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August 30, 2017

VIA ELECTRONIC MAIL

British Columbia Utilities Commission
6th Floor, 900 Howe Street
Vancouver, B.C.
V6Z 2N3

Attention: Patrick Wruck, Commission Secretary and Manager, Regulatory Support

Dear Sirs/Mesdames:

Re: Site C Inquiry – Data and Analysis

We are counsel to the Commercial Energy Consumers Association of British Columbia (the "CEC"). Attached please find the CEC's submissions with respect to the data and analysis relevant to the Commission's Inquiry into Site C.

If you have any questions regarding the foregoing, please do not hesitate to contact the undersigned.

Yours truly,

OWEN BIRD LAW CORPORATION

Christopher P. Weafer

CPW/jj
cc: CEC
cc: Registered Interveners

INTERLAW MEMBER OF INTERLAW, AN INTERNATIONAL ASSOCIATION OF INDEPENDENT LAW FIRMS IN MAJOR WORLD CENTRES

British Columbia Hydro and Power Authority British Columbia Utilities Commission Inquiry Respecting Site C - Project No. 1598922

Submission by:

Commercial Energy Consumers Association of British Columbia

Data and Analysis

COMMERCIAL ENERGY CONSUMERS ASSOCIATION OF BRITISH COLUMBIA

Site C Inquiry – Data and Analysis

Date: August 30, 2017

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1. The Commercial Energy Consumers Association of BC (the "CEC") represents the interests of commercial ratepayers in energy related matters before the British Columbia Utilities Commission ("BCUC" or "Commission"). The CEC has made representations before the Commission for over 15 years in this regard and employs a consultant with over 45 years of experience in the energy industry.

2. On August 2, 2017, the Commission was tasked with advising the BC Lieutenant Governor In Council with regard to the status and future costs of the Site C hydroelectric energy generation project ("Site C"). Further to the Commission Inquiry established with respect to this matter, the CEC provides the following submissions.

A. Terms of Reference and CEC Submission

3. The Terms of Reference as outlined in the Lieutenant Governor Order in Council ("LGIC") of August 2, 2017, (Section 3(a)) requires the Commission to advise on the implications of:

   a) Completing the Site C project by 2024, as currently planned;

   b) Suspending the Site C project, while maintaining the option to resume construction until 2024; and

   c) Terminating construction and remediating the site.

4. Section 3(b) of the Terms of Reference outlines specific questions to which the Commission must respond. These are summarized in the BCUC Site C Inquiry Submissions webpage and include the following:

   a) Whether the project is on time and within budget;

   b) The cost to ratepayers of suspending the project;

   c) The cost to ratepayers of terminating the project;

   d) Given the energy objectives set out in the *Clean Energy Act*, 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?

5. Additionally, the Terms of Reference stipulate that the Commission must use the forecast of peak capacity demand and energy demand submitted as part of the BC Hydro's most recent Revenue Requirements Application but should also consider factors that will influence the demand. The Commission may obtain expert advice on any subject relevant to the Inquiry.

6. The CEC notes that specific answers to several of the above questions outlined in 3(b) require access to technical and financial information, detailed project reporting and other confidential information that is not available in the public domain. Accordingly, the CEC will, for the most part, limit its submission to presenting, from a ratepayer perspective, what it believes are the appropriate decision-making principles for the Commission to use in order to advise the LGIC on the implications of completing, suspending and/or terminating the project. In addition, given data limitations, the CEC will assess, across a range of possible data, where the key decision judgments are, that will require Commission consideration to provide helpful defensible advice to the Government from

this Inquiry given the short period of time the Commission and the public has been given to comment. These submissions will be supplemented by the CEC in later stages of the Inquiry when other data comes available.

B. Review of Current Planning

7. Part A of the Order in Council requires the Commission to advise on the following issues:

   a) Implications of completing the Site C project by 2024, as currently planned;

   b) Implications of suspending the Site C project, while maintaining the option to resume construction until 2024; and

   c) Implications of terminating construction and remediating the site.

8. The CEC considers that a fundamental determination in responding to the above items is an assessment of BC Hydro's current load resource balance and Site C's role within that balance.

9. A critical element of a load resource balance is the forecast of demand and supply. Understanding the role of forecast demand, actual demand and the availability of supply in creating the optimal load resource balance for the province is critical to serving the public interest and ratepayer interest in this Inquiry.

10. Traditionally BC Hydro has generated a 'load forecast', its expectation of future demand over a given planning horizon, to which it manages its supply. The load forecast has embedded uncertainty which increases significantly with the increased planning horizon. It is important to recognize that a load forecast of electricity demand several years in the future contains the distinct likelihood of a significant quantum of deviation from the earlier forecast. Further, historical practice has resulted in substantial over forecasting in the longer-term out from the forecasts. As reasonably expected, BC Hydro's long term load forecasts have significantly more absolute deviation from their shorter-term forecasts. In some cases, the inaccuracy in the forecast can be just as great in the near term as in the long term. This circumstance is in evidence in the BC Hydro Revenue Requirement proceeding. BC Hydro's current practice has resulted in supply planning and supply acquisition occurring several years prior to expected need. This involves decision making based on an uncertain load forecast. Over forecasting bias in the load forecasting at the time of planning and supply acquisition has the potential to result in excess supply over a given period. At this time, BC Hydro is carrying a significant surplus as a consequence of over forecasting of demand or actual demand deviating well below forecast.

11. The CEC understands that BC Hydro plans its supply to meet its load forecast, and has not adequately compensated for potential deviation of the actual from the forecast. BC Hydro has demonstrated challenges in managing matching its load and supply over time

so as to optimize the benefits for the public interest and for ratepayers from its resource planning. Further BC Hydro's planning sets its Demand Side Management activities as a fixed target to be achieved rather than using it as a cost effectiveness optimization opportunity.

12. BC Hydro manages variances in the load resource balance from actual demand with additional energy purchases and/ or energy sales to market. Depending on the marginal costs of over-supply, purchases or sales can be beneficial or detrimental to ratepayers and the public interest.

13. The CEC submits that the optimal planning for the load resource balance is one in which the actual supply curve closely matches the actual demand curve as long as it is cost effective to do so, based on the levelized cost of the demand management and supply options. To the extent that BC Hydro's cost of supply is below that at which it is able to sell any surplus, there are potential benefits to ratepayers from having a surplus. Similarly, where the cost of BC Hydro's supply is above the cost of its appropriate sale alternatives, it is beneficial for BC Hydro to be in a position to acquire energy and capacity where necessary to remain in balance.

14. Being able to tailor supply to demand over the shorter term, where the load forecast has significantly less deviation from actual avoids unnecessary risk of acquiring surpluses or requiring large purchases of energy when it is not cost effective to do so. Tailoring supply to demand represents a value to BC Hydro and ratepayers and to the public interest. Managing supply to a shorter forecast horizon would significantly reduce the risk of acquiring significant surpluses or deficits. Similarly, having the opportunity to acquire inexpensive energy when required would reduce the risk of having significant surpluses or deficits.

15. Under such a methodology the ability for BC Hydro to respond to any load deficits and surpluses within a reasonably short period is essential to optimally managing the load resource balance. Accordingly, the availability or 'ramp up' time for demand management and supply development and acquisition, plus the dispatchability of any sources of supply are key considerations in establishing an optimal supply plan and assessing the implications of continuing, suspending or terminating construction of the Site C dam project.

16. The CEC submits that an analysis of the costs of proceeding with, suspending or terminating Site C should recognize the risks associated with issues that affect planning to a distant and uncertain load forecast.

17. The CEC submits that optimization planning to a nearer term forecast, with the ability to acquire cost-effective energy when in a deficit position and sell energy cost-effectively when in surplus offers an optimal strategy for BC Hydro and an appropriate principle behind any analysis of the Site C termination and/or suspension.

18. The CEC submits that BC Hydro could justifiably acquire all energy supply within reason that could cost-effectively be sold in the market for the benefit of ratepayers, and need not acquire energy or capacity in advance of need unless there is a profitable rationale for doing so and an effective approach to optimizing the acquisition.

19. The CEC submits that an analysis of Site C and its alternatives should also address any appended economic costs and benefits of the project, such as those related to economic development, job creation, community benefits etc. and their future status.

20. The CEC recognizes that the analysis of the Site C project and alternative energy supply options must consider the context of the project's ongoing development. In a forward-looking assessment of the Site C project the historical costs of the project are appropriately treated as 'sunk costs' and the CEC notes that such 'sunk costs' will continue to accrue as the project progresses during the inquiry until a decision is enacted. Also the financial carrying costs or interest during construction, which continues in regard to 'sunk costs' is itself a sunk cost.

21. The CEC submits that an appropriate analysis should rely on incremental future costs and benefits for each alternative.

22. The CEC notes that it is to be expected that the data regarding costs, benefits and other implications will change over the course of the Inquiry, and similarly that important data will of necessity be estimates and will therefore be subject to some uncertainty and/or be open to interpretation for which clarity may not be available. The CEC therefore submits that an appropriate analysis will consider a 'range' of expectations for the data rather than relying upon a fixed data point. The CEC has prepared this submission and will base future submissions in the Inquiry based on this principle.

23. The CEC has made calculations to aid its assessment which it will rely on to assist the Commission in its determinations regarding the implications of the decisions in regard to the Site C dam and its alternatives. The calculations provide a theoretical basis for evaluating the options such that the CEC can make its own judgements regarding the nature of the costs and benefit uncertainties and conduct sensitivity analysis based on the level of uncertainty it deems applicable and those will be the basis of its recommendations.

24. The CEC does not address appended issues such as those related to employment, environment or other considerations as they are explicitly outside the scope of this inquiry.

C. General Context – Load Resource Balance

25. In the CEC's view, a meaningful analysis of the Site C project must consider the context in which it will be operating.

26. Among other factors the value of Site C as an energy and capacity producing project is dependent upon the applicable Load Resource Balance (LBR) and other factors including:

- Requirement for energy and capacity (demand) and the ability to influence/alter this requirement;
- Volumes of energy and capacity planned to come from specific sources;
- Cost to produce the energy and capacity;
- Volumes of energy and capacity potentially available from alternatives;
- Cost and characteristics of alternative options for supply;
- Market price of energy and capacity; and
- Domestic prices for energy used in BC.

27. The above considerations directly influence the cost-effectiveness of supply from the Site C project and the optimization of value from the Site C project upon in service implementation.

28. The requirement for energy and capacity (demand) is determined primarily by customer use, which is influenced by energy price, the state of the economy, government policy and regulations, demand side management activities, alternative options for energy, business and energy environment and other circumstances. Demand therefore should not necessarily be viewed as 'fixed' and changes to all of these parameters can reasonably be expected within the next 20 year time frame as well as within the next 100-year plus time lifetime of Site C.

29. BC Hydro, government and the BCUC have the capability to influence demand to some degree through regulation, pricing, demand side management and other tools. Demand need not be considered as a requirement which may be adjusted at some level in the creation of an optimal load resource balance.

30. The costs to produce the energy and capacity from the Site C project are dependent upon the successful execution of the Site C project. Cost overruns and delay in the project will increase the cost of the energy and capacity from the Site C project.

31. Renewables, DSM, market energy, thermal energy sources[1] or future energy sources represent supply options that will, or could potentially, service the demand that would be met with Site C energy, depending on its characteristics. Each alternative supply option has its own characteristics, cost per unit of energy and available energy levels. They may or may not provide capacity.[2] These supply options provide smaller increments of energy

[1] The *Clean Energy Act* prohibits the use of Burrard Thermal except under certain limited conditions. Thermal energy sources nonetheless can represent viable alternatives that could be considered.

[2] DSM can be considered to offer capacity savings as well as energy savings.

and shorter ramp up periods and therefore can have greater flexibility to meet demand optimally with less risk to ratepayers and the public interest from over supply.

32. To the extent that BC Hydro commits to purchasing supply from its Standing Offer Program ("SOP") and Independent Power Producer ("IPP") program the amount of Site C energy may or may not become surplus to demand. The Load Resource Balance (LRB) represents a key factor in the value of Site C energy; and an evaluation of the value of Site C energy must be considered in the context of commitments to IPP Renewals, SOP and IPP supply.

33. The CEC considers that it is appropriate for the Commission to determine its view of the issues that can affect the Load Resource Balance as it may be, or should be, to optimize the cost-effectiveness of energy supply to the province in order to determine the implications of continuing with, deferring, or terminating the Site C project.

34. The market price of energy provides the value for any surplus energy available from Site C, less transmission costs and losses at the time of surplus. Similarly, it represents an alternative supply option in the event of a deficit to the extent permitted by policy.[3]

35. Each of the above factors is influenced by government policy and such policy can have a significant bearing on the value of Site C energy and capacity.

36. The CEC considers that meaningful advice with respect to the value of the Site C project must address the policy context.

D. Government Objectives for Site C

37. An additional consideration in the assessment of Site C is the objectives of the government in developing and completing the project.

38. For the purposes of this submission, the CEC considers the objective of the Site C project is to provide cost-effective energy supply to the ratepayers of BC in a manner consistent with the public interest.

E. Understanding the Alternatives

39. The CEC considers that a Net Present Value analysis of alternatives provides a valid means to compare the alternatives and identify the implications of proceeding with those alternative courses of action.

[3] *Clean Energy Act* provides limitations on the use of market supply but energy policy opportunities should be considered.

Alternative 1: Continuation of Site C

40. Continuation of the Site C project is forecast to result in 5100 GWh/yr of energy and 1100 MW-yr of capacity becoming available at the plant gate to BC Hydro in 2025 unless significant changes, project delays or other circumstances significantly affect the outcome.

41. Site C has an expected lifespan of 100 years plus, though some of the equipment is expected to have a 70 years lifespan.

42. To the extent that BC Hydro already has in place, or acquires additional energy such as through IPP renewals, Demand Side Management initiatives ("DSM") the SOP and/or if the load forecast is incorrect and customer demand does not meet the available supply, BC Hydro has the risk of being in surplus. The cost or benefit and size of a potential surplus is a key issue in assessing Alternative 1.

43. Using future incremental costs (excluding all sunk costs including Interest During Construction ("IDC") on the sunk costs) as may be incurred by BC Hydro to deliver the energy and capacity from Site C can be valued at its levelized unit costs per MWh and kW-yr respectively.

44. A range of potential values may be generated to account for the risk of cost over-runs and/or delays. The Commission's understanding of and judgement decisions as to the likelihood of cost-overruns will significantly impact the assessment of the cost of the energy and capacity delivered.

45. The range of costs per MWh and kW-yr may then be compared to an estimated market forward price curve, and a determination made as to whether or not a surplus could or could not likely be sold at a profit, should surplus conditions be in effect at any given time. This can provide a lower bound at which Site C would be considered economic and cost effective with little uncertainty with respect to the load resource balance risk of surplus or the benefits of domestic use in BC.

46. To the extent that the BCUC is confident in its assessment of the likely range of the cost per kWh and MW-yr, this figure can be used to make a judgement as to the lowest market price that would be financially cost effective in the event of a surplus and the need for sales being delivered to market.

47. Similarly, where a domestic price for use of the power in BC is reasonably predictable, a break-even point to identify the maximum future cost of the 'Continue Site C' option in order for surplus energy to be sold profitability may be established for any given domestic price scenario the Commission deems appropriate.

48. The CEC considers that to the extent that the BCUC determines that the Site C energy, based on future costs, represents a profitable opportunity, a positive business case could

likely be made for continuing the project. To the extent that cost overruns diminish the profitability the business case may be diminished and the Commission could make judgements with respect to the uncertainties to determine the upper bound for the Continue Site C option.

49. The CEC notes that it is appropriate for the Commission to identify the 'best' alternative and as such, a decision to continue should consider the cost-effectiveness of other alternatives as well as the optimization of the Continue Site C option.

