David Ince. Information Request Number 1.

BC Hydro F2020 - F2021 Revenue Requirements Application

1) PERFORMANCE METRICS

Reference: Appendix E: Service Plan. Page 17 of 36.

1) With respect to the SAIDI and SAIFI and Generation Facility Forced Outage Factor performance metrics: please include key studies undertaken by BC Hydro and/or applied by BC Hydro to determine the optimum economic infrastructure performance level. In particular, please provide the cost curve or relationship between cost and reliability for each of the indicated performance metrics and yearly operations spending. In the tradeoff between (capital and OMA) spending, from a customer utility perspective, what us optimum level of spending?
2) What is the value of lost load applied in any optimization metrics, including $/MWh, $/kw-yr or $ per outage event.
3) Please provide the results of industry benchmarking comparisons which have been contributed to by BC Hydro, including the Canadian Electricity Association and the Transmission and Distribution study conducted by First Quartile Consulting.

2) LOAD SURPLUS

Reference Appendix BB, Section 2.2.

Reference: Section 4.2.2 in Comprehensive Review of BC Hydro.

"Although BC Hydro has not conducted competitive calls for power since 2011, it is projected to have an energy surplus into the 2030s."

1) Please confirm that BC Hydro is forecast to be in an energy surplus with committed domestic resources (including Site C) until the year F2033.
2) Please indicate the last surplus year for capacity.
3) Please provide the forecast dates that BC Hydro will be in energy and capacity balance, under BC Hydro's high and low forecasts respectively.
4) Please provide the average GHG intensity (tonnes/MWh) of B.C Hydro exported power for the last 5 years, and forecast until Fiscal 2024. Please contrast this with the approximate average GHG intensity of electricity in the Mid-C and Alberta markets over this same time horizon.
5) Please provide the actual volume and dollar value of all environmental attributes (such as GHG, or 'green credits' or 'emissions offset credits') sold by Powerex over the last 5 years, and forecast to be sold until F2024.

3) COST OF ENERGY

Reference: Chapter 4: Cost of Energy. Table 4.1 end of Fiscal Year System Storage.

1) Please provide monthly resolution charts indicating system storage (GWh) from F2012 to present with for each of the Peace (Williston) and Columbia (Kinbasket) reservoirs. Also indicate BC Hydro's total value of this storage inventory ($) based on the deemed marginal cost of electricity that was current at the time.
2) Please provide a daily resolution chart from F2012 to present of water levels for each of Williston and Kinbasket reservoirs. Please superimpose on this chart the maximum and minimum water license constraints, and the band (range) of historical levels from 1984 to current.
3) On these charts, also indicate Comptroller Notification Levels and Minimum Normal Water Use Plan Levels, and describe how these differ from the minimum water license levels.
4) Please explain the hydraulic, environmental political and public consent constraints around (low) water levels at these reservoirs. Please explain why BC Hydro does not draw its reservoirs down to the minimum water license levels.
5) Please provide an estimate of the value of one foot of water at each of Williston and Kinbasket reservoirs at current marginal cost values.

4) ISKUT EXTENSION PROJECT

Reference: 2.5.7 Iskut Extension Project Direction (B.C. Reg. 137/2013)

1) Please provide a forecast of load serviced by this extension (peak MW and average yearly energy). Please provide the number of electricity accounts and approximate population serviced.
2) Please indicate the contributions from the Federal government towards the funding of this expansion.

5) SITE C

Appendix J Attachment 1 -Site C Community Benefits and Mitigation Measures specifics and costs

1) With respect to the stated Site C forecast capital cost of $9.297 B. Please provide a cost sensitivity due to potential for future interest rate changes, as in the change to the installed cost of Site C due to a change of interest rates in the magnitude of plus and minus 1%.
2) Please indicate the levelized cost of energy from Site C in $/MWh, and key underlying assumptions including as in discount rate, project lifespan, and the yearly energy production profile.

Chapter 5G - Operating Costs Other

The [Site C] project cost is $10.7 billion, consisting of an expected project budget of $10.0 billion and a project reserve subject to Treasury Board control of $0.7 billion.

3) With respect to the $708 million Site C project reserve held by the Treasury Board, please confirm if this reserve incurs debt servicing costs/payment by BC Hydro to the Province?

6) PRES

Reference: Appendix J Attachment 1. Capital projects (PRES)

1) Please provide BC Hydro's Peace-region gas production forecast for the next 50 years, by gas production sub-region (Dawson Cr., Groundbirch, Chetwynd, Fox/Ft. St. John, GMS and Tumbler Ridge), used as an input into the regional load forecast. That is, for each region, a yearly resolution forecast of natural gas production in MMScf/d, as constrained by all factors, including the inherent quality of the regional gas resource, gas production economics, regulatory and environmental constraints, pipeline access, and LNG economics.
2) Please provide the electricity load forecast specific to the Peace region (energy and capacity) by the sub-regions specified above, in tabular and graphical form with yearly resolution for the timeframe specified above, contrasted against the (N-0 and N-1) servicing capability (capacity) of the existing Peace region infrastructure, and ultimate servicing capability of all seven expansion options. On the (X) time axis of the graph, indicate the timing of the expansion options.
3) In a similar format as with the mid-level forecast requested above, please also provide the high and low load scenarios. Please describe the key assumptions underlying these scenarios, including associated LNG export outcomes.
4) With respect to the electrification of natural gas production, specifically compression work energy, for each gas production sub-region, please indicate key assumptions including:
    a. Electric work intensity (MW/mmscf/d) for gas production,
    b. Electricity load factor for gas production,
    c. Assumed electrification percentage (as in percent of work energy to be provided by BC Hydro provided electricity versus total work energy which includes isolated electricity generation, or traditionally direct natural gas drives),
    d. The number of wells drilled per year,
    e. Well decline rate: the 'type' curve representing the well decline profile over time,
    f. Initial average well productivity, and
    g. Well abandonment threshold (in years of production or minimum production threshold).

5) In the PRES region forecast, please comment on, and provide an approximate quantification (MW and MWh/yr) of other natural gas-related work energy that is expected to be electrified in the PRES region, including: hydraulic fracturing, natural gas processing/dewatering/sweetening.
6) On the map of the Peace Region, please provide the geographical boundaries of the gas producing regions consistent with the assumptions provided above, and map key export pipelines.
7) With respect to the electricity compression requirements of export pipelines from the Peace region serviced by BC Hydro, please provide, actual (F17-F19) and forecast system-coincident peak requirements and annual energy – by year.
8) Please provide a transmission line map of the Peace Region of the province, highlighting the seven options considered for the PRES project, indicating alternative routings, major transformer facilities, and line voltage ratings.
9) Please indicate if a double circuit 230kv line between SBK (Southbank) and SGB (Shell Groundbirch) is still the preferred expansion option. Please indicate estimated capital costs for each of the routing options.

