926	-1,938	-1,932	-1,954	-1,955	-1,966	-1,965	-1,980	-1,993	-2,009	-2,037	-2,058	-2,091
Capacity market reliance	0	204	266	400	400	247	0	16	235	119	258	352	400	282	400	400	400	400	400	400
Effective Load Carrying Capability	11,189	11,125	11,217	11,332	11,583	11,941	12,120	12,152	12,314	12,367	12,490	12,660	12,691	12,683	12,883	12,986	13,168	13,299	13,516	13,594
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-40	5	31	41	101	159	213	234	371	422	483	548	630	709	806	874	962	1,014	1,135
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	382	558	700	866	1,070	1,223	1,361	1,450	1,654	1,766	1,884	2,003	2,133	2,257	2,397	2,508	2,643	2,750	2,881
Surplus / Deficit 2016 (capacity)	268	0	0	-30	3	280	349	280	280	280	280	280	164	0	49	-2	0	-1	64	1

Load Resource Balance including Planned Resources

ENERGY

Scenario: B2
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	1,000	2,000	2,000	3,300	3,300	4,300	4,300	5,400	6,400	6,400	7,400	7,400	8,400	8,400
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-17	-21	-29	-29	-35
Market Purchases	0	0	0	0	0	441	150	0	500	0	332	0	500	67	0	208	0	161	0	273
Total Supply	61,820	61,877	61,213	63,921	63,901	64,312	65,090	65,945	65,934	67,514	67,973	68,636	69,141	69,899	70,960	71,273	72,185	72,464	73,419	73,414
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-224	25	187	231	581	919	1,247	1,389	2,232	2,558	2,959	3,390	3,914	4,438	5,063	5,537	6,054	6,363	7,062
total DSM	1,521	1,970	2,897	3,586	4,303	5,253	6,032	6,751	7,201	8,322	8,914	9,540	10,161	10,841	11,494	12,246	12,847	13,423	13,868	14,378
DSM as % of load growth		66%	66%	68%	70%	70%	69%	68%	65%	68%	68%	67%	67%	67%	66%	66%	66%	66%	65%	65%
Surplus / Deficit (GWh) 2016	2,606	2,137	546	2,460	827	-12	-12	123	-338	121	-12	25	-91	-12	395	-43	267	-29	480	-35

Scenario: B2
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	20	27	40	40	25	0	2	24	12	26	35	40	28	40	40	40	40	40	40	320
Storage	0	0	0	0	39	38	38	37	36	35	35	34	33	33	32	44	54	72	70	81	376
Subtotal	52	71	77	89	127	138	112	112	132	119	131	139	143	129	140	151	160	177	175	185	1,484
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	80	160	160	264	264	344	344	432	512	512	592	592	672	672	2,681
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	11
Market Purchases	0	0	0	0	0	21	8	0	42	0	18	0	32	4	0	15	0	12	0	19	96
Subtotal	0	0	0	0	1	22	89	161	203	265	283	345	377	437	513	528	594	606	674	694	2,789
TRADE REVENUE																					
Surplus sales revenues (\$M)	-54	-50	-13	-68	-26	0	0	-4	0	-5	0	-1	0	0	-18	0	-13	0	-24	0	-215
Surplus capacity revenues		1	0	0	1	-2	-2	-2	-2	-2	-2	-2	-1	0	1	0	1	0	0	1	-6
Subtotal	-54	-49	-13	-68	-25	-2	-2	-6	-2	-6	-2	-3	-1	0	-17	0	-12	0	-23	1	-222
ADDL DSM COSTS																					
Addl DSM	0	-7	1	6	8	19	30	41	46	74	84	98	112	129	146	167	183	200	210	233	852
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-6	4	11	14	27	39	52	58	87	99	114	130	149	167	190	207	225	237	262	1,000
TOTAL INCREMENTAL COSTS	-3	16	67	31	117	185	238	318	391	465	512	596	649	715	803	868	949	1,009	1,063	1,142	5,051