Alternative 2: Suspension of Site C with option to resume construction

50. The Suspension of Site C with the Option to Resume alternative provides an opportunity for BC Hydro to defer construction of the Site C project to a point at which it could become more cost-effective and/or appropriate to complete than being completed as currently scheduled.

51. Benefits of deferral include the opportunity to avoid the risk of non-cost-effective surplus and the time value of the construction costs (less costs to suspend and resume).

52. The suspension option could provide BC Hydro with greater flexibility to address uncertainty in the Continue Site C option. Alternative forms of energy supply may be considered to have a shorter life span and require time and costs to ramp up which may result in potential opportunities. The use of such options could facilitate supply that is highly responsive to demand requirements and optimization of energy planning for BC Hydro.

53. Costs associated with the suspension option would include the cost to suspend the project and to re-instate, and would be dependent upon the period at which the reinstatement occurred. It is expected that re-instatement would occur in a period in which a long-term deficit was anticipated. To the extent that re-instatement was not successful, extending the time for the re-instatement past the 2024 period and ultimately terminating the project could result in additional remediation costs.

54. The CEC submits that an appropriate assessment of the suspension option would consider the costs of implementing the delay and reinstatement as well as the potential benefits of a delay to a more appropriate and cost-effective implementation date.

55. The CEC submits that the cost-effectiveness and availability of alternative energy supply options that might be utilized in lieu of Site C energy, if required or deemed appropriate, would need to be considered as well.

Alternative 3: Termination of Site C

56. Termination of the Site C project would require the authority to terminate the project and remediate the area. To the extent that the Site C project energy supply would have been

required to meet demand, BC Hydro could run a risk of being in deficit, unless and until more cost effective alternative energy sources are available, or are made, available.

57. An assessment of the Termination of Site C would appropriately consider the costs of termination, and the costs associated with purchasing alternative energy supply as required.

F. Approach to Decision-Making

58. In preparing this submission, and in anticipation of further CEC submissions in the Inquiry process, the CEC has developed a decision-making construct, discussed below, which provides an approach to reflecting a ratepayer perspective to the Commission in meeting its responsibility to provide advice on the government's requested determinations and to assessing the value of Site C power in its supply context. The decision-making is centred on the cost of Site C energy and capacity on a go-forward basis.

59. The CEC's view is that the actual costs for the Site C project will be subject to considerable uncertainty, and it is reasonable and appropriate for the Commission to use its judgement in determining acceptability based on a range of costs it deems appropriate. Where the cost range is at a boundary of cost-effectiveness it is appropriate for the Commission to advise the government that additional caution may be required and other trade-off values may become more determinative in the decision making.

a) The initial assessment would establish the cost of Site C energy, and determine whether this rests within a generally cost-effective range from a market and alternative energy standpoint. Such an assessment would examine a range of costs that might be required to complete the Site C project to produce energy and capacity, including a determination for the risk of overruns. It is appropriate for the Commission to exclude any 'sunk costs' from the analysis as these cannot be recovered regardless of the options going forward. Additionally, it is appropriate to deduct an assessment for the cost of termination being sunk costs, as part of this comparison as the termination costs would otherwise be incurred.

   If the Commission judges that the cost of Site C energy and capacity is significantly beyond that of the market, or alternative options such as SOP energy, or IPP energy, it would be appropriate for the Commission to consider termination of the project. In the alternative, it is appropriate for the Commission to consider further analysis of the Site C project.

b) A second assessment would examine the load resource balance and determine if the Site C project is likely optimized within this context at the time of becoming in-service and over its lifespan. It is appropriate for the Commission to examine

the BC Hydro load forecast and Load Resource Balance and to exercise its own judgements as to the likely context in which Site C would be operating.

The Commission should reasonably consider the BC Hydro load forecast, which extends for 20 years, future expectations with respect to load growth and any likely bias contained therein, expectations with regard to the economy and potential impacts from recessions, potential for reasonable government energy policy and optimal future energy purchases from SOP and IPPs, changes to Demand Side Management activities, increased electrification, technological advancements, behavioural transformation in conservation, and such other issues that might affect the BC Hydro load resource balance and the values of Site C.

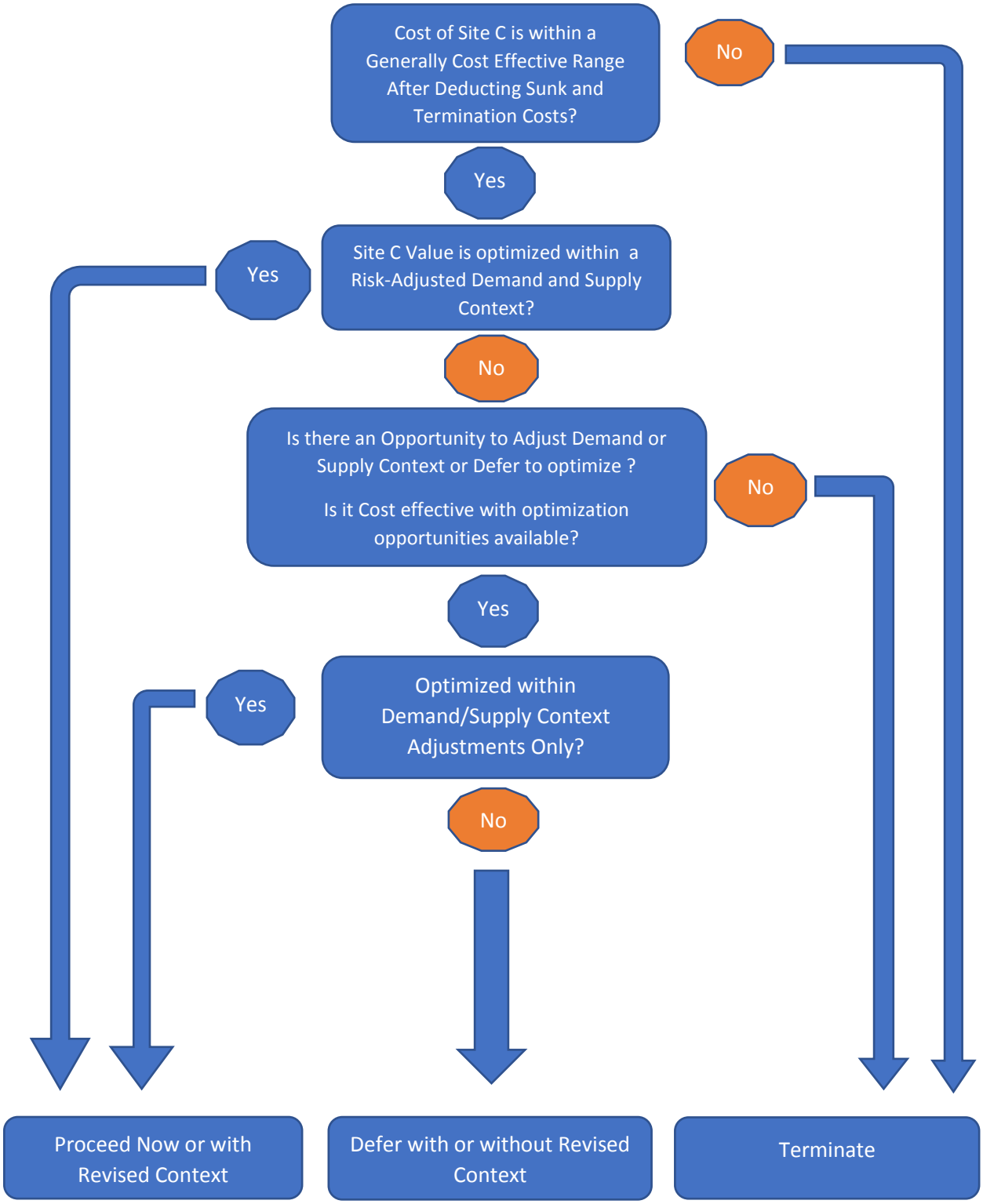
Such an analysis will enable the Commission to establish a risk-adjusted context in which the Site C project would operate. It is appropriate at this point to determine if Site C represents the optimal energy supply alternative under these conditions. If so, it would be appropriate for the Commission to recommend proceeding. If no, it would be prudent for the Commission to conduct further analysis.

c) A third assessment would consider whether Site C represents an optimum supply, as currently planned or if there are opportunities to manage the supply or demand context, or by deferring the project. If the Commission considers that it would not be possible to create conditions by which Site C could represent the optimal energy supply, then it could be prudent for the Commission to recommend termination. If it is possible for Site C to represent an optimal energy supply then it would be prudent to examine those opportunities further.

d) A fourth determination would be an assessment of whether manageable changes to the supply and demand context could result in Site C representing the optimal supply while continuing development. If no, then a deferral could be necessary to ensure that the optimal energy supply and Load Resource Balance is preserved for the public interest and BC Hydro's rate payers.

60. The following graphic represent an appropriate decision tree for the Commission to use in assessing the available evidence and data to make determinations with respect to the advice it has been asked to provide the government from this inquiry.

61. The CEC submits that this is an appropriate and reasonable approach for the Commission to adopt in providing its advice to the government.



62. The CEC provides a forward looking Present Value analysis of the fundamental value of Site C energy, based on the cost to finish the project and the operating costs. The approach enables the CEC, and the Commission if it so chooses, to provide its own inputs as to the expected costs associated with the completion of the project.

63. Additionally, the approach provides an analysis of the value of Site C energy given an expected demand (load) requirement and supply context. The CEC considers that an understanding of the uncertainties around demand and the anticipated supply context is crucial to the decision-making with respect to the Site C project.

64. The approach also enables the Commission to consider its own views as to the likely demand and supply expectations.

65. The CEC notes that ultimately the value of Site C energy will be determined by the need for the energy as part of the overall supply portfolio. In that Site C energy is a 'lumpy' addition to the supply portfolio, it is likely that it could generate a surplus for some period if other supply options are pursued simultaneously and/or if demand is not sufficient to utilize the energy provided.

66. The cost or benefit of the surplus is determined by the volume of the surplus, the cost of the energy produced in BC, and the market price at which it may be sold.

67. Where there is an expected energy surplus, it is appropriate for the Commission to consider which source of supply is contributing to the surplus.

68. The CEC considers that it is reasonable to consider energy supply as being preferentially derived from the most cost-effective supply to the least cost-effective supply, with consideration for capacity requirements.

<u>Load Resource Balance – Volume of Energy Required</u>

Issues Affecting Demand – Demand Inputs

- Demand - Forecast

69. In the BC Hydro Revenue Requirements proceeding BC Hydro provides a mid, low and high load forecast in its Energy Load Resource Balance forecast. BC Hydro also provides a mid-level, Small Gap and Large Gap surplus/deficit forecast.[4]

70. The CEC understands that the Load Resource Balance could potentially be updated in this proceeding.

71. The CEC notes that BC Hydro's load forecasts extend for 20 years, or to F2036, whereas the life of Site C is anticipated to extend to 100 years. A demand forecast over the life of

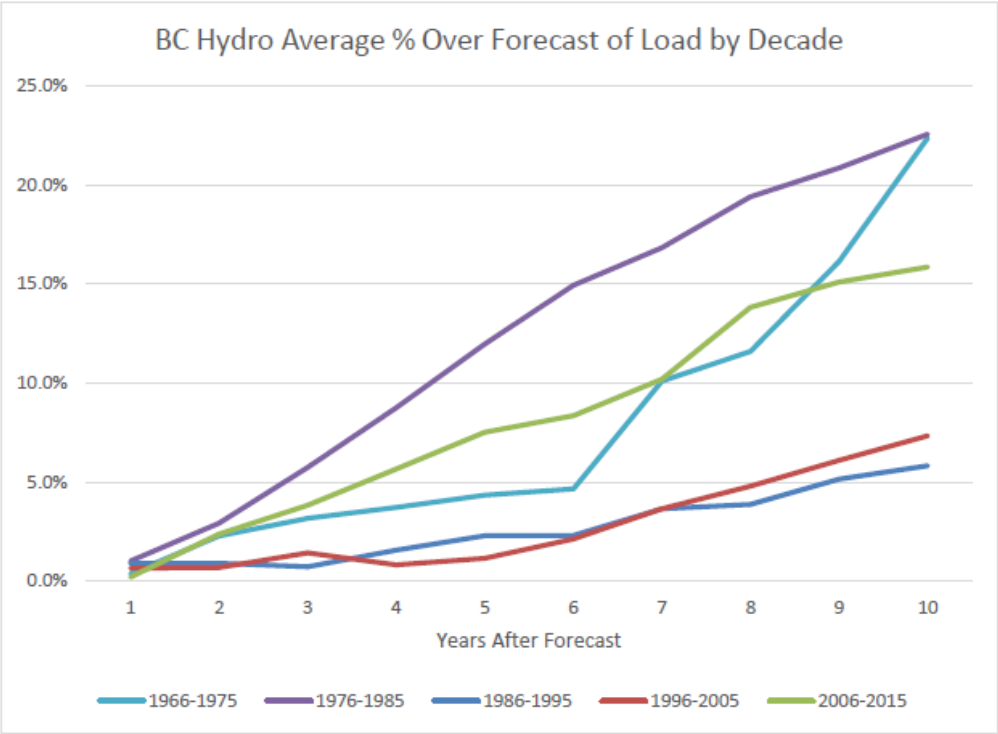
[4] BC Hydro Revenue Requirements Application, Exhibit B-9, BCUC 1.11.1

the Site C project should not necessarily rely on static growth expectations, but should reasonably consider the possibility of significant economic and technological change occurring over the course of the supply horizon.

72. Although electricity use is expected to increase, the rate of growth is expected to remain lower than historic averages. The EIA notes that while growth in the economy is linked to electricity demand, the linkage has continued to shift toward much lower electricity demand growth relative to economic growth.[5]

- Demand Forecast Bias

73. BC Hydro's load forecast has been consistently in excess of its actual load as outlined in the CEC Final Submissions in the BC Hydro Revenue Requirements application.



[6]

74. For the last decade, the degree of BC Hydro over forecasting has been consistent on an annual basis and has been proportionally the same for each year from the forecast unlike the two prior decades where the early 3 to 4 years had significantly less proportional over forecasting compared to the later 6 to 7 years of those decades.

[5] EIA Annual Energy Outlook 2017 with projections to 2050 page 76.
[6] BC Hydro Revenue Requirements CEC Final Submissions page 21.

75. The CEC notes that the data source when analyzed for the last 50 years or for the last 5 decades shows the same pattern of over forecasting has existed at BC Hydro for the entire 50 years. The only difference by decade is that this over forecast bias was at its lowest in the two decades 1986 to 2005.

76. The data on the variance for each sector shows that, on average, the total domestic sales forecast exceeded actuals by 3.9 per cent over the last seven years and by 3.3 per cent over the last eight years.[7]

77. The risk of over forecasting is that it will continue to result in BC Hydro holding excess supply purchased at expensive prices which will on average need to be sold into markets for a loss to the detriment of ratepayers present and future.[8]

78. BC Hydro relies on its standard modelling and inputs in order to arrive at its load forecast which it states is used by many utilities across North America, and uses information sources which it views to be credible.[9]

79. BC Hydro takes exception to several CEC submissions regarding its comments on BC Hydro's Load Forecast. Notably, however, BC Hydro has not taken issue with the CEC's identification of its historical load forecasting deviations from actuals. In fact, the CEC analysis is based on data supplied by BC Hydro, which is uncontested evidence. The facts that BC Hydro's average customer demand per account started to decline in about 2007 and have continued unabated to date are also uncontested data supplied by BC Hydro. Further BC Hydro has not indicated that its forecasting methodology has changed significantly or is managed to compensate for the significant, ongoing bias that has been experienced in the past.

