

DATE/TIME	April 6, 2011 9:00 a.m. – 4:30 p.m.
LOCATION	Sutton Place Hotel, Room Versailles B 845 Burrard Street, Vancouver, B.C.
TYPE OF MEETING	Regular meeting of the BC Hydro Integrated Resource Plan (IRP) Technical Advisory Committee (TAC). TAC is a group of knowledgeable participants with significant interest, stake, and experience in BC Hydro's resource planning process assembled to provide detailed, technical input and feedback to BC Hydro during the development of the IRP.
FACILITATOR	Anne Wilson, BC Hydro
PRESENTERS	Lindsay Fane, BC Hydro (afternoon session) Bruce Laxdal, BC Hydro Kathy Lee, BC Hydro Basil Stumborg, BC Hydro
ATTENDEES TECHNICAL ADVISORY COMMITTEE MEMBERS	Bill Andrews, BC Sustainable Energy Association David Bennett, Fortis BC David Craig, Commercial Energy Consumers (arrived 10:45 a.m.) Robert Duncan, First Nation Representative Matt Horne, Pembina Institute Loch McJannett, Clean Energy Association of BC Andrew McLaren, First Nations Energy and Mining Council Peter Ostergaard, Ministry of Energy Randy Reimann, BC Hydro Richard Stout, Association of Major Power Consumers (AMPC) Mark Thomas, BC Utilities Commission
MEETING OBSERVERS	Nicholas Heap, CANWEA Joe Mazza, Terasen Gas Jim Weimar, Weimar Consulting Inc.
ATTENDEES BC HYDRO	Dave Ince (afternoon session) Trudy Kwong Kevin Maxwell (afternoon session)  Susan Campbell, Recording Secretary, Kirk and Co.

### PRE-READING MATERIAL / HANDOUTS / PRESENTATIONS

- Agendas for TAC Meeting #4 (Days 1 & 2)
- IRP Power point presentation slides 1–142. Note: Revised slides 72–142 were distributed.
- Summary Brief – Incremental Demand-Side Management Activities and Impacts
- Summary Brief – Market Price Scenarios: Further Description and Considerations
- Summary Brief – Apply Energy & Planning Objectives When Creating & Comparing Options
- Sample Consequence Table for Discussion
- Market Scenarios Summary

### KEY THEMES (APRIL 6)

- Several TAC members suggested, in the right circumstances, that gas may make sense and for capacity reasons a gas ‘peaker’ may make sense. Climate change issues and greenhouse gas emissions would also need to be addressed while considering any more gas.
- TAC requested that some analysis allowing run-of-river Renewal Energy Credits compliance be undertaken.
- TAC members suggested a written brief on the analysis results around wind integration be developed and circulated.
- TAC agreed that a high level review of the materials to be presented at the upcoming meetings on April 27 and 28 (and possibly April 29) would be necessary given the amount of material left to review and that any detailed discussions would have to take place outside these meetings.
- TAC members reiterated their appreciation for both for the quality of the presentations and the value of the in-depth discussions.

### 1. WELCOME, AGENDA REVIEW AND ADMINISTRATION – Anne Wilson, Facilitator

The Facilitator welcomed everyone, reviewed the meeting agenda and the handouts (revised slides 72–142 and handout titled *Market Scenarios Summary*).

### 2. ROLE OF THERMAL (NATURAL GAS-FIRED GENERATION) – Kathy Lee

Kathy provided a presentation on the role of thermal (natural gas-fired generation) analysis for the IRP. This included how much room is available in the system as a result of the 93% clean target, and possible circumstances for using gas. Bruce Laxdal, consultant to BC Hydro was invited to sit at the main table and participate in the discussion.