Load Resource Balance including Planned Resources

CAPACITY

Scenario: C2
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	91	181	181	299	299	390	390	489	489	489	489	489	489	489
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280
Total Supply	12,978	12,710	12,702	12,683	12,931	13,476	13,978	14,063	14,016	14,179	14,186	14,263	14,257	14,365	14,912	15,478	15,486	15,464	15,612	15,603
Required reserves	-1,789	-1,789	-1,752	-1,751	-1,748	-1,782	-1,857	-1,926	-1,938	-1,932	-1,954	-1,955	-1,966	-1,965	-1,980	-2,055	-2,133	-2,134	-2,131	-2,152
Capacity market reliance	0	204	266	400	400	247	0	16	235	119	258	352	400	282	182	0	95	250	251	400
Effective Load Carrying Capability	11,189	11,125	11,217	11,332	11,583	11,941	12,120	12,152	12,314	12,367	12,490	12,660	12,691	12,683	13,115	13,423	13,448	13,580	13,732	13,852
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-40	5	31	41	101	159	213	234	371	422	483	548	630	709	806	874	962	1,014	1,135
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	382	558	700	866	1,070	1,223	1,361	1,450	1,654	1,766	1,884	2,003	2,133	2,257	2,397	2,508	2,643	2,750	2,881
Surplus / Deficit 2016 (capacity)	268	0	0	-30	3	280	349	280	280	280	280	280	164	0	280	435	280	280	280	259

Load Resource Balance including Planned Resources

ENERGY

Scenario: C2
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	1,000	2,000	2,000	3,300	3,300	4,300	4,300	5,400	5,400	5,400	5,400	5,400	5,400	5,400
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12
Market Purchases	0	0	0	0	0	441	150	0	500	0	332	0	500	0	0	0	0	0	0	0
Total Supply	61,820	61,877	61,213	63,921	63,901	64,312	65,090	65,945	65,934	67,514	67,973	68,636	69,141	70,221	74,395	75,171	75,294	75,421	75,536	75,264
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-224	25	187	231	581	919	1,247	1,389	2,232	2,558	2,959	3,390	3,914	4,438	5,063	5,537	6,054	6,363	7,062
total DSM	1,521	1,970	2,897	3,586	4,303	5,253	6,032	6,751	7,201	8,322	8,914	9,540	10,161	10,841	11,494	12,246	12,847	13,423	13,868	14,378
DSM as % of load growth		66%	66%	68%	70%	70%	69%	68%	65%	68%	68%	67%	67%	67%	66%	66%	66%	66%	65%	65%
Surplus / Deficit (GWh) 2016	2,606	2,137	546	2,460	827	-12	-12	123	-338	121	-12	25	-91	309	3,830	3,854	3,376	2,927	2,597	1,815

Scenario: C2
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	457	448	439	431	422	414	406	1,328
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	89
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	20	27	40	40	25	0	2	24	12	26	35	40	28	18	0	9	25	25	40	266
Storage	0	0	0	0	39	38	38	37	36	35	35	34	33	33	32	31	31	30	29	29	307
Subtotal	0	20	27	40	79	91	66	67	88	76	94	104	108	552	542	545	537	538	524	525	2,132
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	80	160	160	264	264	344	344	432	432	432	432	432	432	432	2,284
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
Market Purchases	0	0	0	0	0	21	8	0	42	0	18	0	32	0	0	0	0	0	0	0	75
Subtotal	0	0	0	0	1	22	89	161	203	265	283	345	377	433	433	433	433	433	433	433	2,368
TRADE REVENUE																					
Surplus sales revenues (\$M)	-54	-50	-13	-68	-26	0	0	-4	0	-5	0	-1	0	-13	-171	-179	-160	-142	-129	-92	-577
Surplus capacity revenues		1	0	0	1	-2	-2	-2	-2	-2	-2	-2	-1	0	-2	-3	-2	-2	-2	-2	-13
Subtotal	-54	-49	-13	-68	-25	-2	-2	-6	-2	-6	-2	-3	-1	-13	-173	-182	-162	-144	-131	-94	-590
ADDL DSM COSTS																					
Addl DSM	0	-7	1	6	8	19	30	41	46	74	84	98	112	129	146	167	183	200	210	233	852
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-6	4	11	14	27	39	52	58	87	99	114	130	149	167	190	207	225	237	262	1,000
TOTAL INCREMENTAL COSTS	-54	-35	17	-18	69	138	191	273	347	421	474	560	614	1,120	969	985	1,015	1,052	1,063	1,126	5,000

Load Resource Balance including Planned Resources

CAPACITY

Scenario: A2-CE
Resource strategy: Complete Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	118	118	118	118	118	118	236	335	444	444	571	571
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	120	120	120	190	460	460	730
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	13,628	13,774	13,766	13,747	13,715	14,260	14,257	14,252	14,863	15,054	15,061	15,047	15,041	15,170	15,709	15,814	16,001	16,249	16,524	16,785
Required reserves	-1,878	-1,878	-1,898	-1,897	-1,895	-1,890	-1,965	-1,965	-1,964	-2,048	-2,075	-2,076	-2,074	-2,073	-2,091	-2,165	-2,179	-2,205	-2,239	-2,277
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	71	288	400	106	324	400	400	361	400
Effective Load Carrying Capability	11,750	11,896	11,868	11,850	11,820	12,370	12,292	12,287	12,899	13,005	12,986	13,042	13,255	13,497	13,724	13,973	14,222	14,444	14,646	14,908
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity focused DSM	0	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360	390
Total DSM	293	392	494	578	706	818	884	968	1,037	1,103	1,165	1,222	1,275	1,324	1,368	1,412	1,454	1,501	1,556	1,566
Surplus / Deficit 2016 (capacity)	829	781	587	366	80	457	182	22	452	367	175	0	0	5	0	0	0	2	0	0