80. In its Reply Argument BC Hydro argues that:

    a) The CEC's discussion extends beyond the test period;

    b) The CEC's recommendations are one-sided, and do not reflect the possibility of positive variances;

    c) The CEC's views are internally inconsistent regarding the expected impact of LNG and electrification in the oil and gas industry;

    d) CEC's recommendations with respect to recessions is one-sided and speculative; and

    e) CEC has misrepresented growth rates for individual sectors (residential and industrial because they are not temperature adjusted and use varying fiscal years.

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[7] BC Hydro Revenue Requirements CEC Final Submission page 20.
[8] BC Hydro Revenue Requirements CEC Final Submissions page 19.
[9] BC Hydro Revenue Requirements Reply Argument, page 16.

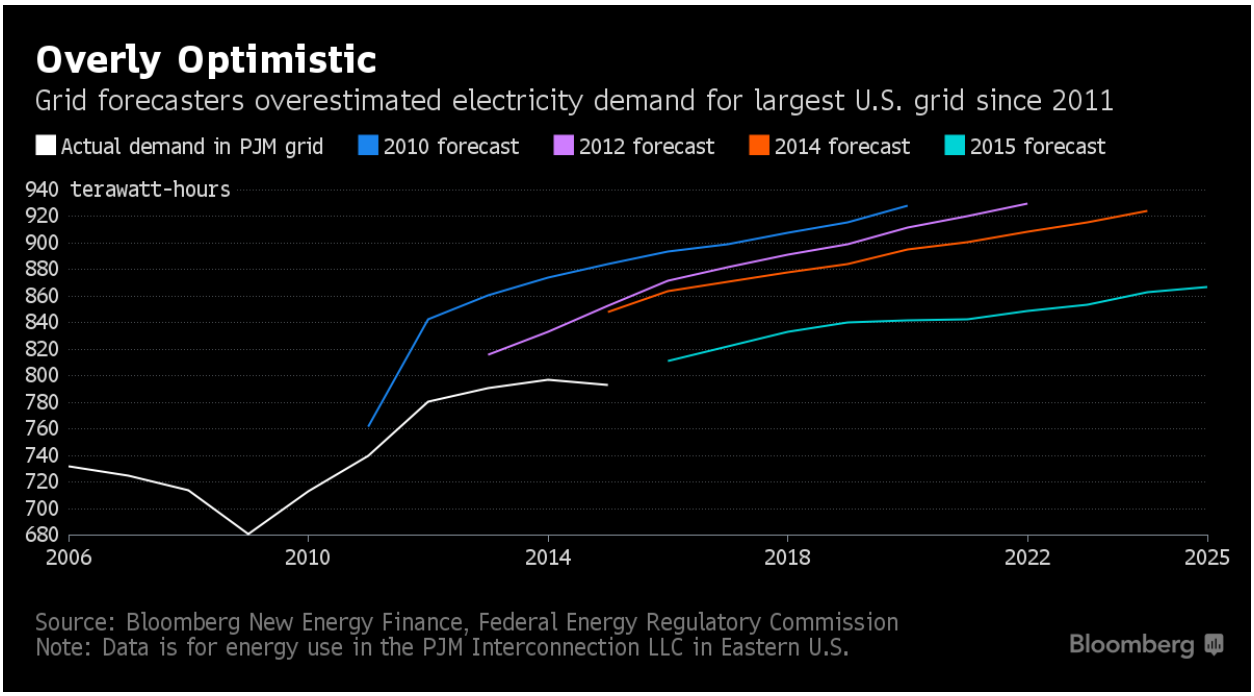
81. BC Hydro's assessment of CEC's submissions and its critiques are of minor importance with regard to the substantive issues identified. The uncontested evidence regarding 10 years of very low to no load growth and the extent of deviations from prior load forecasts is relevant to the extent of current BC Hydro's surpluses and the potential ones which may accompany completion of Site C. The impacts on BC Hydro ratepayers and the public interest are of critical importance to providing quality advice to the government with respect to the Site C options it has asked the Commission to examine.

82. The key issue is that BC Hydro's load forecasting has deviated from actuals over an extended period, and as such a bias appears evident. This evidence was provided by BC Hydro in the BCH RRA proceeding in response to CEC 2.135.1. In the BCH RRA hearing the 3 year test period was of primary concern but for this Inquiry the long-term future and the implications on a decision to proceed with Site C, makes the potential uncertainty with respect to over supply bias in the forecast highly relevant.

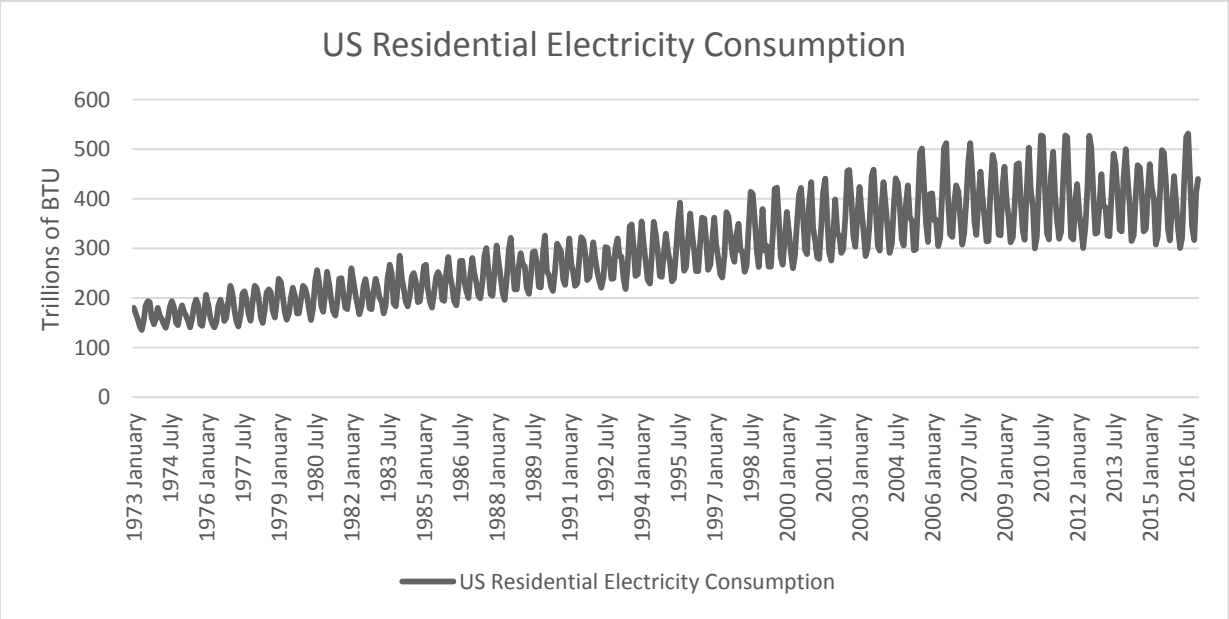
83. Temperature adjusting is intended to account for short term variances due to unpredictable temperature variations; over several decades the actuals and the forecast are the relevant considerations in determining whether a forecast is experiencing a bias.

84. This over forecasting bias is not unusual in the electricity industry in North America or in other developed economies around the world. Evidence of the over forecasting can be found everywhere. It is quite frankly to be expected. In most jurisdictions, the same flattening of electricity demand has been occurring since about 2007.

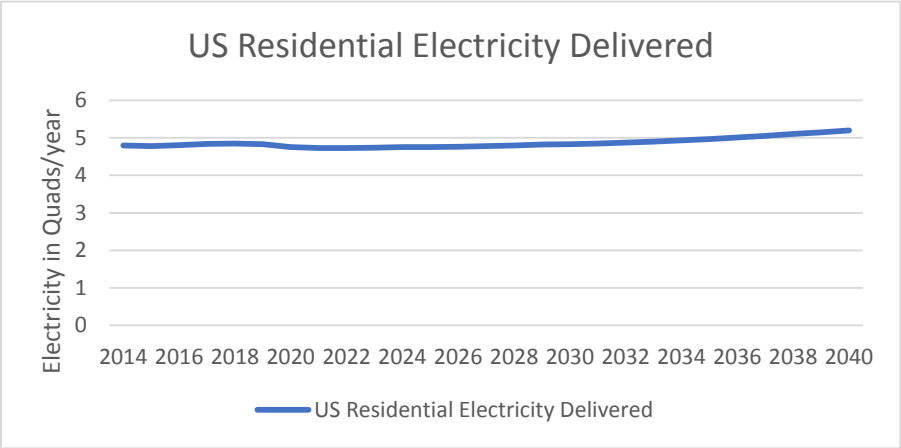
85. Below is evidence of electricity over forecasting in the US by its large utilities.

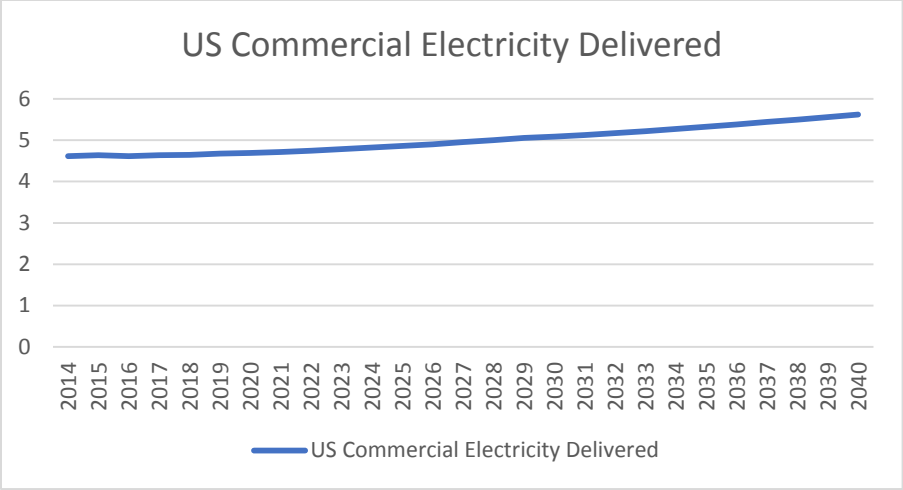


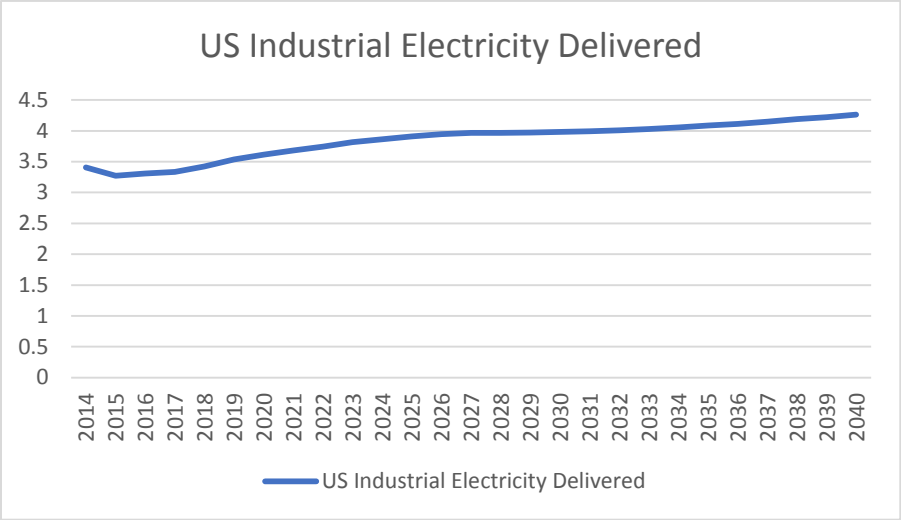
86. The evidence of the flattening electricity loads is evident in US residential electricity consumption as shown below. Since 2007 the electricity consumption has been flat by comparison to the prior years' growth. The same is true for US commercial electricity consumption.



87. The EIA forecasts for US residential, commercial and industrial electricity loads are shown below. The CEC supplies the US electrical consumption as evidence of continued flattening of loads. In aggregate the growth is forecast at about 0.6% well below BC Hydro's growth forecast.







- Electrification

88. Changes in end-use can both increase and decrease electricity for customers. Technologies for reducing carbon such as transportation electrification, or customer heating could serve to increase demand for electricity.

89. Increased demand for electricity would serve to reduce BC Hydro electricity surpluses and improve the context for proceeding with the Site C project.

90. Conversely, improvements in building sciences can serve to significantly reduce the use of electricity.

- Reduced Energy Intensity and DSM

91. In the United States, the amount of energy used per unit of economic growth (energy intensity) has declined steadily for many years, while the amount of CO2 emissions associated with energy consumption (carbon intensity) has generally declined since 2008.

These changes are projected to continue as energy efficiency, fuel economy improvements and structure changes in the economy all lower energy intensity.[10]

92. Innovations in conservation and efficiency are expected to continue into the future and will provide BC Hydro with additional options for supply and for demand reduction.

93. The CEC is of the view that the stability in the load over the last several years, potentially has many causes, but all add up to conservation and efficiency being more embedded in the culture (in BC, Canada, the US, Europe and worldwide) than is currently being accounted for.

94. The CEC notes that codes and standards, rates and regulation are significant and highly cost-effective means of reducing demand. To the extent that such measures are employed and serve to reduce demand, Site C energy could become increasingly surplus.

<u>Issues Affecting Supply – Supply Inputs</u>

- SOP Energy

95. The Standing Offer Program is required under section 15(2) of the *Clean Energy Act*. BC Hydro is authorized to set the terms of the Standing Offer Program and agrees that it should manage the terms to ensure cost-effective supply.[11]

96. To the extent that the Standing Offer Program continues there may be significant additional supply being provided into the Load Resource Balance which could displace the need for Site C energy.

- IPP Renewals

97. IPP renewals are key inputs in assessing the amount of surplus energy that BC Hydro will acquire under a given demand scenario. BC Hydro's approach is to renew IPP energy with the principle of 'reducing near-term costs while maintaining cost-effective options for long-term need'.[12] This can potentially result in BC Hydro renewing IPP energy now that is not cost-competitive with other supply alternatives in the future. To the extent that the renewed IPP energy is not necessary but already acquired, Site C energy would become surplus.

98. There is potential for the renewal of IPP energy to become a costly source of supply if it is not required as anticipated, and is higher cost than other alternatives. Optioning IPP energy, instead of purchasing IPP renewals could provide flexibility and conserve the value of Site C energy to ratepayers.

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[10] EIA Annual Energy Outlook 2017 with projections to 2050 page 24.
[11] BC Hydro Revenue Requirements Reply Argument, page 53.
[12] BC Hydro Revenue Requirements Reply Argument page 52.

- Burrard Thermal

99. Under Section 13 of the *Clean Energy Act* the authority is not permitted to operate the Burrard Thermal, except

    f) in the case of emergency;

    g) to provide transmission support services, or

    h) as authorized by regulation.

- Future energy options

100. The development of alternative energy options, including distributed energy options are likely to arise in the future over the course of Site C lifetime and costs for this energy can be expected to decline in comparison to the cost of Site C energy. To the extent that these options are lower cost than Site C energy they may represent a more cost-effective energy supply option than Site C, which carries its cost through its lifetime.

101. The cost of solar energy has declined significantly over the last decades and can be expected to continue its decline considerably over the Site C project's lifetime. Such energy options could displace the demand for BC Hydro Site C energy resulting in surpluses and could also be developed as utility scale resources[13].

102. Geothermal energy is considered to be a very low-cost supply option at present and may become a significant IPP supply option for BC Hydro.

<u>Issues Affecting Value of Surplus Energy</u>

103. The Forward Market Price Curve represents the expected price at which BC Hydro would be able to sell surplus energy on the market. The forward market price curve for electricity can be expected to vary with the price of natural gas unless other technological, behavioural or other changes create other alternatives for energy supply.

104. Natural gas prices will be affected by the volume of natural gas available, technological advancements influencing greenhouse gas emissions, industrial requirements, development of the LNG industry etc.