10) Please indicate the expected operational lifetime of each of the seven options, and the expected capital amortization periods for each.
11) Please provide a cost sensitivity for the PRES preferred option due to potential for interest rate changes, as in the change to the installed cost of PRES due to a change of interest rates in the magnitude of plus and minus 1%.
12) In the load forecast for the PRES region, what are the energy and capacity savings that are expected to be obtained from DSM for each of the base (mid) forecast and high and low cases.
13) What are the energy and capacity savings expected to be obtained from customer curtailment arrangements, which include self-generation options, and dispatchable/curtailable capacity demand.
14) What natural-gas fired or diesel generation options have been explored as capacity alternative to PRES?
15) Please provide studies indicating that a transmission solution to Peace region capacity shortfalls is required and is preferable to local generation and/or load curtailment/DSM options.
16) Please provide a sensitivity as to PRES construction costs for the preferred option. That is, indicate the change in the annual revenue requirement for PRES due to a 1% change in capital costs.

Reference: Appendix K - Attachment 1.

17) Please provide details of the in-place customer load-shredding scheme, in particular the value provided to participants for their peak shedding services. Please provide specifics such as maximum allowable number of interruption events, duration of such events, and the compensation provided. Please indicate capacity cost of the program to BC Hydro ($/kw-yr). Please provide a history of interruption events under this program, as to dates, duration of interruptions, the number of customers involved, MW of capacity saved and total payments made to customers.

7) ELECTRICITY PURCHASE AGREEMENTS

Reference: Table 4-12: IPP and Long-Term Purchase Volumes the Integrated System

Table 4-13 Breakdown of IPP and Long-Term Commitments for the Integrated System

1) Please provide a third table with the same resolution of Tables 4-12 and 4-13 that expresses IPP purchase costs in $/MWh.

Reference: Section 4.4.3

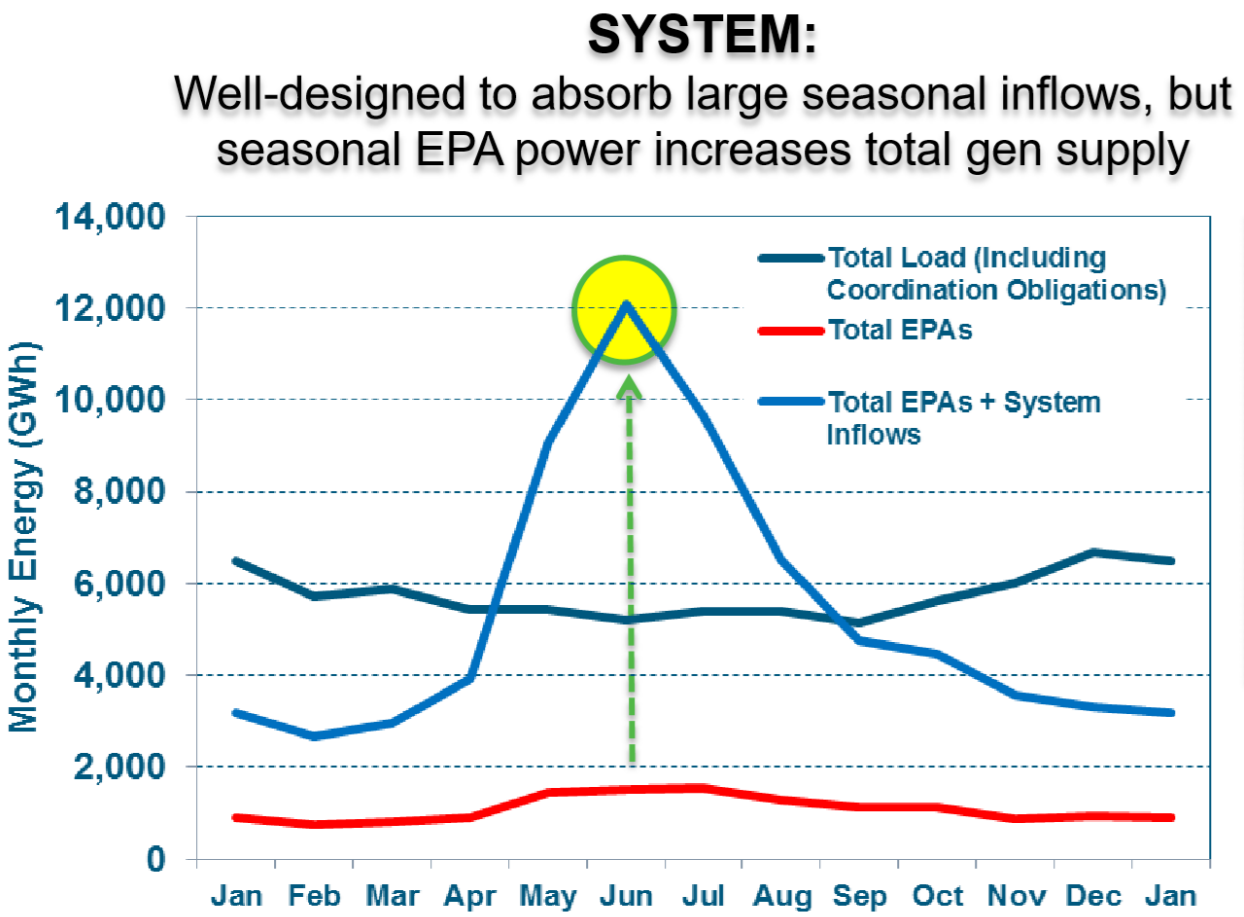
Commitments for the Integrated System Other than Island Generation and certain biomass facilities, most IPPs are not directly impacted by system dispatch decisions.

2) Please confirm that the reason why most IPP deliveries are not impacted by system dispatch decisions is because the significant majority of IPPs contracts are take or pay, and that the majority of energy produced by IPPs is neither dispatchable nor curtailable.
3) Please indicate the size (by capacity) of BC Hydro's current IPP portfolio that is centrally dispatchable (on) by BC Hydro. Please express this as the MW of dispatchable generation (coincident to the BC

Hydro peak requirement – typically 6pm on a December weekday) and contrast with the MW of average yearly maximum coincident IPP output (during the freshet).

4) Please indicate the size (by capacity) of BC Hydro's current IPP portfolio is centrally curtailable (off) by BC Hydro. Please express this as the MW of curtailable generation (coincident to the BC Hydro peak requirement – typically around 6pm on a weekday in December) and please contrast with the MW of average yearly maximum coincident IPP output (during the freshet).