Load Resource Balance including Planned Resources

ENERGY

Scenario: A2-CE
Resource strategy: Complete Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	1,300	1,300	1,300	1,300	1,300	1,300	2,600	3,700	4,900	4,900	6,300	6,300
Canadian Entitlement	1970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	189	189	189	300	725	725	1,151
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	98	500	0	0	0	0	0	500	500	500	500	500	500	500
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	66,021	66,815	71,151	72,596	72,723	72,718	72,723	73,504	74,931	76,142	77,576	78,128	79,643	79,797
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total DSM	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
DSM as % of load growth		99%	65%	62%	64%	59%	55%	52%	49%	46%	44%	42%	41%	39%	37%	35%	34%	32%	32%	29%
Surplus / Deficit (GWh) 2016	4,576	4,330	2,491	4,243	2,578	948	0	-254	3,491	2,972	2,180	1,148	101	-321	-72	-237	122	-419	342	-714

Scenario: A2-CE
Resource strategy: Complete Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	371	419	410	402	394	387	379	372	364	357	350	343	2,293
Site C GHG cost	0	0	0	0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	18.4	15.7	13.4	11.4	9.7	8.3	153
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	0	0	0	0	0	0	0	0	0	0	7	29	40	11	32	40	40	36	40	123
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	7	7	7	7	11	41	41	40	421	499	483	476	485	493	453	464	468	481	468	485	2,800
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	104	104	104	104	104	104	208	296	392	392	504	504	1,316
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	5	37	0	0	0	0	0	45	33	43	30	56	31	77	165
Subtotal	41	46	48	55	62	66	74	109	177	179	182	183	185	246	341	443	536	594	685	765	2,454
TRADE REVENUE																					
Surplus sales revenues (\$M)	-96	-102	-61	-118	-81	-32	0	0	-130	-113	-86	-46	-4	0	0	0	-6	0	-17	0	-661
Surplus capacity revenues		-7	-5	-3	0	-4	-1	1	-4	-3	-1	0	0	1	0	0	0	1	0	0	-20
Subtotal	-96	-109	-66	-121	-80	-36	-1	1	-133	-116	-87	-46	-4	1	0	0	-6	1	-17	0	-679
ADDL DSM COSTS																					
Addl DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity-focussed DSM	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
Subtotal	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
TOTAL INCREMENTAL COSTS	-48	-56	-11	-59	-7	72	114	151	468	566	584	621	675	751	806	921	1,013	1,092	1,154	1,270	4,791

Load Resource Balance including Planned Resources

CAPACITY

Scenario: B2-CE
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	127	127	127	254	254	363	453	453	544	544	544
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	150	170	350
Total Supply	13,628	13,360	13,352	13,333	13,301	13,846	14,257	14,252	14,205	14,377	14,384	14,370	14,491	14,500	14,616	14,712	14,800	14,939	15,107	15,278
Required reserves	-1,878	-1,878	-1,841	-1,840	-1,837	-1,833	-1,908	-1,965	-1,964	-1,958	-1,981	-1,982	-1,980	-1,997	-1,998	-2,014	-2,028	-2,040	-2,059	-2,082
Capacity market reliance	0	0	0	0	116	0	0	0	0	0	0	0	16	180	217	290	400	400	400	400
Effective Load Carrying Capability	11,750	11,482	11,511	11,493	11,580	12,013	12,349	12,287	12,241	12,419	12,403	12,388	12,527	12,683	12,835	12,988	13,173	13,299	13,448	13,596
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-40	5	31	41	101	159	213	234	371	422	483	548	630	709	806	874	962	1,014	1,135
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	382	558	700	866	1,070	1,223	1,361	1,450	1,654	1,766	1,884	2,003	2,133	2,257	2,397	2,508	2,643	2,750	2,881
Surplus / Deficit 2016 (capacity)	829	357	294	131	0	352	578	415	207	332	192	8	0	0	0	0	5	-1	-4	3