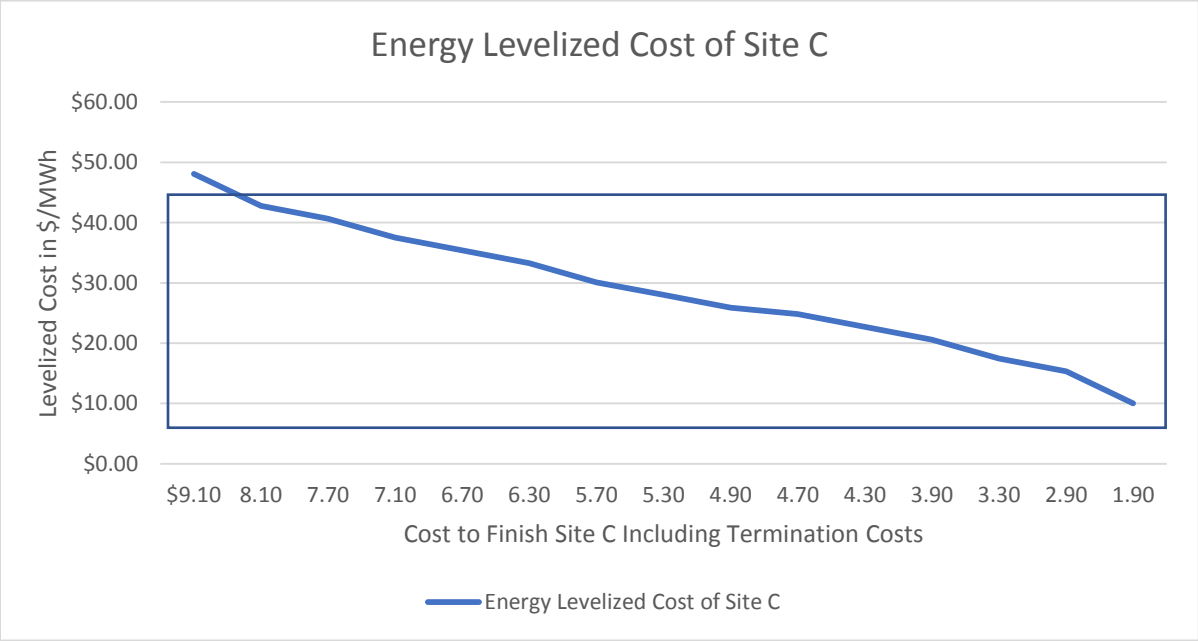
B. CEC's Approach to Valuation Ranges for the Site C Decision Advice

105. The first approach the CEC has developed is used to determine a reasonable approximation of the Site C levelized cost for a range of different outcomes with respect to cost over runs to finish Site C and for different levels of potential termination costs.

[13] EIA Annual Energy Outlook 2017 page 80.

106. The CEC approach gives the following range of costs to finish and the related levelized cost of energy at 2024 from finishing Site C, disregarding the sunk costs spent to date. The box included from $40/MWh down shows the expected Mid C market price of energy range, which in the alternative could be used to pay for Site C profitably in the event that the Site C energy had no uses in the domestic market. This is not the only source of value to pay for Site C in the event there were no domestic requirement. Other market sources with longer term contracts could be considerably more valuable than the Mid C spot market.

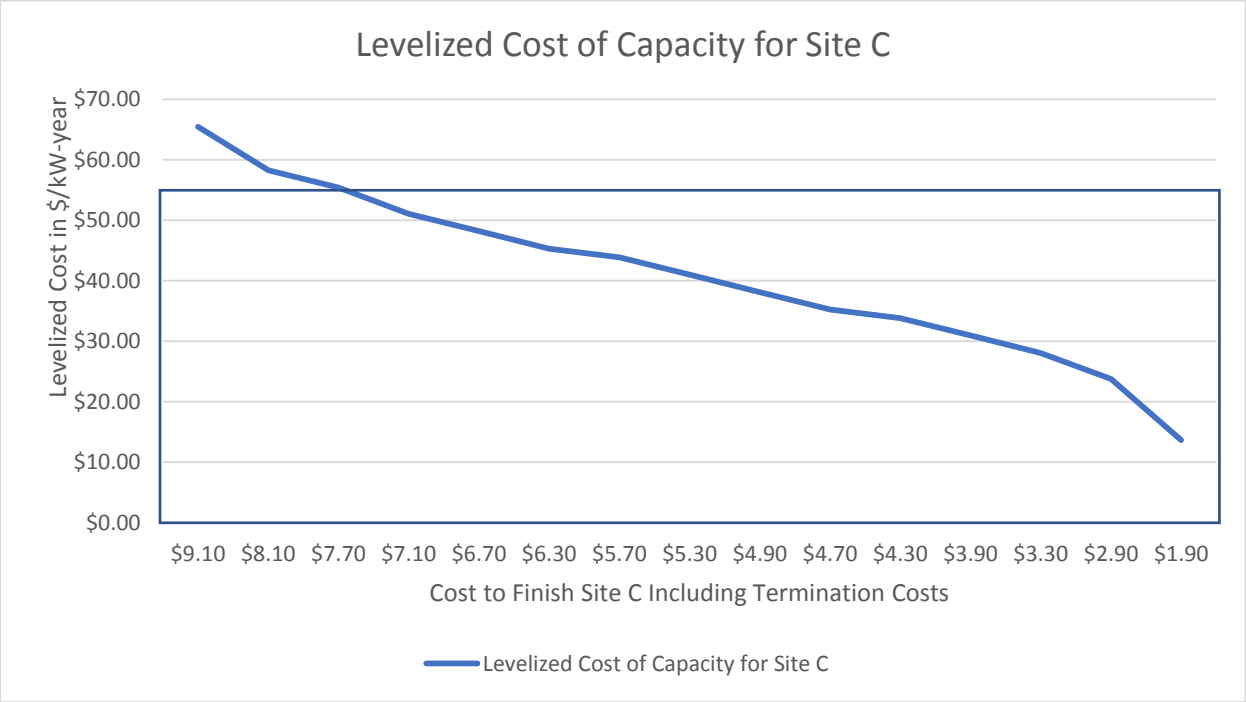
107. Of course, there is uncertainty in all of the data the Commission must assess. The advantage of this analysis is that it provides information as to where the approximate boundaries are for a change in risk profile occur. The areas requiring Commission judgement can be sharply focused.



108. In the CEC's view, for the Commission to assess the cost-effectiveness of Site C as an energy option it will be necessary to determine if in the alternative BC Hydro has a resource option with 100 years supply of energy at these unit cost values and with the service value qualities that Site C has. Candidates for such an alternative would be demand side management activities and possibly renewal of IPP contracts at approximately the cost of Mid C energy in the market place. Standing Offer Program energy would not qualify at levelized costs of $110/MWh as of 2017.

109. The CEC calculations also give an approximation of the values of capacity from Site C across the same range of costs to finish and or terminate Site C at 2024, disregarding sunk costs spent to the date of implementation of a decision. The box included from $55 down represents the approximate cost of capacity supplied from completion of the Revelstoke 6 generation unit and is a good approximation of the value of capacity in the

Mid C spot electricity market for as represented by the premium for high load hour power versus low load hour power, which can only be delivered with capacity resources. This is not the only source of value to pay for Site C in the event there were no domestic requirement. Other market sources with longer term contracts could be considerably more valuable than the Mid C spot market.



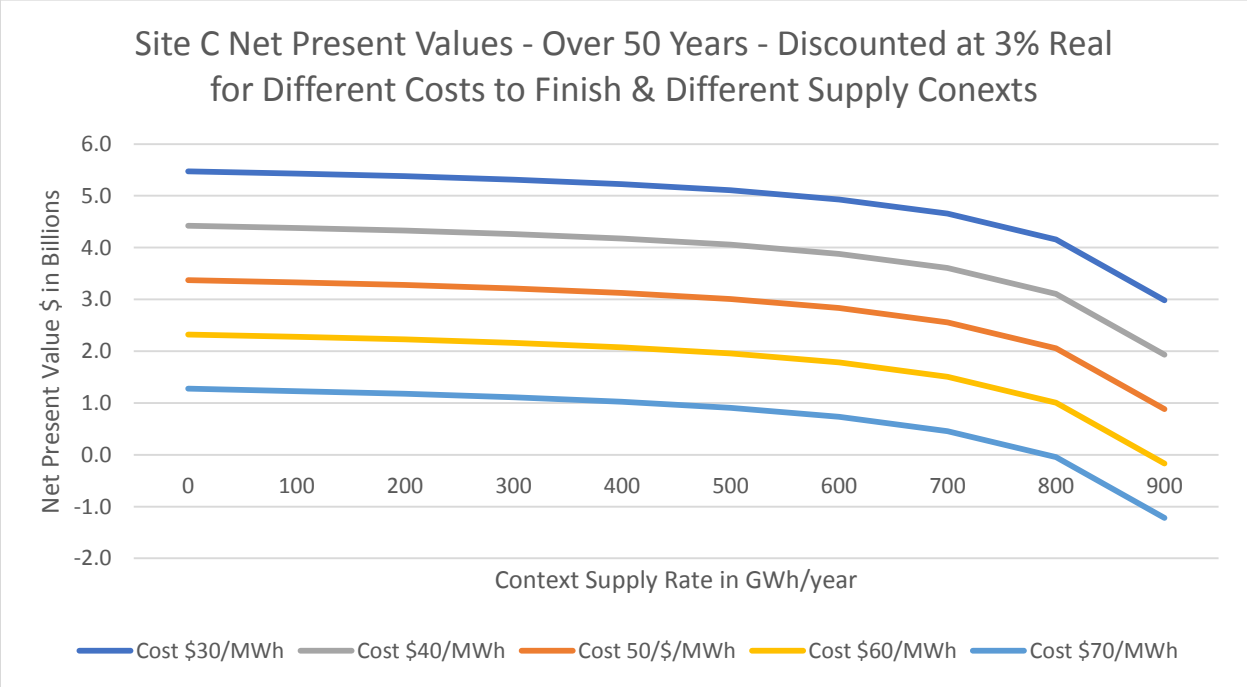
110. For the Commission to assess the cost-effectiveness of Site C as a capacity option it will be necessary to determine if in the alternative BC Hydro has a resource option with 100 years supply of capacity at these unit cost values and with the service value qualities that Site C has. Candidates for such an alternative would be demand side management activities. However, renewal of IPP contracts would not provide any significant capacity for shaping energy to a higher value end use. Standing Offer Program capacity to the extent there is any would not qualify as of 2017. At an approximately the cost of Mid C high load hour power versus low load hour power of $10/MWh in the market place for completion of Site C the levelized cost for capacity would likely be paid for in the Mid C markets. One limitation on this would be the extent to which Powerex trading is capturing high load hour values in the Mid C market place and would be displaced by an excess of Site C power.

111. The next requirement for the Commission to provide advice to the government on decisions with respect to Site C is to analyze whether or not the Site C project is optimizable in the current Load Resource Balance context in which Site C is scheduled to come in to service. This analysis largely boils down to the level of surplus BC Hydro may be carrying at the time Site C would enter service as well as the rate at which demand growth would use up the energy and capacity supplied by Site C.

112. The CEC's assessment approach gives the following range of net present values for the Site C energy in the event of different percentages of actual demand taken up by acquisitions of additional energy from other sources than Site C at 2024. Finishing Site C in the context of the expected levels of surplus that would arise from the combined context of all of BC Hydro's planned acquisitions of energy can give rise to less than optimal implementation of a finished Site C.

113. Adding Site C energy to the context of continued acquisition of SOP energy, acquisition of energy through renewal of IPP contracts and additional demand side management activities reducing demand can lead to surplus to be sold in the Mid C electricity markets rather than being sold at domestic energy tariff prices, which are much higher than electricity market prices. Consequently, not optimizing the implementation of a finished Site C would add to the levelized cost assessment of the energy delivered from Site C.

114. The CEC calculations for optimizing Site C implementation shows the following net present values for different levelized costs for Site C energy and different percentages of demand up take by context supply.



115. Based on the CEC analysis of cost ranges to finish Site C the NPV values for the top three or four lines would be relevant for the Commission to assess. Also, it is important to notice the net present value diminishment in all cases can be up to $2 billion if the context energy is a high % of supply.

C. Valuation of Issues Affecting Load Resource Balance

116. The Commission has been charged with the task of assessing items which may impact the evaluation of Site C.

117. There are a large number of issues that can affect the load resource balance and each of these will need to be evaluated with regard to their impact on the net present value of Site C in the context of an adjustment with respect to any item making up the load resource balance. Each of the potential adjustments can be evaluated independently and as necessary in combination.

118. For its evaluation the CEC has developed an assessment of items which may affect the load resource balance and the evaluation of the Site C decisions on which the Commission has been asked for advice. This assessment could be used to evaluate any number of issues which may affect the Site C decisions.

119. The CEC has assessed a number of these issues and incorporates those analyzes below to demonstrate to capability and suggests an appropriate process for factoring these issues into the Commission's advice to the government.

Demand Bias

120. Given the relatively flat load profile of the last 10 years and the level of forecast demand BC Hydro's load resource balance uses there should be considerable uncertainty with respect to the demand forecast to be used.

Demand Bias				
Volume				
Range 1	Range 2	Range 3	Range 4	Range 5
3%	5%	8%	11%	14%
0.3%	0.5%	0.8%	1.1%	1.4%

121. The CEC has assessed a potential range of adjustments that could be used to adjust for forecasting bias. This range involves examining a range of 5 scenarios between BC Hydro's forecast and a continuation of relatively flat demand.

122. An adjustment of .3% per year to correct for bias would cause BC Hydro surplus to extend by an additional 7 years and would decrease Site C's value by approximately $1 billion. An adjustment of .5% per year to correct for bias

	BC Hydro
Year	Net Demand Growth
2018	0.17%
2019	1.25%
2020	0.92%
2021	2.15%
2022	2.94%
2023	1.83%
2024	1.43%
2025	1.24%
2026	1.42%
2027	1.05%
2028	1.15%
2029	1.15%
2030	1.35%
2031	1.37%
2032	1.47%
2033	1.13%
2034	1.21%
2035	0.95%
2036	1.44%

would cause BC Hydro surplus to extend indefinitely and would decrease Site C's value by approximately $4 billion.

123. BC Hydro's forecasts over the last 50 years have had a minimum over forecast over 10 years of .6% and there is no evidence available that this has been fixed.

124. This analysis illustrates how sensitive the Site C decisions are relative to the assumptions being used with respect to anticipated customer demand.

125. The CEC recommends that the Commission understand why US and BC electricity demand growth rates have over the past been roughly comparable and why BC Hydro's future growth rates forecast should exceed the US future growth rate forecast by approximately 125%.

126. The CEC recommends that the Commission assign a significant probability to the scenario that BC Hydro's forecasting may contain a bias toward over forecasting and could result in excess surplus energy in the BC Hydro system. This is key to a proper assessment of Site C.

Excess Supply Acquisitions

127. Over 20 years, BC Hydro is anticipating acquiring additional supply in the form of renewal of IPP contracts of approximately 5000 GWh or about the equivalent amount of energy as is supplied by Site C. In addition, BC Hydro is anticipating acquiring supply under its standing offer program of about 2500 GWh over 20 years.

128. BC Hydro's proposals for acquisition of IPP contract renewal energy include acquiring approximately ½ of the IPP contracts expiring. Therefore, BC Hydro could choose to acquire none of the energy from IPP contract renewal or could acquire all of the IPP contract renewal energy.

129. The BC Hydro acquisition of SOP energy is expected to be acquired at costs of approximately $110/MWh, well above the cost of Site C energy and well above the potential costs of IPP contract renewal energy.