Points of clarification and discussion regarding the role of thermal were as follows:

- 93% is the target for the overall system, which includes the integrated system and the non integrated areas.
- It was clarified that the interpretation may be that BC Hydro could build any number of natural gas-fired plants to be used for contingency power during peak demand times while still abiding by the 93% Clean Energy Act requirement.
- It was clarified that it is BC Hydro's assumption that the 93% is an annual target and not an average with some years having more or less natural gas-fired generation.
- It was clarified that with respect to the Burrard Thermal Plant – BC Hydro can use Burrard for capacity planning until certain replacements come on line and BC Hydro cannot rely on Burrard for energy or economic export – BC Hydro can only rely on Burrard for emergency purposes.
- It was clarified that the Fort Nelson load forecast has been developed separately from the Horn River Basin forecast. BC Hydro kept them separate because they are different events that are happening. Fort Nelson load growth could occur regardless of electrification occurring in the Horn River Basin.
- It was clarified that actual load today for the Fort Nelson area is 25 MW and the forecast next year is closer to 40 MW. Fort Nelson interconnects via transmission with the Alberta Regulatory System but it is becoming increasingly unstable. There are voltage issues now and they are relatively expensive to correct. The generator is being upgraded now and it is expected to always run when it is available.
- Regarding the use of diesel in non-integrated areas, diesel comprises less than 1% and is not a significant contributor to greenhouse gas (GHG) emissions system-wide. It was suggested the non-integrated area is about 50% clean currently.
- It was clarified in the modelling that if gas-fired generation is used the assumption is that they would be running a minimum of 17%.
- It was clarified that direct GHG emissions will be calculated for each portfolio.
- The difference between a single cycle gas turbine (SCGT) and a combined cycle gas turbine (CCGT) was clarified. A SCGT is cheaper and can fire up quickly and is good for meeting system conditions and CCGT has a lot more capital and more operating costs.
- It was clarified that the water from Horn River Basin flows towards Alberta, rather than into the Peace region.

Member comments regarding the role of thermal were as follows:

- Suggestion to change wording from 'special occasion' to contingency use for certain cases where BC Hydro may use natural gas-fired generation.
- A TAC member stated their association is concerned about what seems to be unreasonable limitations on gas under certain circumstances.

- A TAC member doesn't think there should be restrictions running existing gas-fired capacity should it be required or needed in specific conditions – for example on Vancouver Island and the Burrard Thermal Plant. This member is asking for reconsideration of that legislation.
- If BC Hydro is planning to use gas during peak demand times, it was suggested that BC Hydro make sure gas is available, for example, through a contract for storage so that BC Hydro has a firm supply. In the past Burrard (Thermal Plant) has been a problem for the gas market when gas is bought on the spot market to run during peak demand times.
- If a gas peaking plant is only being dispatched occasionally a TAC member suggested not to use an average gas price as it is thought these prices are a bit high. Prices are more likely to be high on the day it is dispatched; still BC Hydro would need to think about only using it once in a while because that forecasted average gas price might not be the right price.
- BC Hydro should look at the ability for the province to meet its provincial GHG emissions targets (in addition to just tracking direct GHG emissions for a portfolio).
- BC Hydro could look at the assumption of having the gas plants run at a minimum of 17%, unless there is some constraint on the modelling that requires this minimum for some reason. This TAC member thinks in the right circumstances gas makes good sense and for capacity reasons a plant run only to serve peak load makes sense.

Roundtable member comments on the use of gas-fired generation included:

- It is important to have Site C information because it will impact the outcome of the analysis and decisions.
- 17% seems a bit high; and if BC Hydro is looking to where to site a gas facility, keep in mind where gas reserves are.
- A TAC member asserted it is BC Hydro's job to talk to the Minister about fine-tuning of the legislation to give BC Hydro more flexibility and one is clearly related to gas. If the province could build gas which displaces dirty energy that is imported and why is there legislation that would prevent that. It is BC Hydro's responsibility to make those arguments to Victoria.
- The language is confusing to speak of thermal and gas. They have different meanings and BC Hydro should be specific.
- What has been discussed is useful and consistent with what people have been saying is that if you don't have Site C there is more need for gas. It would be interesting to have alternatives to gas that would look better.
- It was a helpful conversation around the trade-offs.
- Regarding the Horn River Basin, so far the discussion is what to do with the development. What has not happened is a provincial discussion as to whether the development should happen or not. What are the implications on a broader scale in terms of Greenhouse Gas emissions, etc.? Maybe it is not Hydro's responsibility to ask but those questions should get asked.