Load Resource Balance including Planned Resources

ENERGY

Scenario: B2-CE
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	1,400	1,400	1,400	2,800	2,800	4,000	5,000	5,000	6,000	6,000	6,000
Canadian Entitlement	1970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	-7	-7	-15
Market Purchases	0	0	0	0	0	0	0	0	500	0	262	500	109	500	11	0	117	0	0	500
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	65,923	65,927	65,916	67,596	67,985	68,218	69,232	69,715	70,553	71,653	71,889	72,896	73,011	73,231
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
DSM & Other Measures																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-224	25	187	231	581	919	1,247	1,389	2,232	2,558	2,959	3,390	3,914	4,438	5,063	5,537	6,054	6,363	7,062
total DSM	1,521	1,970	2,897	3,586	4,303	5,253	6,032	6,751	7,201	8,322	8,914	9,540	10,161	10,841	11,494	12,246	12,847	13,423	13,868	14,378
DSM as % of load growth		66%	66%	68%	70%	70%	69%	68%	65%	68%	68%	67%	67%	67%	66%	66%	66%	66%	65%	65%
Surplus / Deficit (GWh) 2016	4,576	4,107	2,516	4,430	2,809	1,529	821	105	-356	204	0	-393	0	-197	-12	337	-29	403	72	-218

Scenario: B2-CE
Resource strategy: Cancel Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	0	0	0	12	0	0	0	0	0	0	0	2	18	22	29	40	40	40	40	108
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	16	18	36	31
Subtotal	58	57	56	55	66	82	81	80	79	78	77	77	77	93	96	102	121	128	129	147	1,008
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	112	112	112	224	224	320	400	400	480	480	480	1,511
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
Market Purchases	0	0	0	0	0	0	0	0	43	0	14	47	6	39	1	0	9	0	0	46	106
Subtotal	41	46	48	55	62	66	69	72	116	187	203	239	311	347	409	491	502	576	578	627	2,491
TRADE REVENUE																					
Surplus sales revenues (\$M)	-96	-97	-62	-123	-88	-52	-29	-4	0	-8	0	0	0	0	0	-16	0	-20	-4	0	-485
Surplus capacity revenues		-3	-2	0	0	-3	-5	-3	-1	-2	-1	1	0	0	0	0	1	0	0	1	-14
Subtotal	-96	-99	-64	-123	-88	-54	-34	-7	-1	-10	-1	1	0	0	0	-16	1	-20	-4	1	-498
ADDL DSM COSTS																					
Addl DSM	0	-7	1	6	8	19	30	41	46	74	84	98	112	129	146	167	183	200	210	233	852
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-6	4	11	14	27	39	52	58	87	99	114	130	149	167	190	207	225	237	262	1,000
TOTAL INCREMENTAL COSTS	4	-1	45	-3	54	121	156	197	252	343	379	430	518	589	673	768	831	910	941	1,036	4,000

Load Resource Balance including Planned Resources

CAPACITY

Scenario: C2-CE
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	127	127	127	254	254	254	254	254	254	254	254
Canadian Entitlement	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	13,628	13,360	13,352	13,333	13,301	13,846	14,257	14,252	14,205	14,377	14,384	14,370	14,491	14,500	15,047	15,613	15,621	15,599	15,747	15,738
Required reserves	-1,878	-1,878	-1,841	-1,840	-1,837	-1,833	-1,908	-1,965	-1,964	-1,958	-1,981	-1,982	-1,980	-1,997	-1,998	-2,074	-2,152	-2,153	-2,150	-2,170
Capacity market reliance	0	0	0	0	116	0	0	0	0	0	0	0	16	180	0	0	0	0	0	25
Effective Load Carrying Capability	11,750	11,482	11,511	11,493	11,580	12,013	12,349	12,287	12,241	12,419	12,403	12,388	12,527	12,683	13,048	13,539	13,469	13,446	13,597	13,593
Peak Demand																				
Capacity Load Forecast before DSM	11,196	11,489	11,757	11,991	12,243	12,528	12,791	13,030	13,281	13,538	13,773	14,061	14,327	14,613	14,889	15,182	15,473	15,740	15,999	16,271
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	11,214	11,507	11,775	12,062	12,446	12,731	12,994	13,233	13,484	13,741	13,976	14,264	14,530	14,816	15,092	15,385	15,676	15,943	16,202	16,474
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-40	5	31	41	101	159	213	234	371	422	483	548	630	709	806	874	962	1,014	1,135
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	382	558	700	866	1,070	1,223	1,361	1,450	1,654	1,766	1,884	2,003	2,133	2,257	2,397	2,508	2,643	2,750	2,881
Surplus / Deficit 2016 (capacity)	829	357	294	131	0	352	578	415	207	332	192	8	0	0	214	551	301	146	145	0