130. The CEC has calculated the potential for this to affect the Site C decisions by reducing the acquisition volumes. These calculations have assumed a levelized cost for Site C energy of approximately $50/MWh, a market rate for Mid C energy of $35/MWh and a domestic rate for energy consumed in BC of $85/MWh. This arrives at the base line net present value for Site C of about $3 billion. The following are the results of different planning scenarios to compensate for different issues affecting the value of Site C, including combinations with demand forecast bias correction at the minimum level of bias experienced for the last 50 years.

131. If the acquisition volumes for the IPP renewals are removed from the planning scenario the net present value of the Site C project is improved by approximately $450 million.

132. If the acquisition volumes for the SOP are removed from the planning scenario the net present value of the Site C project is improved by approximately $370 million.

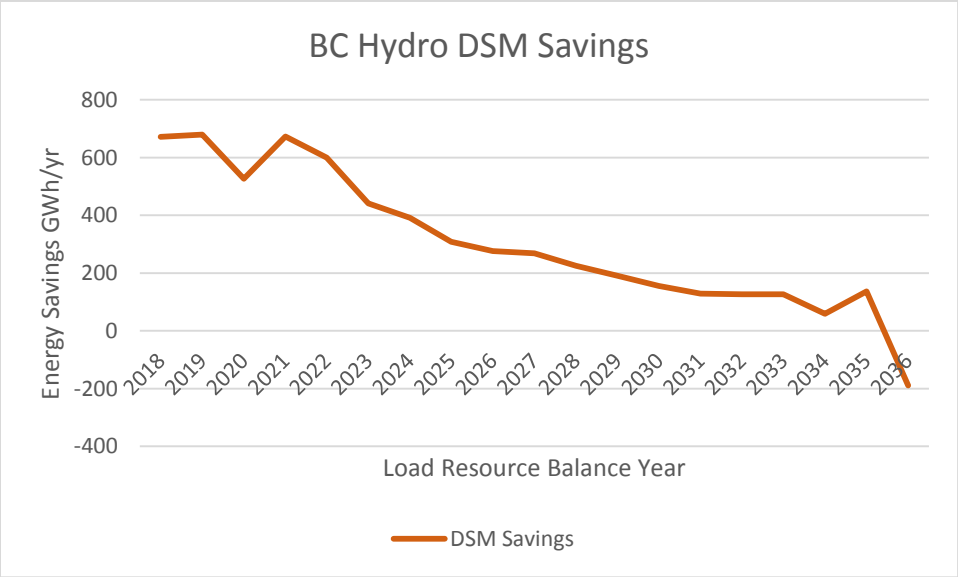
133. If the IPP renewals and the SOP are both removed from the planning scenario the net present value for Site C is improved by approximately $600 million.

134. The reason that the combined reductions are less effective is because the Site C energy supplied is used sooner because of a combined reduction in pre-existing surplus.

135. If the forecasting bias correction is set near the minimum level experienced for the last 50 years and the IPP and SOP acquisitions are removed from the planning the net present value for Site C remains at approximately $3 billion.

Trailing Off of DSM Savings

136. Over 20 years BC Hydro is expecting to have DSM savings dropping off quite significantly.



137. The DSM savings over this future period of time decline because the earlier DSM saving from 20 years previously are assumed to be expiring because BC Hydro's DSM savings are assumed to have a persistence of approximately 20 years. The new DSM investment is needed to continue to maintain a level of DSM savings.

138. This assumption is used for calculating the costs and benefits of the DSM activities.

139. There is a potential interpretation of DSM savings that they do continue to be represented in the ongoing level of demand reduction and or that they may be continued in demand

reductions adopted by customers without the incentives, standards or regulations provided by BC Hydro or government.

140. An explanation for the continued flat load profile experienced by BC Hydro for 10 years since 2007 and in fact experienced by all of the US since 2007 is an important and necessary understanding in order to do load forecasting and load resource planning.

141. If DSM or some other form of conservation and efficiency is continuing to lower the level of electricity demand then a load resource plan with declining DSM savings may prove be a false basis upon which to acquire large quantities of energy.

142. An assessment of maintaining DSM savings at 600 GWh/yr for 20 years shows that the value of Site C would be decreased by approximately $870 million.

143. This issue may evolve in the future to show up as continued over forecasting bias for the net demand after DSM planning.

Electrification of Automobile Transportation

144. Electrification of automobile transportation has been studied by BC Hydro in a previous load forecast study. To this point in time, the BC Hydro load forecasting and load resource planning have not adopted an anticipation of any significant quantity of transportation demand.

145. The automotive industry appears to be developing electric car technology to the point that it is becoming a somewhat more attractive option. The timeframe over which this transformation would take place if it is going to take place could be important to the issues affecting the Site C decisions.

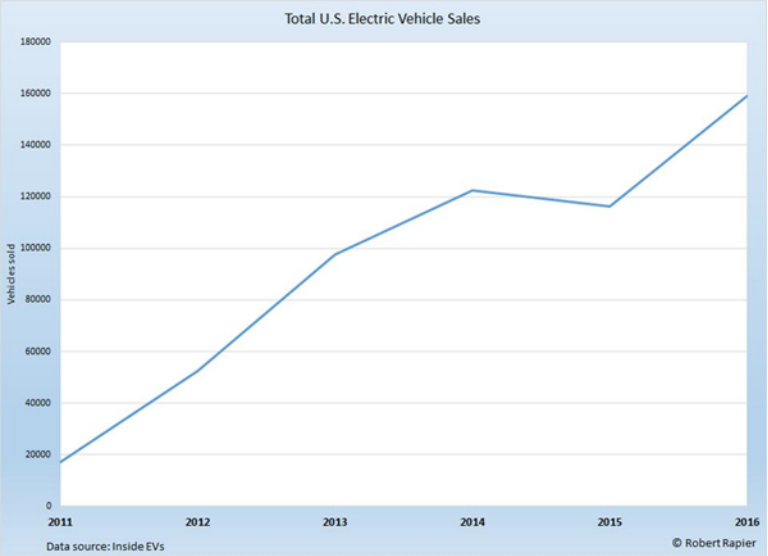
146. The BC Hydro load forecast used for its Revenue Requirements Application for 2017-2019 has a discussion of electric vehicle loads as follows in Exhibit B1-1-1, Page 3-15;

> *"A forecast of electricity demand from electric vehicles is included in the residential and light Industrial/commercial sales projections. Electric vehicle demand is projected to be under 50 GWh per year and estimated total number of electric vehicles (i.e., total stock) is about 6,000 in fiscal 2017 and about 11,000 in fiscal 2019. Beyond the test years, electric vehicle load is forecast to be about 70 GWh per year in fiscal 2022, about 430 GWh per year in fiscal 2027 and 1,760 GWh per year by fiscal 2036. The forecast of the total number of electric vehicles is about 30,000 in fiscal 2022, about 164,000 in fiscal 2027 and about 580,000 in fiscal 2036."*

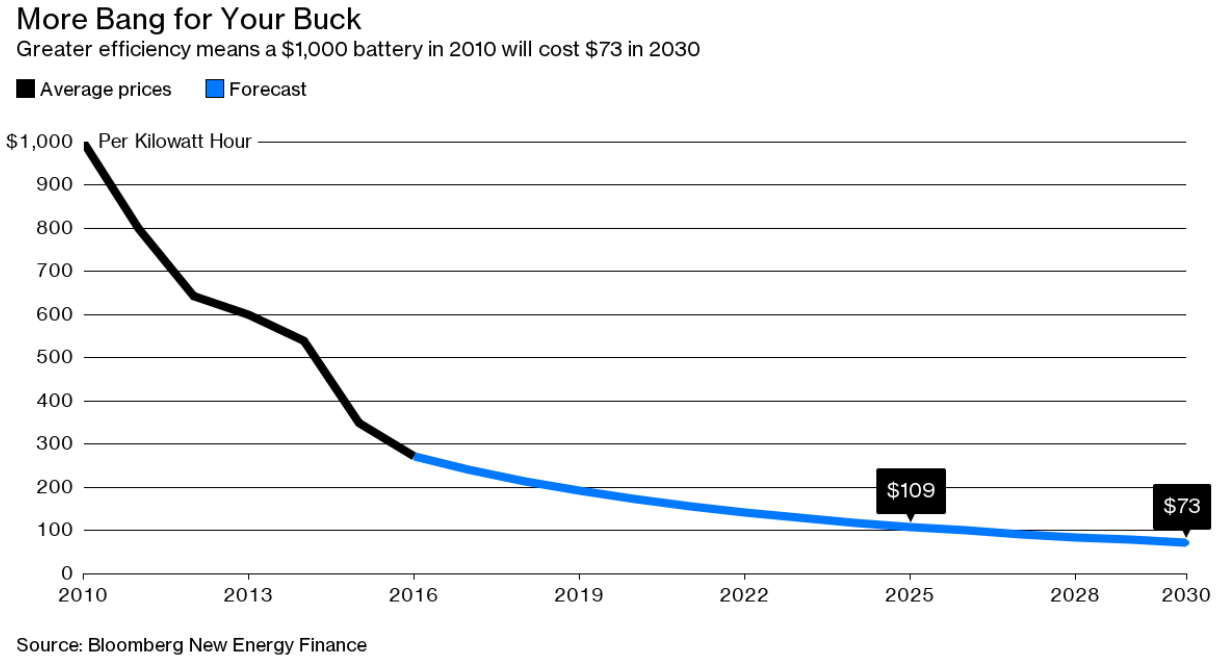
147. This level of electrification of vehicle transportation in BC over 20 years would represent an approximate 20% growth per year.

148. However, recent US electric vehicle growth rates have exceeded this rate significantly growing at a compound average growth rate of 32%.

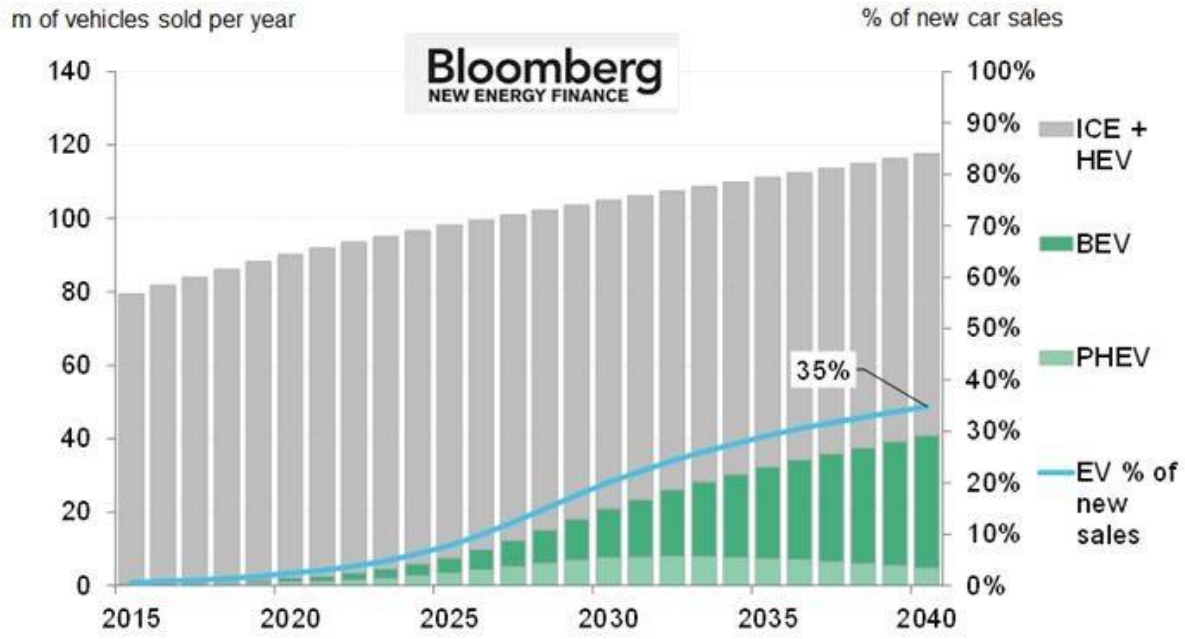
149. A variety of parties are making predictions of very strong growth rates and include among the rationales for these growth rates that the costs for batteries are expected to drop dramatically and that the cost of electric vehicles will soon reach parity with internal combustion powered vehicles.



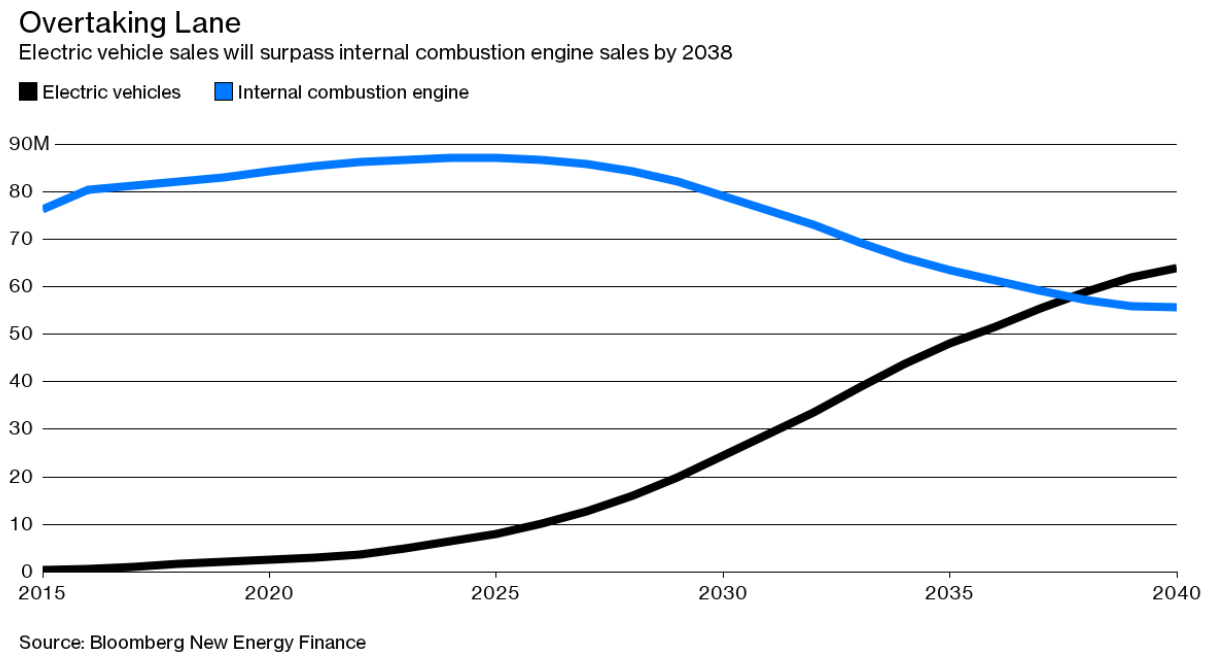
150. The following information on the evolution of battery technology and a forecast of the expected cost reductions could reasonably accelerate electric vehicle sales.