Reference: BC Hydro Transmission Service Rate Design Workshop - October 11, 2018



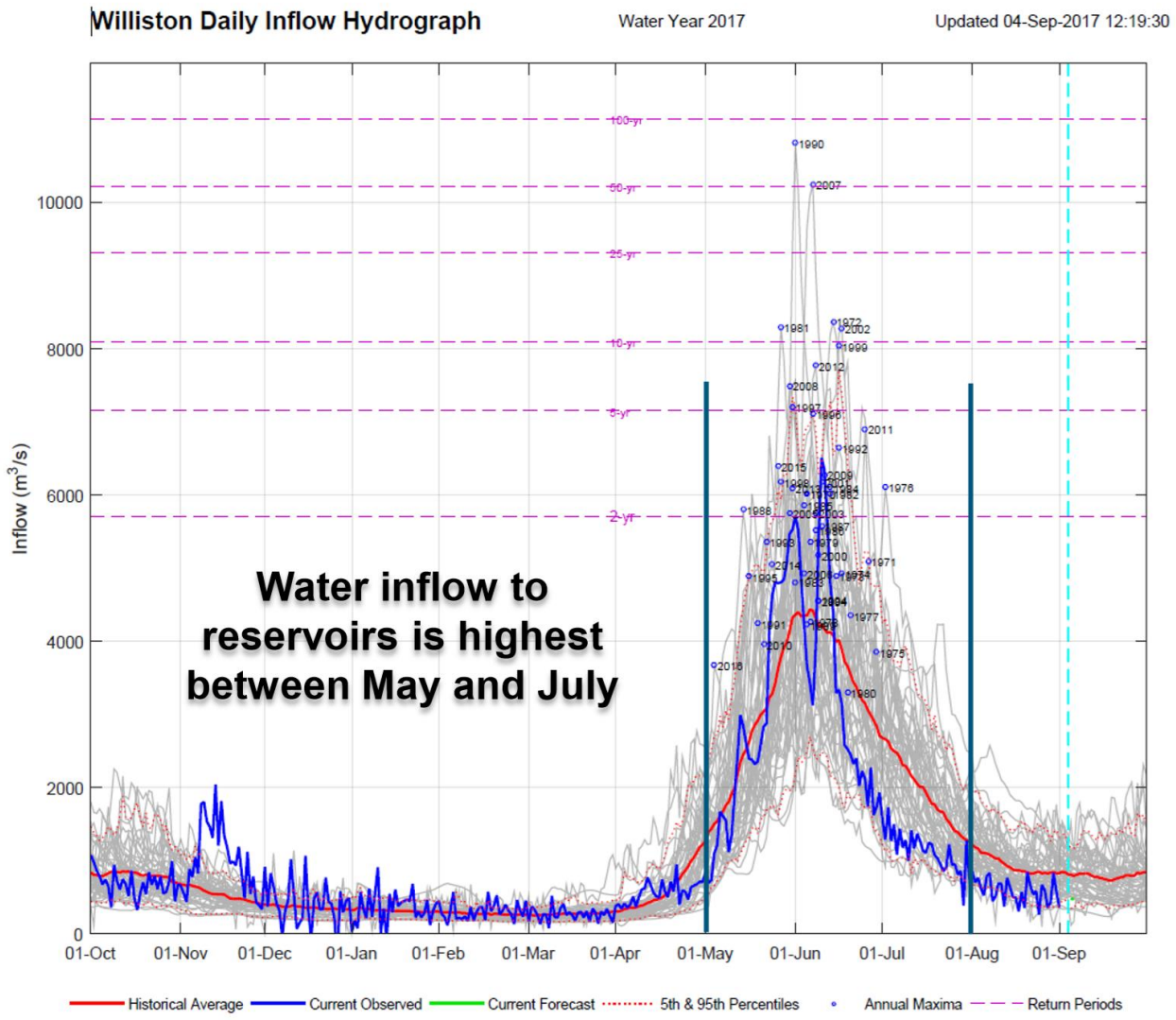
5) Please confirm that the graphic above indicates monthly BC Hydro IPP energy, demand, and BC Hydro energy which <u>could</u> be produced from system inflows. Please provide a similar graphic for the most recent year in which actual data is readily available, which at a monthly resolution indicates IPP energy, Total Load, Total EPAs + System Inflows, and in addition, a line indicating Total EPAs plus BC Hydro energy production at <u>minimum</u> generation constraints. That is, please recast the above graphic to add the line: Total EPAs + minimum generation.

6) Please indicate the magnitude (GWh per month) of the freshet 'pinch point'; that is, the maximum amount of incremental freshet energy that BC Hydro could absorb given the operational flexibility of storage system.

7) Has the point been reached, in which the operational flexibility of the BC Hydro system during the peak of the freshet has been exceeded, requiring mandatory freshet exports, and/or water spills?

8) Please provide a similar graphic as requested above, except for the situation expected in F2021.

Reference: BC Hydro Transmission Service Rate Design Workshop - October 11, 2018



9) Please provide the above chart for Water Year 2018. Please also provide the 2018 chart for the Kinbasket Reservoir.

Reference: 5F.7 Power Acquisitions and Contract Management KBU

The Power Acquisitions and Contract Management KBU is responsible for managing and administering BC Hydro's IPP resource portfolio and contracts, for both the integrated system and the Non-Integrated Area. These contracts represent a cost commitment of over $50 billion for contracts that extend as long as 60 years.

10) Please clarify the basis of the "over $50 billion" value referenced. What is the total dollar value (fixed and forecast variable payments) of the future financial commitment of BC Hydro to Independent Power Producers, expressed in nominal dollars and discounted dollars. Provide the

discount rate used and the rationale for the applied discount rate as compared to BC Hydro's own discount rate.

11) When BC Hydro undertakes economic evaluations to understand the economic perspective of Independent Power Producers, what is the aggregate discount rate assumed, and why.

Reference: Chapter 4 - Cost of Energy - Table 4-13

12) Please provide an aggregated 5-year history of the monthly energy production profile for each of the IPP classes (according to Call) contracted to BC Hydro. That is, monthly production (GWh) for each of the following IPP categories:
    - Pre 2003 EPAs
    - Green Power Generation Call
    - 2006 Open Call
    - 2008 Bioenergy Call - Phase 1
    - 2008/10 Standing Offer Program
    - 2010 Bioenergy Call - Phase 2
    - 2010 Clean Power Call
    - 2010 Integrated Power Offer
    - Negotiated EPAs
    - Expected SOP Projects and other First Nations Commitments
    - Total IPP

Preferably, please additionally provide an energy production breakdown of the Pre 2003 EPAs by the following categories:

- 1988 Over 5 MW
- 1989 Less than 5 MW
- 1994 RFP
- 2000 RFP
- 2000 Over 40
- 2001 Under 40
- 2002 Commercial Based Generation

13) Please provide an aggregated forecast of energy production under each of the above IPP categories - until F2024.
14) Please provide a the last 5 years of actual BC Hydro domestic demand, segmented by major customer rate groups, with monthly resolution.
15) Please provide a summary of recent discussions with third parties with respect to the transfer or sale of the Burrard generation site, for the specific purpose of energy production.