Load Resource Balance including Planned Resources

ENERGY

Scenario: C2-CE
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	1,400	1,400	1,400	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
Canadian Entitlement	1970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970	1,970
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	500	0	262	500	109	309	0	0	0	0	0	0
Total Supply	63,790	63,847	63,183	65,891	65,883	65,853	65,923	65,927	65,916	67,596	67,985	68,218	69,232	69,912	73,777	74,553	74,676	74,803	74,918	74,646
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	60,735	61,710	63,564	65,047	67,377	69,577	71,134	72,573	73,472	75,714	76,899	78,151	79,393	80,752	82,059	83,562	84,764	85,916	86,806	87,827
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-224	25	187	231	581	919	1,247	1,389	2,232	2,558	2,959	3,390	3,914	4,438	5,063	5,537	6,054	6,363	7,062
total DSM	1,521	1,970	2,897	3,586	4,303	5,253	6,032	6,751	7,201	8,322	8,914	9,540	10,161	10,841	11,494	12,246	12,847	13,423	13,868	14,378
DSM as % of load growth		66%	66%	68%	70%	70%	69%	68%	65%	68%	68%	67%	67%	67%	66%	66%	66%	66%	65%	65%
Surplus / Deficit (GWh) 2016	4,576	4,107	2,516	4,430	2,809	1,529	821	105	-356	204	0	-393	0	0	3,212	3,237	2,759	2,310	1,980	1,197

Scenario: C2-CE
Resource strategy: Suspend Site C
Load Forecast: high
Canadian Entitlement: yes

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	457	448	439	431	422	414	406	1,328
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	89
Revelstoke Unit 6	0	0	0	0	0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	231
Market reliance	0	0	0	0	12	0	0	0	0	0	0	0	2	18	0	0	0	0	0	3	20
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	7	7	7	7	18	35	35	35	35	35	40	41	43	515	498	520	504	489	475	465	1,660
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	112	112	112	224	224	224	224	224	224	224	224	1,003
Canadian Entitlement	41	46	48	55	62	66	69	72	73	75	78	79	81	84	88	91	93	96	98	100	873
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	43	0	14	47	6	17	0	0	0	0	0	0	73
Subtotal	41	46	48	55	62	66	69	72	116	187	203	239	311	325	312	315	317	320	322	324	1,949
TRADE REVENUE																					
Surplus sales revenues (\$M)	-96	-97	-62	-123	-88	-52	-29	-4	0	-8	0	0	0	0	-143	-150	-131	-112	-98	-61	-772
Surplus capacity revenues		-3	-2	0	0	-3	-5	-3	-1	-2	-1	1	0	0	-1	-5	-2	0	0	0	-19
Subtotal	-96	-99	-64	-123	-88	-54	-34	-7	-1	-10	-1	1	0	0	-145	-155	-133	-112	-99	-61	-789
ADDL DSM COSTS																					
Addl DSM	0	-7	1	6	8	19	30	41	46	74	84	98	112	129	146	167	183	200	210	233	852
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-6	4	11	14	27	39	52	58	87	99	114	130	149	167	190	207	225	237	262	1,000
TOTAL INCREMENTAL COSTS	-48	-52	-5	-51	6	74	110	151	207	299	341	395	484	989	833	870	895	921	936	990	3,909

Load Resource Balance including Planned Resources

CAPACITY

Scenario: A3
Resource strategy: Complete Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site C	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	13,119	12,700	13,193	13,798	13,805	13,791	14,199	14,208	14,215	14,221	14,229	14,207	14,355	14,346
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,808	-1,750	-1,818	-1,902	-1,903	-1,901	-1,957	-1,958	-1,959	-1,960	-1,961	-1,958	-1,978
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,311	10,892	11,443	11,980	11,903	11,888	12,298	12,251	12,257	12,262	12,269	12,246	12,397	12,368
Peak Demand																				
Capacity Load Forecast before DSM	10,326	10,469	10,531	10,547	10,598	10,659	10,692	10,819	10,947	11,083	11,247	11,418	11,558	11,702	11,879	12,052	12,232	12,400	12,551	12,717
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,344	10,487	10,549	10,618	10,801	10,862	10,895	11,022	11,150	11,286	11,450	11,621	11,761	11,905	12,082	12,255	12,435	12,603	12,754	12,920
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity focused DSM	0	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360	390
Total DSM	293	392	494	578	706	818	884	968	1,037	1,103	1,165	1,222	1,275	1,324	1,368	1,412	1,454	1,501	1,556	1,566
Surplus / Deficit 2016 (capacity)	1,138	1,240	1,252	1,249	1,165	1,277	1,300	838	1,330	1,797	1,618	1,489	1,812	1,670	1,543	1,419	1,288	1,144	1,199	1,014