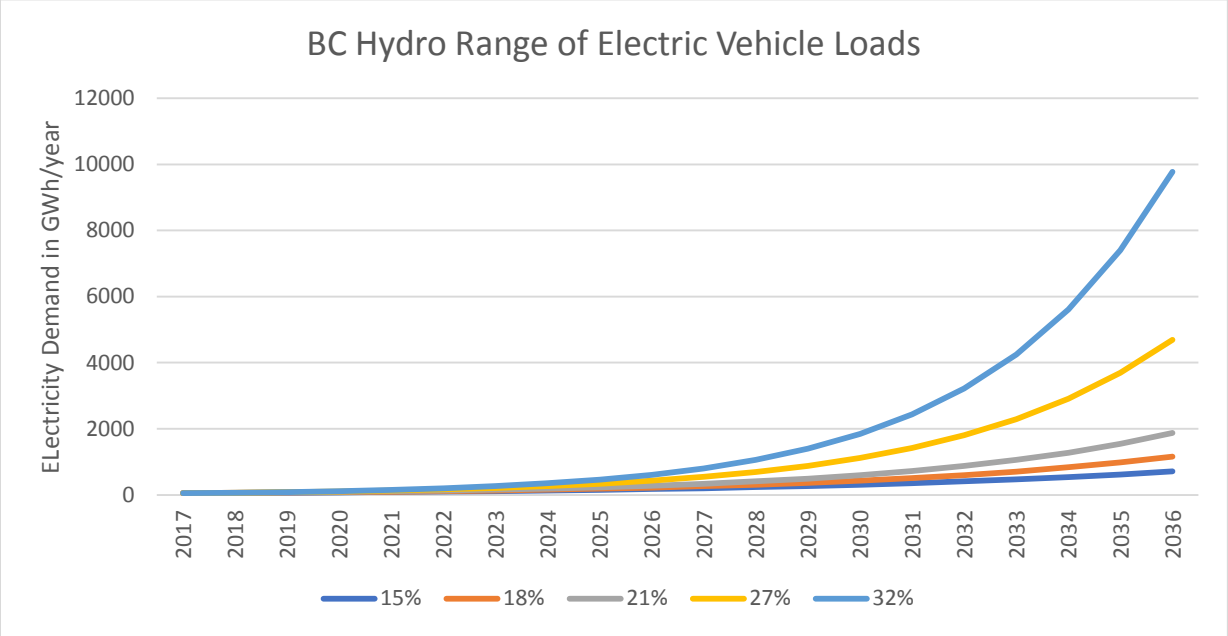
151. Electric vehicle growth is expected to accelerate and become a very significant part of the overall vehicle stock.



152. There is a distinct possibility for a transformation of transportation to electric and autonomous.



153. The CEC has evaluated a number of scenarios around electric vehicle load growth for BC to provide a range of potential forecasts for the Commission to assess.



154. As the potential for electric vehicles in BC would result in very significant greenhouse gas reductions it may be that this significant trend will indeed become a world wide and BC transformation.

155. Should such higher growth rates occur and be sustained the net present value of Site C would be increased by $122 million over the 20 years period. The reason that this increase in present value for Site C is low is because the growth occurs late.

156. The real consequence of such a growth rate would be a requirement for significant addition of resources to supply the demand of a transformation to electric vehicles. Electric vehicles under a 32% growth rate would require as much as 2 resources the size of Site C.

157. Another consideration for the electric vehicle scenarios would arise for the advent of the self-driving vehicle. Under this additional transformation of the transportation market it could be possible that there would be far fewer cars required and car trips could increasingly be shared. Effectively, this could become a potential for DSM in regard to transportation electricity demand and off set a substantial portion of any such projected load growth.

<u>Electrification for GHG reduction</u>

158. For the BC Hydro 2013 Integrated Resource Plan BC Hydro commissioned Mark Jaccard and Associates to conduct an electrification study, which explicitly estimates the

electricity demand increase for different scenarios of GHG pricing to achieve GHG reductions.

Figure 10: Electricity demand by GHG price scenario, medium natural gas price

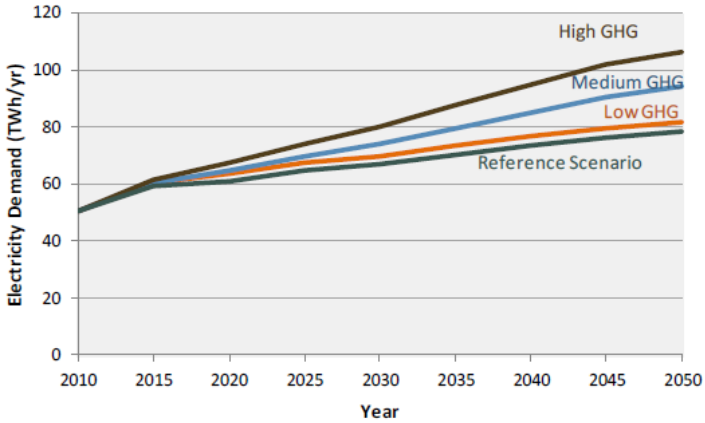
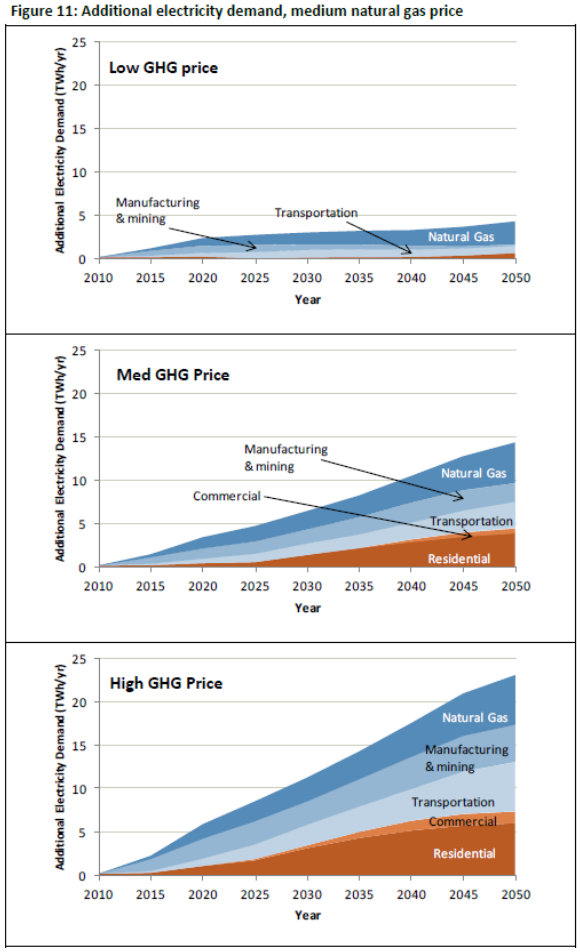


Figure 11: Additional electricity demand, medium natural gas price



159. The additional electricity demand by sector was analyzed to show the potential impact under different GHG price scenarios.

160. The City of Vancouver is working on a plan for GHG reduction from buildings based on changes to its building codes. Estimates of the increase in electricity demand for their plans are in the 10% increase range.

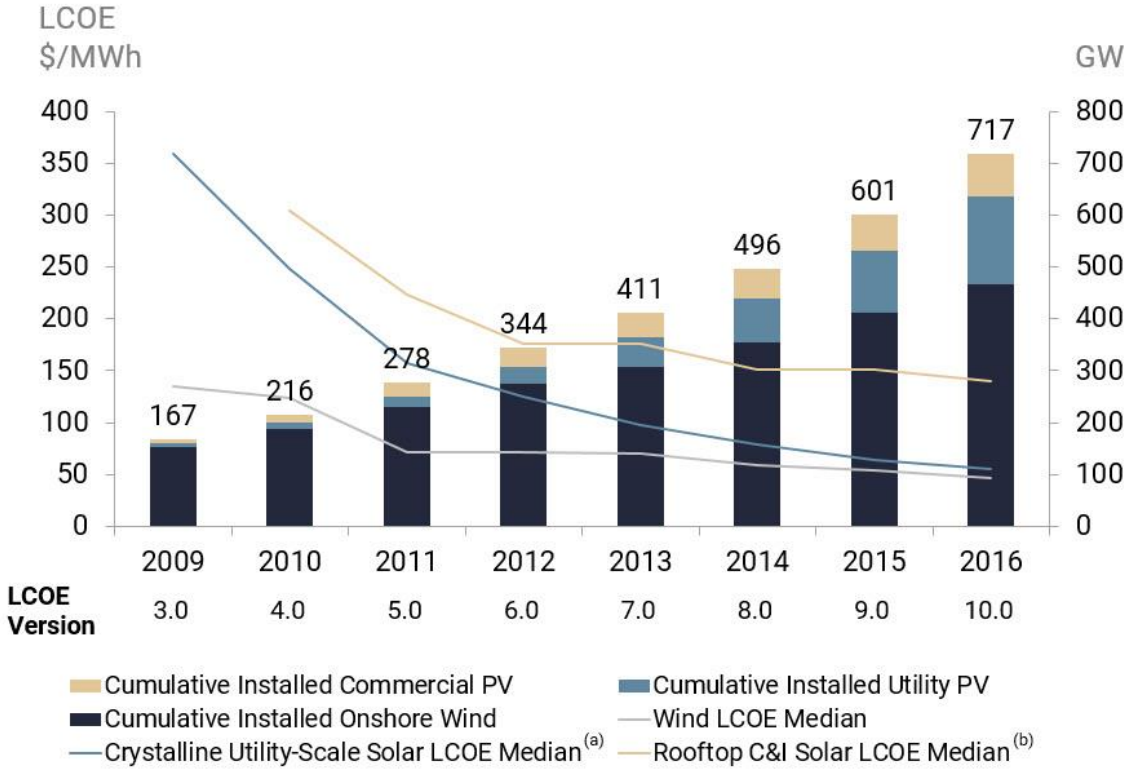
161. Either way this area of uncertainty consideration represents an important potential range for increased electricity demand.

Distributed Energy Supply - Solar Power Future

162. When planning BC Hydro's load resource balance and particularly a resource like Site C it is important to answer the question as to whether or not future technology will change the context sufficiently to warrant being more flexible in the near term to avoid over commitment to a resource, which may become less cost-effective.

163. To that end it is important to note that the levelized cost of wind and solar renewable energy resources have been declining steadily and are expected to continue to decline.

164. Unsubsidized Levelized Cost of Energy—Wind/Solar PV (Historical)



Source: Lazard estimates and BNEF.
Note: LCOE medians represent average between low end and high end of LCOE range for each technology.
(a) Low end represents crystalline utility-scale solar with single-axis tracking in high insolation jurisdictions (e.g., Southwest U.S.), while high end represents crystalline utility-scale solar with fixed-tilt design.
(b) Lazard's LCOE initiated reporting of rooftop C&I solar in 2010.

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165. The overall cost reduction potential for solar PV has been projected to be quite significant and includes anticipated areas in which the cost reductions can take place.

TABLE 5.3 INSTALLED PV SYSTEM COST PROJECTIONS FOR RESIDENTIAL AND UTILITY-SCALE SYSTEMS, 2010 TO 2030

	2010	2015	2020	2030
Utility-scale				
EPIA (c-Si)	3 600		1 800	1 060 - 1 380
IEA (c-Si)	4 000*		1 800	1 200
Resdiential/Commercial				
IEA	5 000 - 6 000*		2 250 - 2 700	1 500 - 1 800
Solarbuzz (c-Si)	4 560	2 280 - 2 770		
Solarbuzz (thin film)	4 160	1 860 - 2 240		

*Note: * data is for 2008.*

Sources: EPIA, 2011a; Solarbuzz, 2011 and IEA, 2010.

166. If reductions in costs of this order of magnitude become possible this could begin at some point to impact the viability of a competed Site C cost of energy.

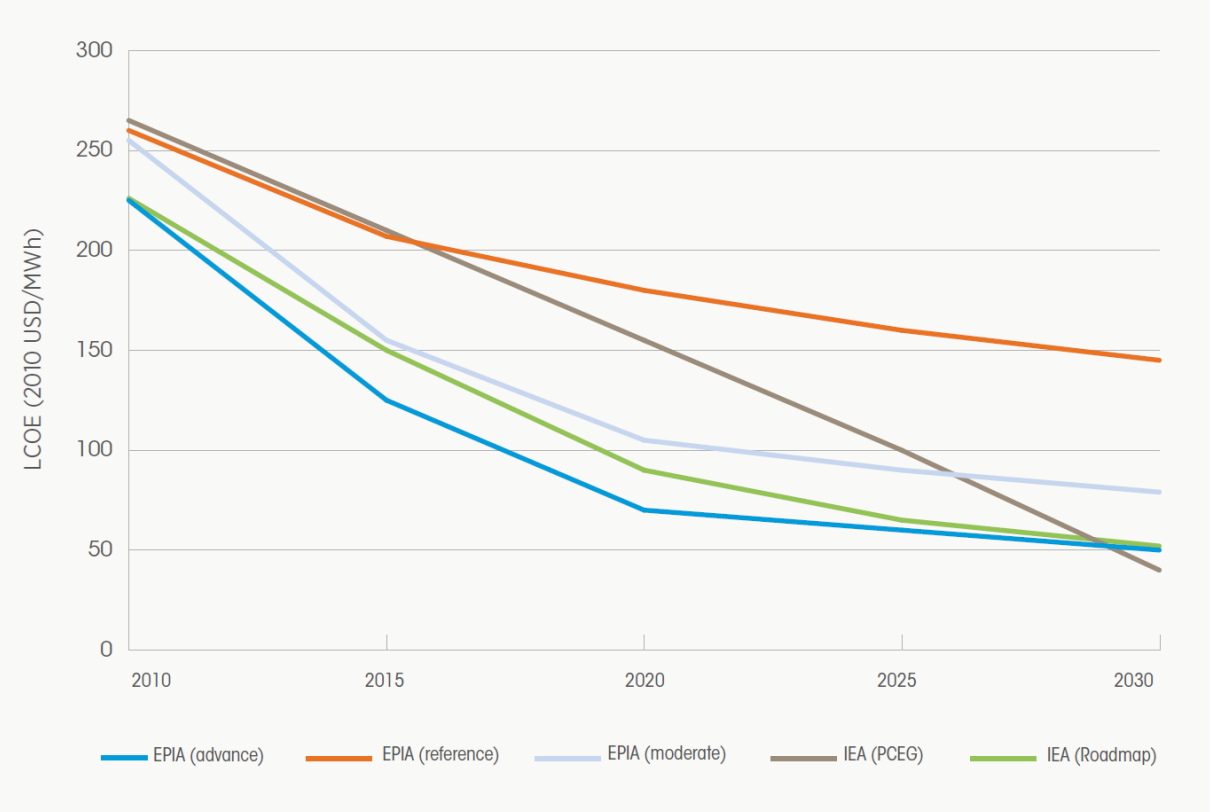
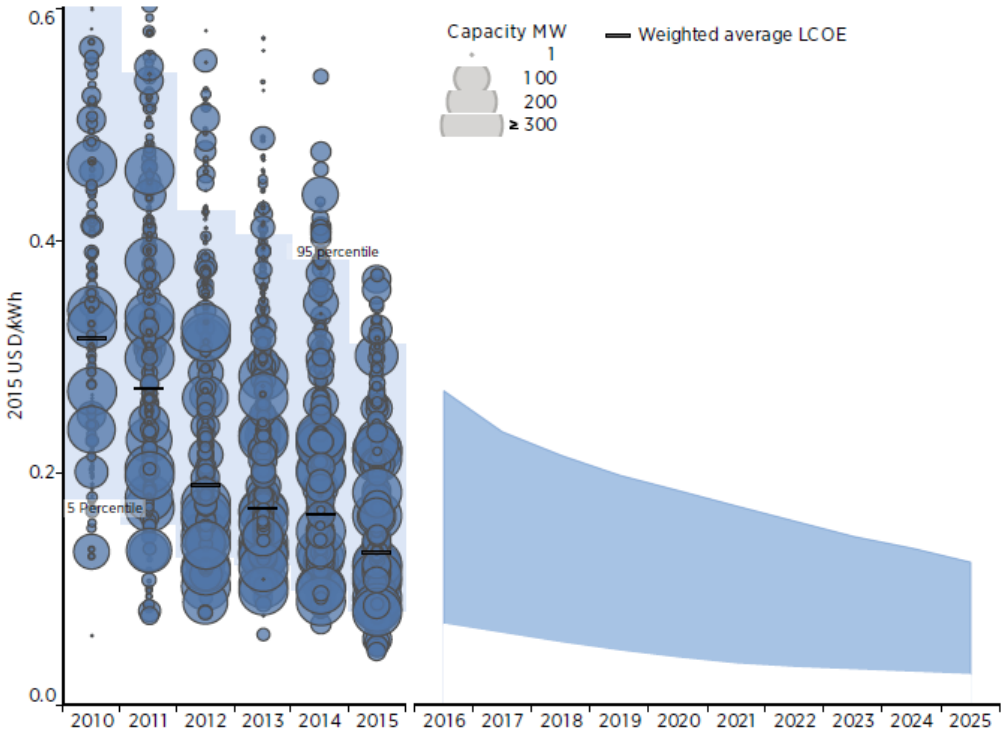


FIGURE 6.1: LCOE SCENARIOS FOR PV SYSTEMS, 2010 TO 2030.