16) LOAD FORECAST

Reference: Appendix O: ELECTRIC LOAD FORECAST REPORT F2019-F2024

1) Please provide BC Hydro's 30-year Load Forecast Document.
2) Given the recent release of report: Canada's Changing Climate Report (CCCR2019) by Environment and Climate Change Canada, please comment on the provision in this or future

load forecasts the incorporation of the impacts of climate change, in particular temperature, precipitation and snowmelt.

3) Please comment on BC Hydro's understanding of seasonal and yearly patterns and trends with respect to changing temperature, precipitation and snowmelt, and the direction of domestic electricity requirements (energy and capacity) to incorporate the trends indicated in CCCR2019.
4) Please provide a summary of BC Hydro's most recent studies with respect to British Columbia historical temperature, precipitation and snowmelt trends, and at a high level the potential effects of future climate change effects on domestic electricity infrastructure.
5) Within BC Hydro's load forecast, please indicate how the persistence of DSM savings is treated. That is, past the assumed savings persistence period, what is the assumption within the load forecast with respect to the efficiency (or use rate) of capital stock that had been originally enabled by BC Hydro's DSM programs? Does the load forecast assume that subsequent (replacement) capital stock will be of the same efficiency as that enabled by BC Hydro, or greater or lower efficiency levels?
6) Please provide any studies with respect to the potential degree of under or over counting in DSM in the BC Hydro load forecast. Include a description of this integration issue, and a quantification in terms of energy and capacity with yearly resolution. Please indicate a mitigation plan for the solution to this problem.

Reference: Section: 2.0 Load Forecast Components

7) In the same format as presented in Figure 2.1, please provide calculated rate impacts (GWh reductions due to elasticity effects for each of a -0.05 and -0.10 elasticity) for the for years F2017 to F2024 inclusive – by year. That is, present charts with a clearly delineated yearly expected load reductions due to rate increase/elasticity impacts.
8) In tabular format, indicate capacity (MW) rate-induced effects by year for F2017 to F2024 inclusive, calculated for each of -0.05 and -0.10 elasticity.
9) In the same table, please provide the elasticity effects (energy and capacity) by each of the major customer rate groups, from F2017 to F2024 inclusive.

Reference: Chapter 3 - Load and Revenue Forecast Section 3.1

While events since October 2018, such as the announcement of the Government of B.C.'s CleanBC Plan are not included as part of this Load Forecast, they are captured within the uncertainty discussion provided in section 3.3.6.

Reference: Section: 3.3.6.2

Reference: CleanBC Plan:

(https://blog.gov.bc.ca/app/uploads/sites/436/2019/02/CleanBC_Full_Report_Updated_Mar2019.pdf)

The CleanBC Plan, released by government in December 2018, is not reflected in the Load Forecast which was finalized in October 2018 but will be incorporated in future load forecast updates. By 2030, the CleanBC Plan could require approximately an incremental 4,000 GWh of energy over and above currently projected demand growth to electrify key segments of the economy. Some of the implications of this include a further commitment to electric vehicle incentives which may mean more

electric vehicle sales and associated loads, increased building load and increased natural gas sector load.

10) Please confirm that CleanBC Plan electrification initiatives such as aspirations of a non-emitting vehicle fleet has not been included in the October 2018 mid load forecast. Please confirm that when these initiatives, when fully implemented, will introduce additional demands that will be above the range of the current high forecast.
11) Please confirm that CleanBC Plan electrification initiatives such as the electrification of the interior BC ferry fleet has not been included in the October 2018 mid load forecast. Please approximate the additional energy and capacity demands if this electrification goal is fully realized.
12) At a high-level, please indicate how the current information on the CleanBC Plan would alter the October, 2018 load forecast, mid, high and low bands, specific to each customer rate group.

Reference: Appendix O: ELECTRIC LOAD FORECAST REPORT F2019-F2024

13) Load Forecast: please provide the Conference Board of Canada June 2018 economic and demographic report used in the preparation of the load forecast.
14) Please summarize the inputs, outputs and information flow within the CBoC econometric model and how the model converges to a stable and internally consistent solution.
15) Reference: Appendix O: Load Forecast. Table 3.1. Please provide the SAE report prepared by Itron for BC Hydro with respect to the relationships between economic drivers and electricity use and between temperature and electricity use which was used in the preparation of the load forecast.
16) Provide a yearly resolution table of the key inputs into the econometric forecast, including major capital investments (including LNG and natural gas production, processing and pipeline infrastructure), BC birth rates, BC immigration, assumptions of economic growth or constraints in key export markets, and key market commodity prices including gold, copper, kraft pulp, dimensional lumber, crude oil and natural gas. Include foreign exchange assumptions – specifically: US/Can$.
17) Specific to the econometric model assumptions for the LNG natural gas industry: please provide:
    a. The assumptions in the econometric model with respect to the number of employees required for LNG, specific to the plants and the immediate area. Please provide during each phase of the project development with yearly resolution. This should include project development and construction phases, and post commissioning (operations).
    b. Provide the assumptions in the econometric model with respect to number of employees required for upstream natural gas and associated pipelines. Please provide during each phase of the project development with yearly resolution. This should include project development and construction phases, and post commissioning (operations).
    c. Specific to LNG, what is the labour intensity assumed – i.e. number of employees per $Billion of investment during both the construction and operational phases, with yearly resolution.
    d. Specific to natural gas production, processing and shipping, what is the labour intensity assumed – i.e. number of employees per $Billion of investment during both construction and operational phases, with yearly resolution.

e. For each of LNG, and natural gas production, processing and shipping, what percentage of the labour has been assumed to be sourced in BC versus imported from outside of the province?

18) Specific to LNG and natural gas production, processing and shipping, please isolate and provide the effects of these industries as indicated in the outputs of the econometric model. That is, what is the incremental effect on the BC economy and demographics for (each of, separately) LNG and natural gas production, processing and shipping with respect to BC GDP, housing starts, population, immigration, employment, commercial GDP, and disposable income.
19) Provide the assumptions in econometric model with respect to the direct number of employees during each phase of the Site C project.
20) Specific to Site C, please provide the effects of this project as indicated in the outputs of the econometric model. That is, what is the effect on the BC economy and demographics of (each of) Site C investment and construction with respect to BC GDP, housing starts, population, immigration, employment, commercial GDP, and disposable income.