Load Resource Balance including Planned Resources

ENERGY

Scenario: A3
Resource strategy: Complete Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	64,345	67,881	69,326	69,453	69,448	69,453	69,545	69,672	69,783	69,906	70,033	70,148	69,876
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	56,028	56,259	56,958	57,253	58,497	59,439	59,729	60,531	60,755	62,315	63,128	63,898	64,405	65,030	65,837	66,707	67,386	68,077	68,497	69,039
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total DSM	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
DSM as % of load growth		99%	65%	62%	64%	59%	55%	52%	49%	46%	44%	42%	41%	39%	37%	35%	34%	32%	32%	29%
Surplus / Deficit (GWh) 2016	7,313	7,811	7,127	10,067	9,488	9,116	9,337	9,318	12,938	13,101	12,681	12,131	11,819	11,442	10,891	10,259	9,830	9,325	9,156	8,153

Scenario: A3
Resource strategy: Complete Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	371	419	410	402	394	387	379	372	364	357	350	343	2,293
Site C GHG cost	0	0	0	0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	18.4	15.7	13.4	11.4	9.7	8.3	153
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	5	6	6	5	386	464	448	434	421	409	398	387	378	369	360	352	2,293
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRADE REVENUE																					
Surplus sales revenues (\$M)	-153	-184	-175	-280	-296	-307	-329	-340	-480	-500	-499	-489	-487	-490	-487	-476	-466	-452	-454	-414	-4,484
Surplus capacity revenues		-11	-12	-11	-11	-12	-12	-7	-12	-17	-15	-14	-17	-16	-14	-13	-12	-10	-11	-9	-150
Subtotal	-153	-195	-187	-291	-307	-319	-341	-348	-492	-517	-514	-503	-504	-506	-501	-489	-478	-463	-465	-423	-4,626
ADDL DSM COSTS																					
Addl DSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity-focussed DSM	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
Subtotal	0	0	0	0	0	0	0	2	3	5	6	8	9	11	12	14	15	17	18	20	63
TOTAL INCREMENTAL COSTS	-153	-195	-187	-291	-302	-313	-334	-341	-103	-48	-60	-61	-74	-86	-91	-88	-85	-78	-87	-52	-2,117

Load Resource Balance including Planned Resources

CAPACITY

Scenario: B3
Resource strategy: Cancel Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	13,119	12,700	12,653	12,698	12,705	12,691	13,099	13,108	13,115	13,121	13,129	13,107	13,255	13,246
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,808	-1,750	-1,744	-1,750	-1,751	-1,749	-1,805	-1,806	-1,807	-1,808	-1,809	-1,806	-1,827
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,311	10,892	10,903	10,954	10,955	10,940	11,350	11,303	11,309	11,314	11,321	11,298	11,449	11,419
Peak Demand																				
Capacity Load Forecast before DSM	10,326	10,469	10,531	10,547	10,598	10,659	10,692	10,819	10,947	11,083	11,247	11,418	11,558	11,702	11,879	12,052	12,232	12,400	12,551	12,717
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,344	10,487	10,549	10,618	10,801	10,862	10,895	11,022	11,150	11,286	11,450	11,621	11,761	11,905	12,082	12,255	12,435	12,603	12,754	12,920
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-106	-158	-232	-321	-375	-420	-413	-439	-352	-324	-294	-283	-255	-211	-160	-126	-81	-70	0
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	316	395	437	504	594	644	735	777	931	1,020	1,107	1,172	1,248	1,337	1,431	1,508	1,600	1,666	1,749
Surplus / Deficit 2016 (capacity)	1,138	1,164	1,153	1,109	963	1,054	1,059	605	530	599	525	426	761	645	564	490	394	294	361	249

Load Resource Balance including Planned Resources

ENERGY

Scenario: B3
Resource strategy: Cancel Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	63,957	63,446	64,226	64,353	64,348	64,353	64,445	64,572	64,683	64,806	64,933	65,048	64,776
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	56,028	56,259	56,958	57,253	58,497	59,439	59,729	60,531	60,755	62,315	63,128	63,898	64,405	65,030	65,837	66,707	67,386	68,077	68,497	69,039
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-596	-925	-1,357	-1,856	-2,135	-2,431	-2,421	-2,617	-2,115	-1,974	-1,814	-1,751	-1,594	-1,320	-1,012	-799	-513	-439	22
total DSM	1,521	1,598	1,947	2,043	2,217	2,538	2,683	3,084	3,196	3,976	4,382	4,767	5,021	5,333	5,737	6,172	6,511	6,857	7,067	7,338
DSM as % of load growth		11%	20%	17%	17%	19%	18%	20%	19%	25%	26%	27%	27%	27%	28%	29%	29%	30%	29%	29%
Surplus / Deficit (GWh) 2016	7,313	7,216	6,202	8,711	7,633	6,982	6,907	6,510	5,887	5,887	5,607	5,217	4,969	4,748	4,472	4,148	3,931	3,713	3,618	3,075