### 3. RESOURCE ACQUISITIONS ANALYSIS – Kathy Lee

Kathy Lee presented the resource acquisitions draft analysis to the TAC members for comments and discussion. The analysis included the influence of market price scenarios on the results; and how Renewable Energy Credit (REC) values influence modelling choice of resource types. A specific discussion of wind integration costs and issues also occurred.

Points of clarification and discussion regarding the resource acquisitions analysis included:

- It was clarified at this point that small hydro is not able to claim the REC value within the modelling assumptions because they are not considered eligible within certain Portfolio Renewable Standards.
- At this time, the assumption is RECs are only traded in the US. There is not a lot of appetite to sell REC into Alberta and there is limited access into Saskatchewan.
- BC Hydro is very close to releasing the REC report. The consultant ascertained the big player is California and BC Hydro has a long history with trying to make California see the value of small hydro. Depending upon the market there is a preference for certain resources and BC Hydro may consider that in acquisition contract price.
- It was clarified in 2016 that the size of the assumed REC prices (embedded within the market price scenarios) makes a qualitative difference between choosing resource types of small hydro and wind, where if REC prices are high the model will choose all wind but if REC prices are low then the model chooses small hydro. Advancing up on the supply curve there is a cross-over point but that doesn't completely change the supply curve. It is a factor that needs to be considered in the acquisition process.
- It was clarified that the wind average energy is firm energy only the small hydro is non-firm energy.
- It was clarified that there is a distinction between firm energy and firming up wind. Firming up wind is the wind adder (\$10) and that deals with daily fluctuations.
- Specific questions arose with TAC members regarding what percentage of wind and small hydro is firm. BC Hydro explained that around 70% of average energy for small hydro is firm. For wind resources, 100% of average energy is assumed firm due to the lower annual variability in wind production. To compare: a 100 MW small hydro facility might have a 40% capacity factor and be 70% firm, so firm energy is  $100 \text{ MW} \times 8760 \text{ hours/year} \times .40 \text{ capacity factor} \times .70 \text{ firm} = 245 \text{ GWh/year}$ . For a 100 MW wind farm, it may have a 30% capacity factor and be 100% firm, so the firm energy is  $100 \text{ MW} \times 8760 \text{ hrs/year} \times .30 \text{ capacity factor} \times 1.0 \text{ firm} = 260 \text{ GWh/year}$ .
- It was clarified that there is a time element to non-firm small hydro. The key issue for us is how much water the system can absorb during the freshet time. 60-year water record is used for planning firm water flows and its 60-year record have inflows as the same time as the coast.
- It was clarified that the wind integration cost does not include a level of detail that assesses the cost of wear and tear on hydro system equipment due to changes in operation used for integration.
- The assumption for energy purchase agreements is that they will get renewed, with the exception of biomass projects.
- It was clarified that the 5, 10, and 15 \$ wind integration adder was chosen because it is a qualified expected range.
- It was clarified that the 3,000 MW wind integration limit is for the existing system without Site C, Revelstoke 5 and 6 or Mica 5 and 6.
- It was stated by BC Hydro that this exercise of assessing wind integration is complex and BC Hydro's assessment is that the system must be kept in a condition to cycle up and down and there are two constraints. The first constraint is with the freshet and the second constraint is the Peace River icing concern which also reduces flexibility in the system. It was a very complex exercise and will need continual work.

Member comments regarding the resource acquisitions analysis were as follows:

- BC Hydro should look at technological efficiencies of wind over time within BC Hydro's modelling capabilities.
- BC Hydro should consider the possibility that run of river hydro is eligible for RECs and model a portfolio run under those conditions. This member commented that the 30 MW constraint in California is very limited. BC Hydro response was that some analysis allowing run-of-river to be REC compliant is merited.
- Given the predominance of wind based on data and environmental attributes and the associated connection to of attributes to hectares, BC Hydro should take a look at avian impacts on wind projects.
- With regards to how the costs of run of river and wind are shown on the graphs, the supply curves makes people think it the prices are low compared to what BC Hydro is buying and the critical elements aren't being shown like transmission and shaping. There needs to be a context explanation or maybe there is a way to get the data brought up to a more realistic level. It is a fundamental problem in not modelling real world acquisition. Somewhere that explanation needs to be made.
- With respect to the \$124 acquisition number is the median firm energy price bid in at the last clean power call and not all the power sold by Independent Power Producers (IPPs) is purchased at that price. Non-firm power is more like \$55 and a significant amount is sold at that price – so if the numbers are combined the average goes down.
- A TAC member wanted to know what the extra 2000 MW limit is attributed to Site C, Revelstoke and Mica. BC Hydro response was that BC Hydro doesn't have the break down as the numbers are being upgraded so look at it as illustrative purposes at this point.
- It was suggested the integration cost should be lower than \$10, and 3000 MW limit is overly conservative. BC Hydro response was that the biggest variable is Site C and other firming resources, and without Site C the need for firming up wind is much higher and will likely cost more than the \$5 adder.