21) Please provide BC Hydro's assessment of the effect of weather (specifically temperature) on actual sales.
    a. For each of the last 3 years where BC Hydro has actual data, what was the actual temperature variation (in terms of heating and cooling degree days) from 10-year and 30-year averages, with resolution by month?
    b. Provide the calculated effect of this variation on sales to each of the Residential and General Service rate categories.
    c. What is expectation of the forecast temperature variation (in terms of heating and cooling degree days) variation for the remainder of F20?
    d. Please provide information on potential El Nino/La Nina events, for the remainder of F2020 which have been incorporated in to BC Hydro's most recent Energy Study.
22) What is BC Hydro's peak thermal dependency in terms of MW per degree during the peak hour? Please provide a breakdown by customer class.
23) What is the energy thermal dependency of BC Hydro in terms of GWh per year per degree? That is, assuming a one degree average increase in yearly temperature (uniformly across the year), what is the expected net increase or decrease in domestic electricity demand (with monthly resolution). In this analysis, please provide a breakdown of increased thermal demands such as air conditioning versus reduced thermal demands such as space heating (energy with monthly resolution).
24) Please provide reports or studies that attempt to quantify the relationship between temperature and BC Hydro electricity demand.
25) Please provide reports or studies that quantify the effects of (internal and externally-derived) climate change scenarios on BC Hydro energy and peak demand.
26) Please indicate the results of the most recent Energy Study on expected energy demand for the coming winter of F2020 in terms of changes in energy demand for each customer group relative to the filed RRA load forecast.

Residential Sector Forecast

27) With respect to residential housing stock assumptions:
    a. As included in the load forecast, provide the assumed penetration (percentage) of primary electrically heated versus heated by natural gas by housing type (single family, multi-family, apartments, mobile).
    b. In the load forecast, provide the assumed penetration (percentage) of primary electrical water heaters versus natural gas by housing type (single family, multi-family, apartments, mobile).
    c. Please provide the efficiency of natural gas space heating (energy in versus out as a percentage), and the assumed efficiency of electrically-heated residences. Please provide these assumptions for each of natural gas and electric heating by housing type (single family, multi-family, apartments, and mobile).
    d. For each of space and water heating, please describe what drives these percentages? Specify the assumptions in this analysis, including future electricity prices, assumed natural gas prices, yearly maintenance expenditures, the lifespan of each heating appliance, and the installed capital costs of each heating type. If a stock turnover model, please provide details of the model.
    e. Does BC Hydro use a stock turnover model in undertaking this analysis? If so, please summarize the workings of the model, including inputs, outputs, model architecture, and methodology.
    f. Given the above assumptions, what is the forecast cost of heating an average residential account (in F2020) with electricity and natural gas using BC Hydro's base (mid) assumptions. Please provide the results of this analysis by housing type (single family, multi-family, apartments, and mobile) with yearly resolution.

Commercial Sector Forecast:

28) Please provide a summary of the economic and demographic drivers used in the Statistically Adjusted End Use (SAE) Model with respect to commercial building stock assumptions:
    a. In the load forecast, what is the assumed penetration (percentage) of primary electrically heated versus heated by natural gas?
    b. In the load forecast, what is the assumed penetration (percentage) of primary electrical water heaters versus by natural gas?
    c. What are assumed efficiencies of natural gas space heating (energy in versus out)? What is the assumed efficiency of electrically-heated buildings?
    d. What drives changes to this forecast? If a stock turnover model, please provide details of the model.
    e. For each of space and water heating, specify assumptions in this analysis, such as future electricity prices, assumed natural gas prices, and the capital costs and lifespan of each heating type.
    f. Given the above assumptions, what is the average cost of heating a commercial building (by square foot) with natural gas with electricity versus natural gas?

Elasticity

Reference: Appendix C - Comprehensive Review of BC Hydro: Phase 1 Final Report, Revenues/Load Forecasting

29) With respect to elasticity assumptions and the application of elasticity in the load forecast:
   a. Please confirm the assumed elasticity -0.10 is applied to all customer sectors, Residential, Commercial, Industrial and Other;
   b. Please confirm that the effect of this elasticity effect has been subtracted from the load forecast, and therefore is embedded in the net load forecast;
   c. Please confirm that this elasticity also applies to sales made to FortisBC and the City of New Westminster;
   d. Please confirm that this same elasticity is assumed to apply over the entire load forecast horizon, that is, the elasticity assumption of -0.10 is invariant over time, with no distinction between short and long-term elasticity effects;
   e. Please confirm that this elasticity assumption does not depend on customer income level, or home heating type, or housing type;
   f. Please confirm that elasticity assumption does change depending on the time of year;
   g. Please confirm that this elasticity value is assumed to be the same for all end-uses and industrial processes in the load forecast. That is, the single aggregate elasticity value of -0.10 is applied uniformly to all uses of electricity in the load forecast;
   h. Please describe any assumptions that have been made in the load or DSM savings forecast with respect to the existence of threshold rate levels, at which beyond, customers may cease operations, or move to another jurisdiction, or change to another energy source;
   i. Please confirm that the -0.10 elasticity value does not change based on the rate level. That is, there is no threshold rate level beyond which elasticity is assumed to increase;
   j. Please reference or provide any studies that BC Hydro has used with respect to the relationship between income, home heating type and elasticity;
   k. Please reference or provide relevant and recent studies with respect to the percentage of electricity as an input costs to major industrial customers such as mining, oil & gas, pulp & paper and chemical;
   l. Please reference or provide relevant and recent studies with respect to threshold rate levels at which major industrial customers will cease operations or move to other jurisdictions or switch fuels;
   m. Confirm that if the assumed elasticity was doubled, that the rate-induced savings would also double;
   n. Please confirm that BC Hydro applies a probability weighting to each industrial customer in the load forecast (except for LNG), which essentially quantifies the future viability of that customer demand, based on considerations that include market competitiveness, plant longevity, and plant input costs (including the cost of fuels such as electricity);
   o. Please confirm that this probability weighting is partially based on the forecast of electricity rates, and is consistent with BC Hydro's long-term rates forecast;
   p. Please confirm that rate-induced elasticity is a quantification of the expected response of customer electricity demand to <u>changes</u> in rates;
   q. Since the rates in BC Hydro's long-terms rate forecast have been embedded in the long-term load forecast as invariant, please confirm that the probability weighting approach applied by BC Hydro's is not the same as or a substitute for rate-induced elasticity;
   r. Please confirm that future rates may differ than those assumed in BC Hydro's long-term rate forecast;
   s. Please confirm that future probability weightings assigned to industrial customers in the load forecast may therefore differ from those currently assigned by BC Hydro;

t. Please confirm that in real world conditions, that a decrease in cost competitiveness (due to an increase in electricity rates) is likely to have a much larger and immediate impact than a similar magnitude improvement in cost competitiveness. This former impact could result in facility closures, and moving production elsewhere; and
u. Please confirm that BC Hydro's elasticity calculation does not consider potential step-changes in industrial demands.