Scenario: B3
Resource strategy: Cancel Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	52	51	50	49	48	47	46	45	44	43	43	42	41	40	39	39	38	37	36	36	557
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRADE REVENUE																					
Surplus sales revenues (\$M)	-153	-170	-152	-242	-238	-235	-243	-238	-218	-225	-221	-210	-205	-203	-200	-192	-186	-180	-179	-156	-2,532
Surplus capacity revenues		-11	-11	-10	-9	-10	-10	-5	-4	-5	-4	-3	-7	-5	-5	-4	-3	-2	-3	-1	-79
Subtotal	-153	-180	-163	-252	-247	-245	-253	-243	-223	-230	-225	-214	-211	-209	-204	-196	-189	-182	-182	-158	-2,608
ADDL DSM COSTS																					
Addl DSM	0	-20	-31	-45	-61	-70	-80	-80	-86	-70	-65	-60	-58	-53	-44	-33	-26	-17	-14	1	-580
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-18	-28	-40	-55	-63	-71	-69	-74	-56	-50	-43	-40	-33	-23	-11	-2	9	13	29	-432
TOTAL INCREMENTAL COSTS	-101	-148	-141	-243	-254	-261	-278	-267	-253	-242	-232	-215	-210	-202	-188	-169	-154	-136	-133	-93	-2,483

Load Resource Balance including Planned Resources

CAPACITY

Scenario: C3
Resource strategy: Suspend Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Existing and Committed Heritage Resources</u>	11,372	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525	11,525
<u>Existing and Committed IPP Resources</u>	1593	1685	1633	1583	1502	1473	1179	1144	1081	1037	1037	987	950	818	818	814	808	754	730	675
<u>Future Supply-Side Resources</u>																				
IPP Renewals	9	23	55	79	120	135	419	441	450	486	486	514	538	671	671	674	680	705	862	901
Standing Offer Program Renewals	4	6	12	19	27	34	41	49	56	64	71	79	86	94	101	108	116	123	138	145
Mica 1-4	0	0	0	0	0	0	0	-414	-414	-414	-414	-414	0	0	0	0	0	0	0	0
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	540	1,100	1,100	1,100	1,100	1,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	12,978	13,124	13,116	13,097	13,065	13,122	13,119	12,700	12,653	12,698	12,705	12,691	13,099	13,108	13,655	14,221	14,229	14,207	14,355	14,346
Required reserves	-1,789	-1,789	-1,809	-1,808	-1,805	-1,801	-1,808	-1,808	-1,750	-1,744	-1,750	-1,751	-1,749	-1,805	-1,806	-1,882	-1,960	-1,961	-1,958	-1,978
Capacity market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Effective Load Carrying Capability	11,189	11,335	11,307	11,289	11,260	11,321	11,311	10,892	10,903	10,954	10,955	10,940	11,350	11,303	11,849	12,339	12,269	12,246	12,397	12,368
Peak Demand																				
Capacity Load Forecast before DSM	10,326	10,469	10,531	10,547	10,598	10,659	10,692	10,819	10,947	11,083	11,247	11,418	11,558	11,702	11,879	12,052	12,232	12,400	12,551	12,717
LNG Load	19	18	18	71	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
Total Capacity Requirements	10,344	10,487	10,549	10,618	10,801	10,862	10,895	11,022	11,150	11,286	11,450	11,621	11,761	11,905	12,082	12,255	12,435	12,603	12,754	12,920
DSM & Other Measures																				
RRA Base Case	293	392	494	578	706	818	884	938	977	1,013	1,045	1,072	1,095	1,114	1,128	1,142	1,154	1,171	1,196	1,176
Additional DSM	0	-106	-158	-232	-321	-375	-420	-413	-439	-352	-324	-294	-283	-255	-211	-160	-126	-81	-70	0
Capacity focused DSM	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570
Total DSM	293	316	395	437	504	594	644	735	777	931	1,020	1,107	1,172	1,248	1,337	1,431	1,508	1,600	1,666	1,749
Surplus / Deficit 2016 (capacity)	1,138	1,164	1,153	1,109	963	1,054	1,059	605	530	599	525	426	761	645	1,104	1,515	1,342	1,243	1,309	1,197