Roundtable member comments related to the resource acquisitions analysis included:

- These are fairly strong real world conclusions and the implications are more than some of the other points. This warrants being written up and explained to people providing some real information. As well a written brief gives an opportunity for people with a different view to respond.
- Gas peaking would be something to look at and if decisions are being made based on flexibility running out and using Site C it would be less expensive to do a gas peaking facility with a LNG storage plant. That would free up a lot of resources and reduce rate impacts. Gas is very flexible and you don't need it to run it all the time.
- BC Hydro clarified it would need to be a base load gas plant to help with wind integration.
- Interesting and important discussion.
- The gas issue is critical and the most obvious area to improve if the constraints were lifted. It is essential that it be re-examined by the legislators and it was suggested that it is BC Hydro's responsibility to question those directions in Clean Energy Act.
- Climate change issues and GHG emissions also need to be addressed while considering any more gas.
- These issues are critical and key and it would be good to have a good write up on the issue. Good decisions come from understanding.
- There has been a lot of modelling around wind integration and the assumed cost picture however improved wind technology could have more significant influences over the longer term. Getting the context right and not jumping to end points or solutions is important.

### 4. CAPACITY ANALYSIS – Lindsay Fane and Kathy Lee

Lindsay Fane and Kathy Lee presented the capacity draft analysis to the TAC. This included a discussion on the need for new capacity resources, and the results of looking at various capacity options such as pumped storage, the use of gas, rate incentives, and industrial load curtailments.

Points of clarification and discussion regarding the capacity analysis were as follows:

- It was clarified Fiscal 2023 is the year the BC Hydro integrated system is capacity constrained.
- It was clarified that the existing supply graph shows a reduction in capacity over time because 400 MW (market allowance) are coming out in 2016 and BC Hydro also assumes biomass projects coming out and that is why supply is going down.
- It was clarified that in 2016, capacity associated with Burrard will no longer be relied on for planning purposes, however, essentially the Mica upgrade with new capacity coming on line and the Burrard Thermal coming out will off-set each other.
- It was confirmed that the electrification scenarios were added onto the mid-gap scenario.
- It was clarified that these capacity graphs show gaps without having the portfolio runs completed. When the portfolio runs are completed than costs of filling these gaps and associated rate impacts for select portfolios will be available.
- The ramp up of capacity requirements in 2022 in the electrification scenarios speaks to stock turnover, such as replacement on heating.
- It was clarified that the firming tariff is something that BC Hydro is looking at to firm resources on an hourly basis. It is essentially an enabling tariff that BC Hydro is looking to establish.
- It was clarified that the Columbia River Treaty is about to be renegotiated. There is a trigger point, which is by 2014, when one of the entities needs to trigger the intention of renegotiation. BC Hydro will be supporting the federal and provincial government in the negotiation.
- It was clarified that the costs for the gas-fired generation (SCGT) is based on fixed costs, and does not include fuel costs.
- Regarding pumped storage, it was confirmed that up to 200 potential sites were identified. BC Hydro used a GIS mapping process that introduced a lot of potential sites. Discussions have occurred which have shown two or three sites that are more alive than others.
- It was confirmed that, although other options were considered, such as compressed air, the cost was over \$200 for these other options and so pumped storage was the cheapest option.
- It was clarified that with the use of pumped storage, more energy would be required in order to run the pumped storage facility, however, that analysis has not been incorporated to date.
- It was estimated that the maximum capacity for pumped storage at Mica was estimated at 500 MW.
- Regarding industrial load curtailment, it has had some success within B.C. and the biggest issue is moving from short term solution to a long-term planning.
- It was mentioned that industrial load curtailment has been occurring on the gas side for a long time. For example, regarding firm energy sales to a customer, a contract rate may include a cost of firm energy or a lower rate for providing interruptible service. Customers would make a contribution to the system to get firm energy, or take a lower rate and have interruptible service with a high economic penalty for noncompliance.
- It was clarified that 400 MW of market reliance for capacity is added to the load and after 2016 it is removed due to the self sufficiency policy. There is no specific insurance requirement for capacity.
- It was confirmed that all capacity focussed options are voluntary.