167. A 75% cost reduction would potentially get into the range of a completed Site C cost but not as likely without further technological development.

168. Utility Scale PV systems, however, start from a much lower levelized cost and are equally expected to undergo significant cost reductions approaching 50% by 2030.

FIGURE 14: GLOBAL UTILITY-SCALE SOLAR PV LCOE RANGE, 2010-2025

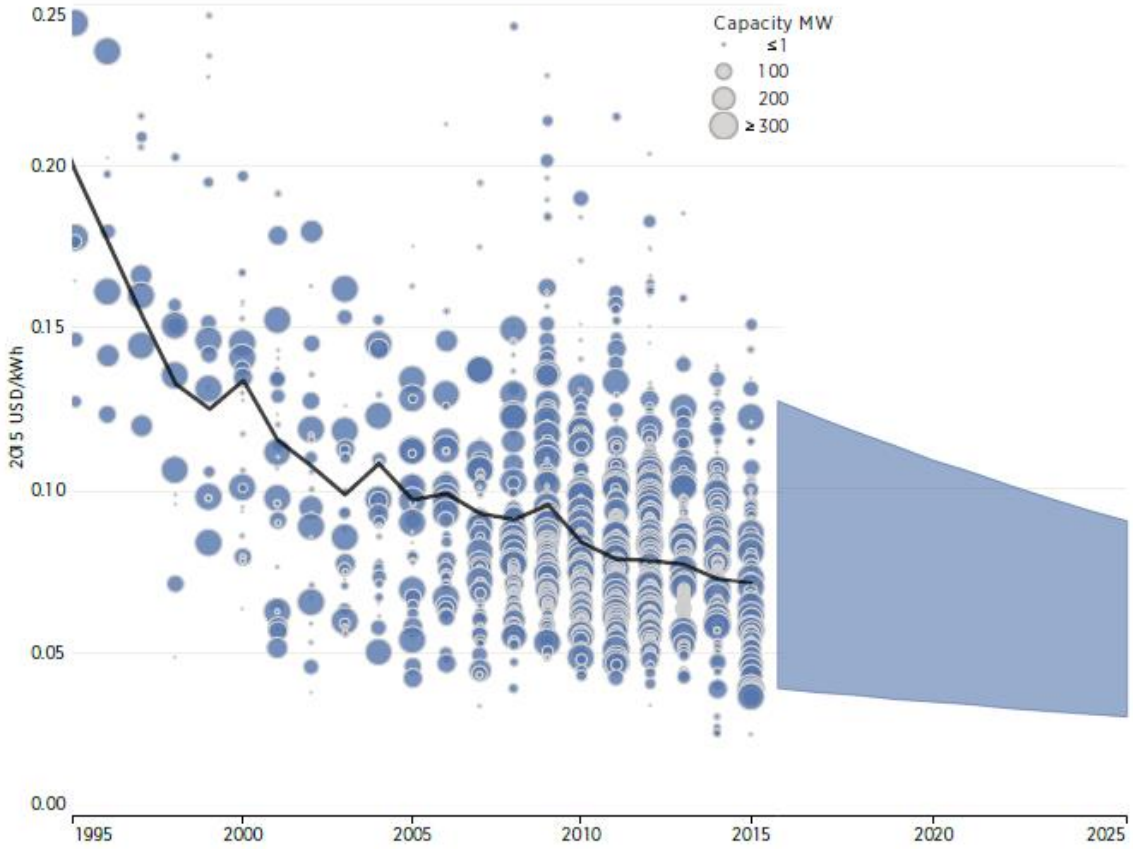


Source: IRENA Renewable Cost Database and IRENA analysis.

169. Adjusting the costs for utility scale solar for the lower levels of insolation in BC and adding capacity costs for managing the intermittency of the resource it could become a serious possibility or uncertainty that such a resource could challenge the Site C completed costs but not a certainty.

170. Wind power as an alternative renewable energy has also become more cost effective and is expected to continue to experience significant cost reductions.

FIGURE 29: LEVELISED COST OF ELECTRICITY OF ONSHORE WIND, 1983-2025



Source: IRENA Renewable Cost Database and analysis.

171. At some point these costs for renewable wind power may have the potential to come close to a cross over the completed Site C costs. With added capacity costs to shape the energy for delivery to customers at this time the cross over is less certain.

<u>Non-firm Energy Supply for BC</u>

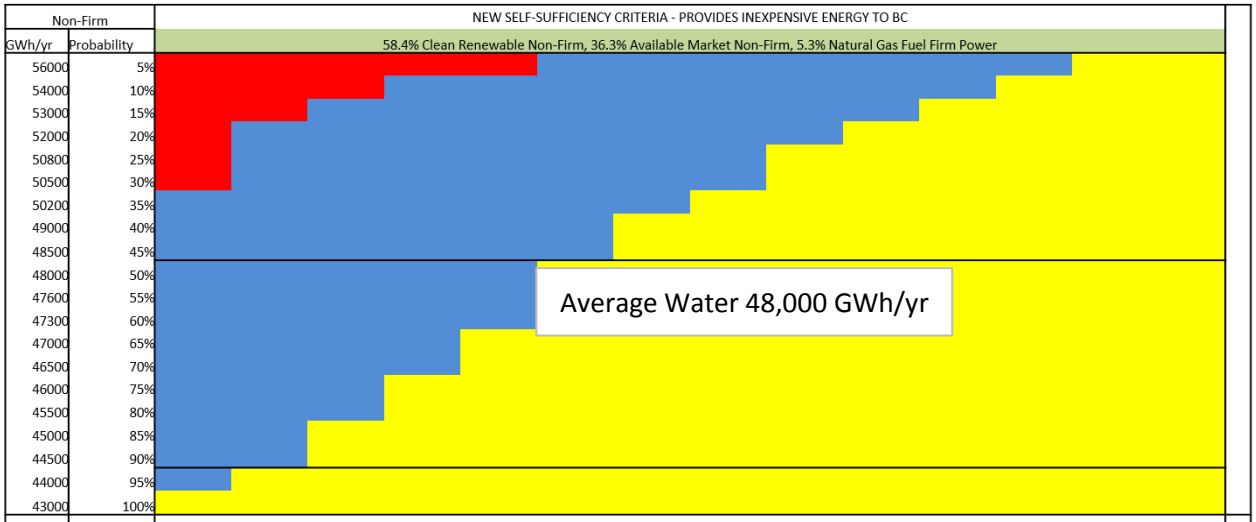
172. Non-firm energy is energy that cannot be counted on to be available from year to year on average. The advantage of non-firm energy is that because it cannot be counted on as firm supply it typically has a significantly lower price.

173. BC Hydro has a significant amount of non-firm energy in its hydroelectric system, whereby for ½ the time BC Hydro may have more than average water flows in the rivers that produce power for BC Hydro and half the time BC Hydro may have less than average water.

174. When BC Hydro is expecting below average water conditions for the river systems it uses, BC Hydro can make up the energy it requires by importing energy or producing energy from its thermal systems.

175. BC Hydro could acquire non-firm energy from the electricity power markets, whenever it does not have energy above average water and in so doing BC Hydro could make available a considerable amount of non-firm energy every year at low prices.

176. The chart below provides a probability map for energy from the BC Hydro electric system. The yellow represents the energy from water flows in the rivers BC Hydro uses to produce energy. The blue represents the probability and amount of energy which could be imported at low market spot prices to ensure a more reliable non firm supply at affordable prices.



	Frequency	3	4	5	6	7	8	7	4	4	5	2	3	2	1	61
	GWh/yr	43000	44000	45000	46000	47000	48000	49000	50000	51000	52000	53000	54000	55000	56000	
	Probability	4.9%	6.6%	8.2%	9.8%	11.5%	13.1%	11.5%	6.6%	6.6%	8.2%	3.3%	4.9%	3.3%	1.6%	
	Shortfall	4.9%	11.5%	19.7%	29.5%	41.0%	54.1%	65.6%	72.1%	78.7%	86.9%	90.2%	95.1%	98.4%	100.0%	
	Excedance	95.1%	88.5%	80.3%	70.5%	59.0%	45.9%	34.4%	27.9%	21.3%	13.1%	9.8%	4.9%	1.6%	0.0%	

177. A moderate amount of this energy could be captured and repatriated to BC cost effectively.

D. Establishing an Integrated Context

<u>Managing the Risk of Site C</u>

178. A key issue with regard to the appropriateness of continuing, terminating or deferring Site C is the risk of associated with the 5100 GWh block of energy contributing to a costly energy surplus at the time it comes into service and beyond into its 100 years service life. Conversely, there is also a risk of supply deficit in the event that demand exceeds BC Hydro's ability to supply energy if Site C is terminated or deferred. Assessing and managing these risks can provide an integrated context for making the Site C decisions in question.

179. To the extent that Site C energy is used and useful in BC, it is likely to be a cost-effective resource. To the extent that it is not used and useful in BC, and instead contributes to

additional surplus, it becomes a cost to ratepayers only to the extent it cannot be sold profitably into electricity markets. Where ratepayers are paying for any energy above market value that is not used by BC Hydro ratepayers they are negatively affected.

180. The CEC has estimated the risk impact to ratepayers of a surplus of costly energy arising from the addition of a block of energy on the scale of Site C as being in the order of up to $2 billion if it is not used and useful in BC, supplying BC Hydro customers. The size of this optimization of value based on Site C energy being used by BC Hydro customers is directly related to the levelized cost of Site C energy versus the domestic sale value of energy to BC Hydro customers.

181. Such non-optimization costs have in the past, and would in the future, be borne by BC Hydro ratepayers and the benefits would potentially be delivered to US ratepayers in the form of subsidized energy below the cost of its acquisition.

182. The risk of a deficit can be determined by understanding the ability to acquire supply or reduce demand to ensure an adequate Load Resource Balance at any time.

183. Identifying an expected demand, the likely context, understanding the range of outcomes, and recognizing the significant uncertainty associated with all variables is critical to the determination of the appropriateness of completing or terminating Site C.

184. It would be inappropriate to add an additional 5100 GWh block of energy if the Commission anticipated a significant ongoing surplus which ultimately resulted in losses to ratepayers. However, if the Commission anticipated a significant ongoing deficit in energy supply, it could be appropriate to add Site C energy through completion of the project to the extent that Site C future costs (without sunk costs and termination & rehabilitation costs) would be the best resource option available.

185. In understanding the risk of proceeding with Site C it is highly desirable for the Commission to consider whether or not there is an opportunity to manage the substantial risk associated with uncertainty surrounding the load resource context for Site C energy, and to factor this into its decision-making.

186. If the Commission, BC Hydro or government is able to manage the risk of surplus to a reasonable extent the block of Site C energy becomes considerably more likely to be used and useful to domestic customers of BC Hydro.

187. Similarly, the ability for BC Hydro to manage the risk of deficit by adding additional cost effective supply or using DSM to reduce demand can substantially mitigate the risk associated with a deficit. Inability or failing to take an integrated approach to energy supply results in significant risk of surplus or deficit and unnecessary risks and costs being shouldered by ratepayers.

188. Factors influencing the Load Resource Balance and the appropriateness of Site Cover time can be grouped into two major categories, those which are generally not within control of BC Hydro or government policies, and those which may be influenced by policy.

189. Factors that are generally not within BC Hydro or government policy control relate to the potential costs of finishing, terminating or delaying Site C, existing bias in the demand forecast, the influences of the overall market and demand trends, the price of market energy and the cost of alternative energy supply within the market and long term issues such as distributed energy.

190. Factors that are within policy determinations' influence include the parameters under which additional supply is acquired for BC Hydro, the price at which additional supply is acquired, the use of Demand Side Management (DSM) to manage and reduce demand, policies related to electrification and GHG reduction, among others.

191. In assessing the role of Site C within its context and understanding risk it is necessary for the Commission to first identify those contextual items which are not within control and establish a range of likely scenarios. Following this, it is appropriate to determine how BC Hydro can influence the likelihood of surplus and mitigate the risk of oversupply.

192. The CEC recognizes that there are several constraints currently in place in managing the provisions of supply and the risks of surplus. The CEC considers that it is appropriate for the Commission, in its response to the government request, to provide advice with respect to the easing of potentially counterproductive constraints on effective load resource planning.

Site C Decision

Is the Cost of Site C Within A Generally Cost Effective Range?

193. The CEC has reviewed the appropriate costing determination with respect to the cost of Site C energy and capacity in Section 8 of this submission.

194. The CEC anticipates that a levelized cost of energy of approximately $40/GWh to $50/GWh could result in a generally cost-effective price of electricity to be generated from Site C as compared to anticipated market prices and the costs and qualities of alternatives. This will be dependent on BC Hydro's ability to manage the risks of surplus in its load resource planning.

195. The CEC anticipates that the costs estimates associated with completing, terminating or delaying the Site C project will be provided by BC Hydro and will enable the Commission to exercise its judgement across a range of potential cost outcomes.

196. The CEC submits that it would be appropriate for the Commission to assess the range of uncertainty associated with BC Hydro's cost estimates based on the level of costing detail provided by BC Hydro, and by an examination of the record of BC Hydro's historical ability to deliver projects of this scale on budget.

197. The CEC considers that the range of uncertainty for the costs of proceeding may be significant; and that cost overruns could create a substantive change in the costs and associated value of Site C energy. The CEC considers it unlikely that the uncertainty will extend to a significant reduction in any of the costs under consideration.

198. Given that the cost of energy from completing Site C has a significant possibility of being generally cost-effective relative to other costs of energy, the CEC anticipates that the Commission would resolve the determination of its advice based on the abilities which could be provided to BC Hydro to manage the risks of surplus.

Is Site C Value optimized within a Risk-Adjusted Demand and Supply Context?

199. Determining whether Site C is optimized requires an understanding of the Demand and Supply context in which the project would be operating in order to establish an optimum Load Resource Balance.

200. It is appropriate for the Commission to apply its own judgement and assess the likely risk associated with BC Hydro's forecast of demand and supply. Considerations should include the size and timing of any changes that the Commission anticipates to the demand forecast and supply context. The CEC considers that it is appropriate for the Commission to determine its view of a reasonable range for the demand and supply context in order to understand the boundaries under which the project would not be optimized.

201. Key considerations affecting the immediate demand forecast include the potential for bias in BC Hydro's load forecast and a potential adjustment for the demand side management savings trail off. It is the CEC's view that there has been significant bias in BC Hydro's load forecasting in the past because of 10 years of relatively flat demand and that it is highly likely that the load forecast will not materialize as planned over the current planning horizon.

202. The over-forecasting embedded in the BC Hydro load forecast has been significant in the past and there has been no equivalent under-forecasting.

203. Assessing the supply context requires the Commission to consider the existing surplus, and determine the likely levels of IPP and SOP supply that should or should not be included in the Load Resource balance. The acquisition of supply is a key factor in creating a risk of surplus. Where additional costly supply is 'locked in' on a policy basis the uncertainty associated with demand creates a significant risk to the value of Site C energy.