Large Industrial Sector Forecast

30) Provide the high, base and low commodity price forecasts used in the Large Industrial sector load forecasts. This should include Natural gas (Sumas and Henry Hub), gold, copper, moly and crude oil (Brent or WTI). Please provide references to the sources of these forecasts.
31) Please provide the aggregate probabilities applied to existing industrial sector demand in the load forecast for each of the forecast years. That is, what is the discounting applied to existing customer demand in each of the major industrial sectors (including mining, oil, gas, pulp & paper) expressed as discounted load divided by full load, with yearly resolution?
32) If the load forecast were to be updated, please indicate what would be the effect on the mining sector load forecast of due to the January, 2019 cessation of operations at Imperial Metals Mt. Polley mine.
33) If the load forecast were to be updated, please indicate what would be the effect on the mining sector load forecast of due to the March, 2019 sale of a 70 per cent interest in its Red Chris copper and gold mine in B.C. to Australia's Newcrest Mining Ltd.

Reference: Appendix O: Table 7-22 Large Industrial Sales History and Forecast Before Rate Impacts

Reference: 7.5.2.2: Other large oil and gas operations

34) Please confirm that natural gas pipeline compression loads is included in the load forecast.
35) Please confirm that oil pumping loads is included in the load forecast.
36) Please specify the assumed timing of full operations of the Trans Mountain pipeline expansion included within the oil & gas forecast. That is, in what month & year are the full expansion pumping loads are realized? Please indicate if this expansion has been included in the load forecast at full load, or if this demand has been discounted considering expansion uncertainties. Please provide the aggregate oil sector energy and peak demand forecast, before and after the discounting of the full loads.
37) Please explain the approximate doubling of forecast demands in the 'Other Oil & Gas' in the year F2024.
38) With respect to Canada's Oil Tanker Moratorium Act (Bill C-48), has this information been or will be incorporated into the load forecast? If incorporated, directionally, what would be the effect on the load forecast?
39) With respect to Canada's Bill C-69, or the "Impact Assessment Act", has this information been or will be incorporated into the load forecast? At a high level, if incorporated, what would be the effect on the load forecast?
40) Please indicate the effect on the load forecast of the February 22, 2019, National Energy Board (NEB) Reconsideration report to the Government of Canada, with an overall recommendation that the Trans Mountain Expansion Project is in the Canadian public interest and should be approved subject to 156 conditions enforceable by the NEB.

Reference: Load Forecast Section 3.3.4.1: Mining

Reference: 7.8.8: Mining Customer Payment Plan Regulatory Account

In accordance with section 3(2) of Order in Council No. 123, issued on February 29, 2016, BCUC Order No. G-34-16 authorized BC Hydro to establish the Mining Customer Payment Plan Regulatory Account to defer to future fiscal years amounts equal to the sum of the following related to mining customers participating in the Mining Customer Payment Plan Program.

This Order arose from the Government of B.C.'s decision to allow companies operating metal and coal mines in B.C. to temporarily defer a portion of their electricity payments during periods of low commodity prices.

41) Please provide a high-level summary of the commodity price conditions (copper, gold or other) which trigger rate payment deferrals by qualified mining customers. Please indicate the formula (including trigger levels, indices, price caps and floors) applied by which mining customers defer or repay payments.
42) Please summarize the aggregate change in mine probabilities and energy and capacity adjustments made to the 2016 load forecast as a result of the implementation of the mine rate deferral package. If the forecast was not altered as a result of this program, please explain why.
43) Provide a breakdown of percentage (energy and capacity, by year) of mining customer demand not participating in the rate program, and participating demand. For those participating, please provide (energy and capacity) of avoided load attrition, expected free riders, and forecast load for which there is expected to be no effect as a result of the program.

Electric vehicle forecast:

44) With respect to the electric vehicle forecast:
    a. Please provide the forecast of assumed work intensity for electric vehicles as expressed as kWh/km driven for each of the vehicle types in BC Hydro's EV model. Directionally, please indicate how this may change in the future;
    b. Please provide a distribution of BC driving distances assumed in BC Hydro's EV load forecast model;
    c. Provide the assumed minimum economic threshold distance driven per year, below which customers are assumed not to purchase an EV;
    d. Provide assumed vehicle availability constraints, due to manufacturing or distribution constraints, expressed as the maximum number of EVs that can be delivered to the BC market, regardless of customer demand or economic viability. Provide background support as to the reason for this assumed constraint;
    e. Provide the electricity price forecast used in the electric vehicle model;
    f. Provide assumptions with respect to potential discounting of electricity rates for electric vehicle charging. This could include Time of Use or Off-Peak price discounts;
    g. Provide the gasoline price forecast used in the electric vehicle model.
    h. Provide the initial purchase price assumptions for electricity and gasoline vehicles.
    i. Please provide a description of the class of proxy vehicle(s) assumed in the model;
    j. Provide the assumed threshold in the model, in terms of maximum vehicle range expressed as daily and yearly travel distance;

k. Provide the conversion efficiency assumed for electric vehicles and associated charging hardware, as the ratio of electrical energy delivered to the vehicle wheels divided by metered electricity;
l. Provide assumptions with respect to purchase price rebates or incentives from the provincial or federal government. These rebates could take the form of lowering the purchase price of EVs, or lowering the installation cost of charging infrastructure or both;
m. Please provide assumptions into the EV peak load forecast as to the breakdown between EV customers who have 110V vs. 220v vs. faster charging options;
n. Provide assumptions with respect to the installed cost of EV charging hardware for an average installation, by charging level;
o. Provide assumptions with respect to the charging profile (by time of day) for each charging level above. That is, kW by hour for an average customer;
p. Provide a generic charging profile used in the peak load forecast, that shows current (kW) from time zero (initial connection of EV charger) until full charge is achieved, by each charging level;
q. Please provide coincidence assumptions in the EV peak forecast. That is, what percent of vehicles are assumed to be charging per hour of the day, and what is the aggregate charging profile (MW of EV demand with hourly resolution) during the system peak day; and
r. Please provide specifics on the incentives or programs (rate, capital cost or technology) that BC Hydro is undertaking in order to minimize potential negative local and system effects of on-peak period EV charging.

45) Please provide an update on the load forecast stock & flow (stock turnover) model, and provide cost and implementation timelines.

17) MARIJUANA GROW OPERATIONS:

Reference: Appendix O: Section 8.2 CANNABIS AND CRYPTOCURRENCY METHODOLOGY

1) Please confirm that Table 8-2: Cannabis and Cryptocurrency Forecast Before Rate Impacts indicates an approximate six-fold increase in forecast sales to this sector between F2019 and F2024.
2) Provide the historical (5 years) and forecast (to F2024) of electricity demand from marijuana growers in energy and capacity. Please break this into the category of growers who pay, and an estimate of losses arising from growers who steal.
3) Please outline BC Hydro's theft prevention measures.

18) ENTERPRISE RISK MANAGEMENT

Reference: Appendix E: Board Chair Accountability Statement

The 2019/20 – 2021/22 BC Hydro Service Plan was prepared under the Board's direction in accordance with the Budget Transparency and Accountability Act. The plan is consistent with government's strategic priorities and fiscal plan. The Board is accountable for the contents of the plan, including what has been included in the plan and how it has been reported. The Board is responsible for the validity and reliability of the information included in the plan.