- It was clarified that there is a high secondary peak on Monday mornings, when operations are starting up again.
- Regarding electric vehicles, it was clarified the scenarios assume fairly aggressive electrification of vehicles. BC Hydro has assumed 200 volts and a concentration in terms of charging so it is fairly aggressive at 600 MW in 2031 for base load. There is a lot of work to be done here; with the right technology and right motivation batteries could flow back into grid but it is not part of the base case right now.

Member comments regarding the capacity analysis were as follows:

- A TAC member was concerned about how much it will cost to fill the capacity gaps with the electrification and export scenarios, and wanted to get a sense of the costs, including transmission costs and rates.
- BC Hydro should talk to Government about using downstream benefits as a capacity option. BC Hydro pointed out that the electricity is not generated in B.C., and the benefits go directly to government.
- A TAC member suggested calling Mica pumped storage, 'seasonal' pumped storage to distinguish it from daily pumped storage capability.
- A TAC member suggested at a minimum someone should estimate consequences of mandatory time of use rates. BC Hydro should be looking at wider options; if the smart metering infrastructure is in place, BC Hydro should use it.
- It was mentioned that BC Hydro may save on transmission costs if there was pumped storage capability in the Lower Mainland.
- BC Hydro should be consistent with how uncertainty is assessed across the stack (i.e., supply-side and demand-side).
- For the capacity daily peak graphs, it was commented that it may be worth putting a line on the graphs where BC Hydro feels maintenance requirements and upgrades are needed for the system as there is a certain allowance that is needed for maintenance.
- BC Hydro needs to be careful about unintended consequences of a program designed to decrease peak load but in fact ends up causing another problem elsewhere.

Roundtable member comments on capacity analysis included:

- Regarding the peak graph – it would be valuable to know how much is caused by electric heating and response to cold weather. If the issue is electric heating, are there different responses that could be taken. Smoothing out heating daily to get rid of the impact of the peak will be significant to look at and we haven't seen those solutions as yet.
- A TAC member requested the graphs for new acquisitions to meet the gap. It was confirmed the next set of meetings will show the analysis of the actual portfolios.
- A TAC member asserted that one of the problems is that Demand-Side Management (DSM) assumptions are related to technology and currently don't relate to kilometres driven – that piece is missing and should be added. This is a significantly productive area and it is not correct to say the DSM impact can only be a few percentages.
- A TAC member wondered if a summary of Air Condition load might be interesting. BC Hydro response was that it is less than one third, so is much less discernible than the heating load. In the interior of B.C. it is more of an issue.
- Regarding interruptible power this TAC member was not sure where BC Hydro is going with that because each industrial customer is unique and different customers can do different things and their characteristics can range. BC Hydro should sit down and have a separate exercise with the industrials and see what you can come up with to help the system. With respect to the operating reserve there are customers that can be fast acting and can help release energy back to you in that way and help.

- BC Hydro should look at ways to combine renewables with gas peaking plants. The TAC member realizes there are GHG emissions but there may be instances where it is a more economical solution and the plant is run infrequently.

### 5. INPUTS ON REPORTS

The TAC was given time to ask questions on any of the reports or inputs that had been made public to date. Some comments and questions on the portfolio modelling and the reports (where identified) included:

- It was confirmed that a 6% discount rate was used, with inflation at 2.1%.
- The assumption on the exchange rate was at par.
- It was confirmed that the models run in US dollars and at the end there is a conversion. As the Canadian dollar escalates energy becomes cheaper.