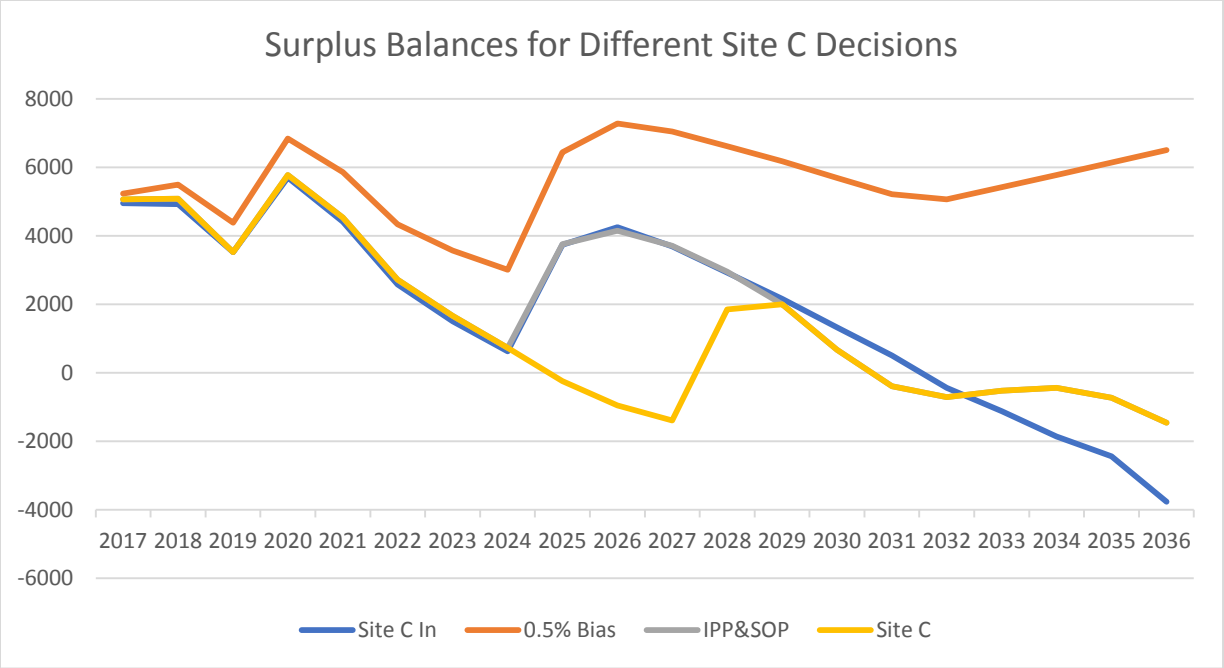
204. Assuming a demand forecast bias of 0.5% (the least level of bias in the last 50 years), and the inclusion of all planned SOP and IPP energy from the BC Hydro load resource balance, plus the addition of Site C results in a surplus of about the size of Site C or larger being maintained between 2024 and 2036.

205. Under this scenario the CEC considers that Site C would not likely be optimized, because the Site C energy would have to be sold in the spot electricity markets with little benefit to BC Hydro rate payers.

206. Reducing the volumes of IPP and SOP energy completely has the potential to reduce the potential risk of surplus significantly. Under this scenario, additional supply could be required in 2030. This supply could be met by renewing IPP supply contracts at market prices.

207. The extent to which the Commission expects that costly supply will continue to be added or diminished in the future, will significantly affect the risk of surplus and the potential size of possible loss to ratepayers from ongoing rate payers.

	BC Hydro Site C In LRB	BC Hydro 0.5% Bias Adjusted	BC Hydro IPP&SOP Adjusted	BC Hydro Site C Delayed
	GWh/year	GWh/year	GWh/year	GWh/year
2017	4954	5238	5061	5061
2018	4929	5498	5088	5088
2019	3524	4382	3520	3520
2020	5697	6846	5780	5780
2021	4411	5857	4532	4532
2022	2581	4334	2724	2724
2023	1509	3574	1659	1659
2024	627	3009	731	731
2025	3736	6439	3755	-246
2026	4256	7284	4149	-951
2027	3694	7051	3708	-1392
2028	2925	6614	2952	1852
2029	2155	6181	1998	1998
2030	1328	5695	673	673
2031	505	5218	-391	-391
2032	-443	5064	-713	-713
2033	-1121	5419	-520	-520
2034	-1865	5778	-437	-437
2035	-2436	6141	-728	-728
2036	-3771	6509	-1454	-1454



208. Additional factors influencing long term demand and supply as identified earlier in these submissions should also be considered in the Commission's evaluation of a risk adjusted demand and supply context.

209. Factors influencing the value of Site C energy will include a range of potential risks and or developments in the future, which may significantly affect the BC Hydro load resource balance and anticipated surplus.

210. The CEC provides the following view of risks affecting the Demand, Supply and Market Price context.

Surplus Risk Contributors	Size Range	Change to Context	Time Frame
Site C	5,100 GWh	Increase in supply	2024-2124
Risk of Load Forecast bias (flatter load future)	5,000 to 10,000 GWh	Reduction in load	2017-2036
Electrification of Transportation	1,500 to 10,000 GWh	Increase in future load	2030 - 2036
Electrification for GHG reduction	5,000 to 20,000 GWh	Increase in future load	2017 - 2036
LNG	-1,500 to 5,000 GWh	Reduction or Increase in future load	2017 - 2036
Major Industry changes	-2,000 to 2,000 GWh	Reduction or Increase in load	2017 - 2036
Distributed Energy	1,000 – 5,000 GWh	Reduction in load	2027 – 2036
Renewable Cost Reduction	30% to 70%	Reduction in future value of energy	2020 – 2040
Change in Market Prices	$-10/MWh to $20/MWh	Reduction in value of energy	2017 - 2036
IPP Supply @ Market	5,000 to 10,000 GWh	Increase Cost Effective Supply	2017 - 2036
SOP Supply	-2,500 GWh	Reduction in Cost Ineffective Supply	2017 - 2036
DSM Supply	5,000 to 10,000 GWh	Cost Effective Reduction in Demand	2020 - 2036
Recession	-5,000 to -10,000 GWh	Reduced demand (Flattening of demand)	2020 to 2025

Is there An Opportunity to Adjust the Demand/ Supply Context or Defer?

211. The CEC considers that there are several opportunities, directly within the control of BC Hydro and the Commission, to modify and reduce risks arising from the demand and supply context. These include the ability for BC Hydro to alter the terms and conditions related to the Standing Offer program and also the terms and prices under which they purchase IPP and other energy supply.

212. The CEC recognizes that there are several policy constraints currently affecting the demand and supply context which are not immediately controllable by BC Hydro. The CEC considers that it is important for the Commission to evaluate whether or not there is potential for the Commission, BC Hydro or the government to manage the existing constraints to mitigate the risk associated with Site C and or surpluses.

213. The CEC considers it appropriate for the Commission comment on these constraints in the scope of this inquiry as they relate directly to the value of Site C energy and the potential cost effectiveness of the project.

Immediately Manageable	Policy Constraints
Standing Offer Program Rules	Existing surplus
IPP Renewal Prices	DSM target 66% (minimum)
IPP Renewal volumes	Self-Sufficiency
DSM options	Standing Offer Program
Integrated Resource Planning vs. Siloed planning	Exempt Energy Acquisition
	Feed-In Tariff
	93% Clean Energy
	GHG Emission Reductions
	Biomass
	Net Exporter
	Option 2 DSM
	Rate Caps
	Siloed Planning in IRP context

214. The extent to which the Commission considers that these constraints are manageable by government and worthy of advice to the government, will have a bearing on assumptions about the ability for BC Hydro to manage the risk associated with a potential surplus.

215. If the Commission considers that it is possible to adjust the supply and demand context, or defer the project to a later period in which the risks are better known or manageable it is appropriate for the Commission to recommend avoiding termination of the project.

<u>Optimized within Demand/Supply Context Adjustments?</u>

216. The decision to defer or proceed immediately will be dependent upon the optimal time for the project to be in-service, based on a revised supply and demand context. If the project can be optimized under available supply and context changes, it is appropriate to proceed.

217. If not, it is appropriate to consider deferral and consider the range of costs that would accrue under this scenario. To the extent that the costs of deferral diminish the benefits of deferral, it would be appropriate for the project to proceed immediately.

E. Conclusion

218. Information relevant to the Site C decision currently before the Commission is highly uncertain and comprises a large array of possibilities.

219. In giving advice to the government the Commission must focus on the key issues comprising risk and uncertainty and on the tools necessary to manage and mitigate risk and uncertainty.

220. The following represents the submissions of the CEC with respect to assisting the Commission to answer the government's questions in a measured and meaningful way in order to enable the government to cope with the risks and uncertainties present.

221. It is the CEC's submission that an analysis deducting the sunk costs and costs to terminate and reinstate the Site C site and assuming significant probability of and level of cost over-run would likely still show the cost of Site C energy to be within a reasonably competitive price for energy and capacity compared to alternatives.

222. ***The CEC recommends that the Commission, after making its own judgement on the risks and uncertainties, advise the government that Site C has a significant range within which it could be a very good renewable, relatively low-cost energy and capacity resource which can be economic for BC Hydro ratepayers in the right context. Outside of this range the merit of proceeding with Site C diminishes.***

223. Given the potential levelized cost of completing Site C, the risk of excess surplus energy from Site C exclusively can be largely mitigated by being able to sell any Site C surpluses into the spot Mid C electricity market with a likely outcome of reasonable cost-effectiveness. The upside potential for the Site C energy and capacity to be used domestically in BC could deliver a good economic value to BC Hydro ratepayers.

224. However, the context in which Site C energy would be acquired remains a key consideration.

225. Site C provides a large block of energy and, depending on the supply and demand context for BC, continuation of the project has the risk of placing BC in a significant continuous surplus energy position. Recognizing and evaluating the risk of oversupply and ongoing surpluses acquired at high cost should be a primary focus of the Commission's judgement in its assessment of Site C.

226. ***The CEC recommends that the Commission, after making its own judgement on the risks of a continuous ongoing surplus situation, advise the government that it should find such a risk unacceptable and a significant contributor to less that affordable electricity for BC Hydro's customers.***

227. If the Commission finds that the risk of over forecasting, such as has been going on for the last ten years, is a realistic uncertainty, then the mitigation strategies of avoiding acquisition of expensive energy and ensuring that any renewals of energy supply contracts are acquired at market prices becomes a viable method of ensuring affordable energy for BC Hydro ratepayers.

228. ***The CEC recommends that the Commission, after making its own judgements on the risks of a continuous surplus energy position, advise the government that if Site C is to be completed it should be completed into a context where the risk of excess surplus acquired at high costs are fully mitigated.***

229. The CEC considers that the ability to optimize Site C and all energy acquisitions can represent as much as a potential $2 billion issue for ratepayers. If it is not managed properly there is a significant risk of oversupply being acquired at high cost and sold into the electricity markets for a loss.

230. This has been in the past, and would continue to be in the future the equivalent of writing a cheque from BC Hydro ratepayers to the United States. This issue can continue to repeat for each and every significant acquisition of energy, which contributes to significant surpluses, placing BC Hydro ratepayers at considerable risk.

231. ***The CEC recommends that the Commission, after making its own judgements on the risks of not optimizing value from Site C, advise the government to (a) restore flexibility to the Commission and to BC Hydro to manage risk and deliver affordable energy to its customers (b) examine the constraints in policy, regulation and law which handicap the management of risk (c) consider ways of recasting the framework which governs BC Hydro to enable BC Hydro to make more affordable energy available to its customers (d) enable integrated resource planning while avoiding specific disaggregated planning for each different source contributing to the load resource balance.***

232. The key issue in managing the risk of surplus is the flexibility of the integrated resource planning policy. Integrated resource planning which is able to shape supply to demand has the ability to manage the significant risk associated with the uncertainty of the demand and ensure that Site C does not contribute to an unnecessary and costly surplus.

233. ***The CEC recommends to the Commission that it advise government that a willingness to address context policy constraints to develop good quality integrated resource planning for affordable energy will be critical as a path forward for any decision the government may make with regard to Site C.***

234. The CEC recommends the following decision-making framework for providing advice to the government on the three Site C questions it has been asked to advise on.

a) Implications of completing the Site C project by 2024, as currently planned.

235. Benefits of completing the Site C project include the following:

- Acquisition of a large block of clean, renewable energy for a period of 100 or more years;
- Advantageous use of the sunk costs to obtain economic value for ratepayers; and
- Reduced economic risk from uncertainty associated with significant future electric load increases (eg. transportation electrification).

236. Key risks associated with the completion of Site C include:

- Risk associated with cost-overruns, which increases the levelized costs of energy and capacity from the project;
- Increased risk of surplus from the addition of a significant block of energy and capacity combined with uncertainty in the load forecast;
- Risk of technological obsolescence; and
- Environmental impacts similar to those of other BC Hydro hydroelectric systems.

237. In particular the risk of cost over-runs combined with the risk of surplus impacts the economic value to ratepayers of Site C energy and capacity.

238. Determinations around this risk may be evaluated as follows:

a) If the levelized cost of energy, accounting for over-runs is greater than BC Hydro's Long Run Marginal Cost (LRMC) then the project may be considered to be uneconomic, and termination would be appropriate. The CEC expects that the LRMC may be appropriately valued at $85/MWh or could be assessed lower based on evolving circumstances.

b) If the levelized cost of energy is lower than an expected Market Price (MP) for electricity (accounting for transmission costs) then there is limited economic risk to ratepayers as surplus energy may be sold to market. The CEC expects that the MP may be appropriately valued at $40/MWh or the Commission may set an alternative boundary for this value.

c) If the levelized cost of energy is between the MP and the LRMC, then the risk of surplus creates the risk that higher cost Site C energy will be sold to market for a net loss, resulting in an economic loss to ratepayers or that Site C energy sales to domestic customers will be significantly delayed, creating opportunity cost. The CEC estimates the economic loss to ratepayers from a surplus the size of Site C lasting for a number of years to be in the order of up to $2 billion. Where the duration of the surplus is longer the economic risk to ratepayers increases proportionally. Termination would be appropriate under such a scenario if surplus risks cannot be managed.

239. The CEC submits that the levelized cost of energy associated with Site C has a significant probability of being either lower or just marginally higher than Market Price.

b) Implications of suspending the Site C project, while maintaining the option to resume construction until 2024.

240. Benefits of suspending the Site C project include the following:

- Opportunity to reduce uncertainty in decision about when to implement;

- Reduced risk of surplus and uneconomic sales to market; and
- Improved opportunity to sell into domestic market.

241. Key risks associated with deferring the completion of Site C include:

- Risk of suspension costs; and
- Risk of reinstatement costs.

242. The CEC submits that the appropriate considerations around the deferral decision is to determine whether the suspension and reinstatement costs are likely to exceed the benefit of delay. If so, delay is not an appropriate option.

243. The CEC submits that the likely range of benefits are in the same order as the costs, provided that the risk of surplus is mitigated. To the extent that the risk of surplus is significant, delay may represent a preferred alternative.

c) Implications of terminating construction and remediating the site.

244. Benefits of terminating the Site C project include the following:

- Avoidance of risk associated with uneconomic energy; and
- Avoidance of environmental impact associated with Site C.

245. Key risks associated with terminating Site C include:

- Risk of the opportunity cost; (loss of valuable resource and sunk cost benefits)

  CEC defines the opportunity costs as:

  Cost of alternative energy option + (cost of termination + cost of remediation) – Site C levelized cost to finish including estimated potential for cost over run

- Contract termination cost risks; and
- Site remediation cost risks.

246. The CEC submits that the appropriate determination around the termination option are:

a) If the risk of opportunity cost is significant then there should be no termination.

b) If the Site C levelized costs are above the LRMC then termination is appropriate.

ALL OF WHICH IS RESPECTFULLY SUBMITTED.

David Craig

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David Craig, Consultant for the Commercial Energy Consumers Association of British Columbia