Load Resource Balance including Planned Resources

ENERGY

Scenario: C3
Resource strategy: Suspend Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036
<u>Heritage Resources</u>	48,445	46,895	46,014	48,491	48,491	48,491	48,491	48,469	47,948	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677	48,677
<u>Existing and Committed IPP Resources</u>	13,198	14,592	14,337	14,364	14,097	13,782	13,547	13,210	12,814	12,414	12,307	11,983	11,467	10,720	10,259	10,203	10,163	10,015	9,476	8,110
<u>Future Supply-Side Resources</u>																				
IPP Renewals	106	260	571	647	779	936	1,114	1,349	1,628	1,951	2,032	2,223	2,617	3,328	3,788	3,828	3,863	4,011	4,549	5,515
Standing Offer Program Renewals	71	130	291	419	546	674	801	929	1,056	1,184	1,311	1,439	1,566	1,694	1,821	1,949	2,076	2,204	2,320	2,448
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	26	26	26	26	26	26	26	26	26	26
Site C	0	0	0	0	0	0	0	0	0	0	0	0	0	388	4,435	5,100	5,100	5,100	5,100	5,100
Clean Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Supply	61,820	61,877	61,213	63,921	63,913	63,883	63,953	63,957	63,446	64,226	64,353	64,348	64,353	64,833	69,007	69,783	69,906	70,033	70,148	69,876
<u>Demand - Total Gross Requirements</u>																				
Load Forecast Before DSM	58,334	59,013	60,413	61,371	62,309	63,675	64,836	66,008	67,109	68,310	69,267	70,256	71,222	72,296	73,374	74,535	75,462	76,393	77,215	78,089
LNG	61	139	139	243	1,139	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439	1,439
Energy Demand Before Conservation	56,028	56,259	56,958	57,253	58,497	59,439	59,729	60,531	60,755	62,315	63,128	63,898	64,405	65,030	65,837	66,707	67,386	68,077	68,497	69,039
<u>DSM & Other Measures</u>																				
RRA Base Case	1,521	2,193	2,872	3,399	4,072	4,672	5,113	5,504	5,812	6,090	6,356	6,581	6,771	6,927	7,056	7,183	7,310	7,369	7,505	7,316
Additional DSM	0	-596	-925	-1,357	-1,856	-2,135	-2,431	-2,421	-2,617	-2,115	-1,974	-1,814	-1,751	-1,594	-1,320	-1,012	-799	-513	-439	22
total DSM	1,521	1,598	1,947	2,043	2,217	2,538	2,683	3,084	3,196	3,976	4,382	4,767	5,021	5,333	5,737	6,172	6,511	6,857	7,067	7,338
DSM as % of load growth		11%	20%	17%	17%	19%	18%	20%	19%	25%	26%	27%	27%	27%	28%	29%	29%	30%	29%	29%
Surplus / Deficit (GWh) 2016	7,313	7,216	6,202	8,711	7,633	6,982	6,907	6,510	5,887	5,887	5,607	5,217	4,969	5,136	8,907	9,248	9,031	8,813	8,718	8,175

Scenario: C3
Resource strategy: Suspend Site C
Load Forecast: low
Canadian Entitlement: no

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033	F2034	F2035	F2036	
CAPACITY COSTS																					PV (\$ millions)
Site C Capital Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	457	448	439	431	422	414	406	1,328
Site C GHG cost	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.5	6.3	5.2	15.1	45.5	38.1	31.8	26.5	22.0	89
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market reliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	5	6	6	462	463	485	469	454	441	428	1,328
ENERGY COSTS																					
Addl Wind costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Entitlement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Purchases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRADE REVENUE																					
Surplus sales revenues (\$M)	-153	-170	-152	-242	-238	-235	-243	-238	-218	-225	-221	-210	-205	-220	-398	-429	-428	-427	-433	-415	-3,150
Surplus capacity revenues		-11	-11	-10	-9	-10	-10	-5	-4	-5	-4	-3	-7	-5	-10	-14	-12	-11	-12	-11	-103
Subtotal	-153	-180	-163	-252	-247	-245	-253	-243	-223	-230	-225	-214	-211	-225	-408	-443	-440	-439	-445	-426	-3,248
ADDL DSM COSTS																					
Addl DSM	0	-20	-31	-45	-61	-70	-80	-80	-86	-70	-65	-60	-58	-53	-44	-33	-26	-17	-14	1	-580
Capacity-focussed DSM	0	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	148
Subtotal	0	-18	-28	-40	-55	-63	-71	-69	-74	-56	-50	-43	-40	-33	-23	-11	-2	9	13	29	-432
TOTAL INCREMENTAL COSTS	-153	-199	-191	-292	-302	-308	-324	-312	-297	-286	-270	-250	-245	204	33	31	26	24	9	31	-2,263