*ACTION: Consider how the exchange rate might affect cost as an extended consequence of a U.S. financial crisis.*

- A TAC member wanted clarification as to whether energy savings were discounted to Present Values. It was clarified that yes, energy is being discounted in the tables shown today. The tables show PV energy savings and it would have discounted using a 6% discount rate.
- Typically, if anything can be traded in the market then it makes sense to discount. Over a long time with impacts that can't be traded there is a debate whether they should be discounted and typically within a 20-year timeframe it is discounted. BC Hydro is not discounting environmental impacts rather some are being added up.
- Regarding the GHG price forecast report, it is complex. Two things distinguish it in terms of output. The general trends are not smooth and are not in the same direction; and low-medium-high actions are not characterized here. More information is needed around the mid-scenario because it is actually stronger than the national adder at a certain point. This TAC member questioned what directionally has changed since this study.
  - BC Hydro responded that depending on the scenarios around the 2020 time frame – We are further away from a national scheme largely due to the economy and other priorities. The political and regulatory side is changing.
  - With respect to the GHG report date it does say April 2010 but it was completed in April 2011. The 2010 date remains because the forecast was based on US policy in 2010. So what has changed since then will be communicated to BC Hydro for response.

### 6. CLOSING COMMENTS

Randy summarized where the analysis is and what is left for the late April meetings. TAC is coming to the end of the analysis phase and the last two days of April likely will be action packed. There is a lot of information and BC Hydro hopes that TAC is comfortable with the portfolio modelling because we will need to work at a higher level at the end of the month. Topics covered, and to be covered:

- Complete DSM – 75% done; still to see Option 5 analysis.
- Future acquisitions – 90% done.
- Electrification – to be covered at end of April.
- Transmission – to be covered at end of April.
- Export – to be covered at end of April.

Comments from members included:

- A TAC member expressed disappointment because the list (above) seemed to be missing rate impacts and cost of portfolios. BC Hydro clarified that these topics are included within the categories and will be covered at the end of the month.
- It was clarified that if the updated costs for Site C are available they will be on the agenda.
- A TAC member agreed with summarizing the impacts of the portfolios and let TAC members get into detail on their own outside of the meeting if they wish.
- A TAC member wanted to see the portfolio modelling results. BC Hydro intention is that TAC will see similar level tables as for acquisition and DSM and will pull out key portfolios and cost differentials and then walk the TAC through it, including the attributes and results of DSM Option 5.
- A TAC member confirmed the need for the discussions to be fairly high level.
- A possibility of adding an extra day, Friday April 29 was considered.
- TAC member agrees with a high level discussion but the trade-off conversations between attributes will be tough conversations. It would be good to receive the background materials a week in advance, and seems tight to cover this material in two days.
- BC Hydro was not sure if the material will be available a week in advance however hopefully these past two days has provided some useful context.
- Numerous comments have come up and an aggregate of those points might be valuable – is there a possibility of doing something about that? The TAC member felt that there is a gap regarding describing the input into this process and where it is going.
- BC Hydro responded that was similar to other TAC Member's point and BC Hydro will taking it away to see what can be done.
- A roundtable showed that two members could not make a third day, but the rest likely could, so TAC members were asked to tentatively schedule in April 29.

*ACTION: BC Hydro to consider process for communicating TAC input.*

- They were long days but this was the best meeting for me and I appreciated having more conversation time.
- Job well done, the material is getting easier to absorb. Getting information ahead of time is helpful.
- Appreciated the tone of the meeting and I like how it is informational and not confrontational. In the rate design – the customer pays more or you can pay for energy that is saved by season and you may get higher participation rates because I like the carrot rather than the stick approach. We do that with capacity blocks and there is high value that goes into that.
- Happy with the last two days and I am getting a better sense of the structure and content but I am looking forward to seeing where the rubber meets the road. I am looking forward to the results of the analysis.
- Appreciated the efforts of BC Hydro staff.
- Great job to BC Hydro staff and good dialogue.
- Appreciated the quality of the work done by the hydro team and the patience around the table.

TAC was advised that the next confirmed meeting dates are Wednesday, April 27 and Thursday, April 28, and that April 29 will be scheduled as a place holder.

The Facilitator thanked everyone for their engaged participation.

The meeting ended at 4:15 p.m.