All significant assumptions, policy decisions, events and identified risks, as of January 31, 2019 have been considered in preparing the plan. The performance measures presented are consistent with the

Budget Transparency and Accountability Act, BC Hydro's mandate and goals, and focus on aspects critical to the organization's performance. The targets in this plan have been determined based on an assessment of BC Hydro's operating environment, forecast conditions, risk assessment and past performance.

1) Please provide the BC Hydro enterprise-level risk matrix and risk prioritization report.

19) NORTHWEST SUBSTATION UPGRADE PROJECT

Reference: 2.5.8 Transmission Upgrade Exemption Regulation (B.C. Reg. 140/2013)

In Directive 3 of its Decision on our Previous Application, the BCUC ordered BC Hydro to file a CPCN for the Northwest Substation Upgrade Project. BC Hydro is requesting an amendment to Directive 3 to remove this requirement as it is inconsistent with this regulation.

1. Please indicate BC Hydro's assumption as to the operational lifespan of the LNG Canada liquefaction and export facility.
2. Please indicate the assumed operational lifespan and the amortization period of the Northwest Substation Upgrade Project.
3. If the technical operational lifespan of the Upgrade Project exceeds the lifespan of the LNG Canada facility, please indicate if there is alternative use or customer for the latter years in the lifespan of this asset?
4. Is it technically and economically possible that major components of the Upgrade Project could be moved and recommissioned in other parts of BC Hydro's system for useful purposes?

20) DSM

DSM - load forecast integration.

Reference: Table 10-14 Average Measure Life (years)

1. Provide a yearly breakdown of the assumed persistence of the Transmission Program savings. That is, for the aggregate Transmission Program savings, provide a table showing the assumed drop-off (energy and capacity savings) by Fiscal year.
2. With respect to the Transmission Program Savings, and the need for coordination between BC Hydro's DSM savings forecasts and load forecasts, what equipment efficiency levels are assumed in BC Hydro's load forecast for industrial process equipment after the Transmission Programs have expired? Is it assumed that DSM-enabled equipment efficiencies reverts to pre-DSM Program levels, continues at the same levels, or improves due to future technological developments?

References: Section 10.4.1

BC Hydro's next IRP will consider a recently completed Conservation Potential Review. BC Hydro worked with FortisBC Energy Inc., FortisBC Inc., Pacific Northern Gas and Navigant Consulting Ltd. to perform the review. The review estimated the technical and economic conservation potential for both electricity and natural gas in B.C., over the next 20 years, in each utility's service territory. In addition, it provided a model that allows BC Hydro to develop market potential estimates.

Appendix X - Section 2.3

Finally, the development of the Demand-Side Management Plan considered the results of the conservation potential review study that was completed in partnership with FortisBC. This review study prepared a conservation potential estimate for electricity and natural gas across all of British Columbia over a 20-year forecast horizon from 2016 to 2035.

3. Please provide the completed Conservation Potential Review study.

Reference: Section 2.3 Demand-Side Management Plan Evolution

Conservation and Energy Management has made a numbers of changes to the Demand-Side Management Plan to address the external and internal considerations outlined above, including:

- **Launching a new Non-Integrated Areas program to increase support for these remote and predominantly Indigenous communities;**
- **Increasing participation in the Low-Income program by including Crisis Fund participants in program outreach, and providing Energy Savings Kits at pre-qualified events (e.g., foodbanks, and Indigenous community events) which will not require a BC Hydro account number to receive a kit, introduction of an Indigenous offer within the Low Income Program for customers connected to the integrated BC Hydro electrical system;**

4. How is 'low-income' defined for the purposes of apportioning the limited funding and resources of the Low Income program?
5. What is the selection and screening process for 'pre-qualification' indicated above? Specify the criteria for selecting qualifying charitable organizations or indigenous communities.

Reference: 10.5.1 Forecast Expenditures and Energy and Capacity Impacts – Table 10-10

Table 10-10 Fiscal 2020 to Fiscal 2021 Expenditure Summary ($ million)

	F2020 Plan	F2021 Plan	Total
Rate Structures	0.5	0.5	1.0
Programs			
Residential	18.4	19.7	38.1
Commercial	18.9	17.5	36.4
Industrial	26.5	26.9	53.4
Total Programs (excluding TMP)	63.7	64.1	127.8
Capacity-focused	6.9	4.3	11.1
Supporting Initiatives	19.8	20.2	40.0
Thermo-Mechanical Pulp	0	27.2	27.2
Low-Carbon Electrification	18.3	9.7	28.0
Total Expenditures	109.2	126.0	235.1

6. Does the 'Supporting Initiatives' cost category include advertising? Please indicate at a high level, the DSM advertising campaigns planned for F2020 and F2021 in terms of focus and objectives.

Please comment on the media channels to be utilized including social media, print, radio, television, and digital advertising.

7. Please provide an approximate quantification of: 'Supporting Initiatives' in terms of how the approximate $20 million per year forecast costs indicated in Table 10-10 support and enable BC Hydro's other DSM programs. That is, a high-level breakdown and clarification of how 'Supporting Initiatives' expenditures supports more tangible DSM expenditures.

Reference: Appendix Y – Section 2.0: BC Hydro Funded Initial Low Carbon Electrification Projects

8. Please provide an un-redacted version of this chapter.

Reference: Appendix Y – Table 2-1 – Expenditures for Initial LCE Projects

Table 2-1 – Expenditures for Initial LCE Projects

Initial LCE Projects		Expenditures ($ million) [3]					
GGRR Regulation Subsection	**Project**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
4(3)(a)	Project 1	-	6.30	-	2.70	6.00	15.00
	Project 2	-	-	13.50	-	-	13.50
	Project 3	-	0.28	-	-	-	0.28
4(3)(c)	Project 4	0.01	-	-	-	-	0.01
	Project 5	-	0.07	-	-	-	0.07
	Project 6	0.00	-	-	-	-	0.00
	Project 7	-	0.50	-	-	-	0.50
	Project 8	0.07	-	-	-	-	0.07
	Project 9	-	0.09	-	-	-	0.09
	Project 10	-	0.06	-	-	-	0.06
	Project 11	-	0.00	-	-	-	0.00
	BC Hydro Program Staff Labour	0.12	-	-	-	-	0.12
Project Total		**0.21**	**7.30**	**13.50**	**2.70**	**6.00**	**29.71**

9. Please provide a calculation of the (long-term, levelized) cost of carbon abatement under these programs expressed as $/tonne. In these calculations, please indicate any energy and capacity credits applied to the economics arising from efficiency gains. Please also indicate green/GHG offset credits applied. Please provide and contrast this with BC Hydro's forecast of provincial carbon tax levels.
10. Please provide BC Hydro studies with respect to the comparative cost of carbon abatement through capital stock turnover, DSM programs and direct taxation. In particular, studies that present marginal carbon cost curves specific to British Columbia.

Reference: Section 3: Expenditures to Date

The cumulative portfolio DSM electricity savings since F2016 have been achieved at an average net levelized utility cost of -$20 per MWh. Table 4 presents the net levelized utility cost of actual DSM

electricity savings achieved from April 1, 2015 through March 31, 2017. Net levelized utility cost is calculated by subtracting capacity benefits from gross utility costs and then dividing the resulting net utility costs by electricity savings. A negative net levelized utility cost means that the subtracted capacity benefits exceed gross utility costs.

Reference: Appendix X – Appendix B - Portfolio-Wide Assumptions

Generation capacity:

- **Fiscal 2020 to fiscal 2022: $38 per kW-year (Fiscal 2018 $)**
- **Fiscal 2023 to fiscal 2031: $60 per kW-year (Fiscal 2018 $)**
- **Fiscal 2031 onwards: $123 per kW-year (Fiscal 2018 $)**

11. Please clarify the capacity value assumptions specified above.
12. Please specify the location, generation type and fuel source of the proxy generation units for which these values are based.
13. Please outline the calculation used to determine these values.
14. Can future capacity units assumed to be natural-gas fired, given the low cost, and available headroom in BC Hydro's clean portfolio standard?

Reference: Section 3.3.2: Economic Development Benefits

The implementation of the Demand-Side Management Plan will continue to generate significant economic activity and jobs within the province. These jobs include direct employment through the purchase of labour and materials, spin-off jobs from business activity in the supply chain and the spending of wages, and jobs created by customers spending of energy bill savings from demand-side management. Demand-Side management actions undertaken by customers also make them more competitive through the better use of electricity, creating expanded economic development.

Conservation and Energy Management has updated a study completed by the Deetken Group (Economic Impact Study of BC Hydro's DSM Plan: fiscal 2017-fiscal 2026) which assessed the economic development benefits of the F2017 - F2026 Demand-Side Management Plan that was included in the Fiscal 2017 to Fiscal 2019 Revenue Requirements Application. For the fiscal 2020 to fiscal 2029 10-year period, economic impacts expressed in terms of GDP, employment and provincial tax revenues are as follows:

- **GDP impacts of $1.1 billion;**
- **Employment of 11,600 full-time equivalent positions; and**
- **Provincial tax revenue of $115 million.**

15. Please provide the most recent DSM economic development benefits assessment report.

Reference: Appendix X Section 12

Key Program Assumptions:

The following table provides the Key Program Assumptions of the adjustments that apply to the energy savings based on the activities from fiscal 2020 to fiscal 2022. Ranges indicate that there are sub-components within the initiative that have different adjustment factors.

Sector	Program	Compliance Rate (%)	Cross Effects (%)	Direct Rebound Effect (%)	Free Riders (%)	Market Effects (%)	Persistence (years)	Spill-over (%)
Cross Sector	Building Codes	63-100	0	0	n/a	n/a	30	n/a
	Product and Equipment Standards	70-100	0-6	0	n/a	n/a	30	n/a
	Capacity Focused		n/a	n/a	n/a	n/a	n/a	n/a
Residential	Behaviour Program		0	0	0	0	1, 6, 24	0
	Home Renovation Rebate		0	0-6	0-45	0	9-30	0-44
	Low Income Program		0-5.7	0-6	0-69	0	1-30	0-17
	Non-Integrated Areas	Non-Install (%) 0-80	0-5.7	0-6	5-69	0	1-30	0-17
	Retail Program	Non-Install (%) 0-20	0-5.7	0	10-40	0	6-20	0-10
Commercial	Leaders in Energy Management – Commercial		0-4	0	0-25	0	2-30	0-22
	New Construction Program		1	0	22	0	18	7.6
Industrial	Leaders in Energy Management – Industrial		0	0	14-31.7	0	1-16	11-23
	Thermo-Mechanical Pulp		0	0	0	0	10	0

16. Please provide the basis of the assumption with respect to the provincial building code compliance rates. Please provide BC-specific audits or studies that support the assumptions.

17. MISCELLANIOUS

Reference: Figure 3 in: Comprehensive Review of BC Hydro (Appendix C).

1. Please provide Figure 3 for each of the years: F20-24 inclusive.

Reference: Section 4.4.2.1: Energy Study Inputs

2. Please provide a history of electricity market prices at Mid-Columbia and Alberta (last 5 years) and BC Hydro's forecast for these markets to F2024, with monthly resolution and segmented according by: all hours, and by heavy and light load hours.
3. Please comment on market liquidity for the electricity (Mid-C and Alberta), and natural gas (Sumas) markets at 12 and 24 months in the future.
4. Please calculate the cost of procuring market-based electricity at Mid-C plus wheeling to within British Columbia at 70 and 90% load factors. Assume an average Mid-C price of 30 $US/MWh. Please indicate variable and fixed wheeling charges for both the US and BC legs of the route. Please compare to Rate 1823.
5. Please indicate if BC Hydro has any intention of requesting a repeal of Special Directive 8 (7) regarding retail access.

Reference: 4.8 Cost of Market Energy

6. Please provide Tables 4-17 and 4-18 expanded out to monthly resolution.

Reference: Appendix DC. Energy Studies Process Audit. Succession planning.

7. With respect to succession planning, as a secondary owner been identified for the COSTA model?

Appendix C: Comprehensive Review of BC Hydro: Phase 1 Final Report

8. Rate rebalancing. Please specify cost recovery ratios for major customer rate categories for last 5 years and a forecast for F20-24 inclusive.

Reference: Section: 8.9 Subsidiary Net Income

9. Please provide Powerex staffing levels, total operating costs and net profits for last 5 years, and forecast for F20-24 inclusive.

Reference: Table 4.6

10. Columbia River Treaty benefits: Please explain the drop-off in Columbia River Treaty benefits in F20?

Reference: 5C.9 Generation System Operations KBU

11. Columbia River Treaty negotiations: please provide a breakdown of BC Hydro's contributions (actual F17-F19 and forecast staff time and dollars) towards Treaty negotiations. Similarly, please provide Powerex contributions.
12. Please describe any remuneration provisions by the Provincial government to compensate BC Hydro for these costs.

Reference: Chapter 5E - Operating Costs Finance, Technology, Supply Chain Business Group

13. Given the recent all-time record provincial gasoline prices, please provide a sensitivity of motor gasoline prices on BC Hydro's revenue requirements and customer rates. Please provide a sensitivity on $0.10/litre increase in gasoline prices on yearly revenue requirement ($/year) and corresponding percent customer rate increase.
14. Similarly, please provide a sensitivity on revenue requirements and electricity rates due to a $10/tonne increase in the provincial carbon tax.