

DATE/TIME	January 27, 2011 9:00 a.m. – 5:00 p.m.
LOCATION	Sutton Hotel, Chateau Belair 845 Burrard Street, Vancouver, B.C.
TYPE OF MEETING	Regular meeting of the BC Hydro Integrated Resource Plan (IRP) Technical Advisory Committee (TAC). The 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	Names are provided in the order that presentations were made: Randy Reimann, BC Hydro Basil Stumborg, BC Hydro Patrice Rother, BC Hydro Dave Ince, BC Hydro Rohan Soulsby, BC Hydro
ATTENDEES TECHNICAL ADVISORY COMMITTEE MEMBERS	Bill Andrews, Sustainable Energy Association of British Columbia David Bennett, Terasen/Fortis BC David Craig, Commercial Energy Consumers Derek Griffin, Ministry of Energy Matt Horne, Pembina Institute Loch McJannett, Clean Energy BC Andrew McLaren, First Nations Energy and Mining Council Randy Reimann, BC Hydro Richard Stout, Association of Major Power Consumers Mark Thomas, BC Utilities Commission Lori Winstanley, COPE Local 378 Absent: Robert Duncan, First Nations Representative
MEETING OBSERVERS	Thomas Hackney, BC Sustainable Energy Association (Alternate) Nicholas Heap, CANWEA Jim Weimar, Jim Weimer Consulting Brian Wallace, Association of Major Power Customers (Alternate) Peter Ostergaard
ATTENDEES BC HYDRO	Kenna Hoskins Kevin Maxwell

PRE-READING MATERIAL / HANDOUTS / PRESENTATIONS

- 2011 IRP Technical Advisory Committee Meeting #2 Presentation Slides and associated Summary Briefs
- IRP Technical Advisory Committee Terms of Reference

1. INTRODUCTION/MEMBERSHIP AND FUNDING – Anne Wilson

The session was opened by Anne Wilson with the following:

- A membership update;
 - Robert Duncan, First Nation Representative, would be joining the group to replace Fred Fortier, who is unable to continue as a TAC member due to other time commitments.
 - TAC is now at a full Committee stage particularly in terms in membership.
 - The membership of TAC will be posted to the website and a list of attendees will appear on the summary notes.
- Review of the meeting notes; and
- Review the agenda for the meeting.

A concern regarding membership was raised:

- There are only two rate payer representatives at the table, and the residential rate payers are not being represented, specifically the Public Interest Advocacy Centre (PIAC).
- It was clarified that PIAC was invited to participate in TAC however PIAC declined to send a representative due to insufficient funding.
- Concern was raised that the funding level offered is much less than in a regulatory proceeding in front of the BCUC.
- Five members supported BC Hydro revisiting the ability to bring PIAC to the table.

ACTION: Anne Wilson to take back as an action item the funding issue for PIAC; and, report back to TAC.

2. TERMS OF REFERENCE (ToR) – Anne Wilson

Anne reviewed the previously circulated copy of the revised TAC ToR. Changes had been made to clarify the following: roles of the chair and the moderator, the purpose of the meeting summary notes, and how comments will be attributed at certain junctures in the process.

Discussion on the ToR including the following comments:

- TAC agreed with the revision of 4.3.
- TAC agreed with the revisions of 7.2 and 7.3 with the following comments:
 - A concern was raised that if a specific no comment was provided then it could be misinterpreted. It was clarified that no comments can be associated with a rationale to prevent any misperception.
 - BC Hydro clarified that the addition of attributed comments provides an important level of transparency and accountability for the broader consultation program.

- Although not required, the Ministry of Energy and the BCUC may also provide attributed comments.
- A member felt that economics/low cost objective should be the key objective and should be explicitly stated within the mandate section of the ToR.
 - A discussion followed which clarified that the topics listed in the mandate were intended to demonstrate the key questions that the IRP will address within the context of the Clean Energy Act and that they do not constitute objectives that need to be achieved.
 - There was discussion regarding the need to edit the ToR to distinguish between IRP objectives and the mandate of the committee. It was not the intention to set up in the mandate leading objectives or weighting of the objectives.
 - Maintaining low cost rates is a very clear objective in the Clean Energy Act; however, it is one of 16 objectives in the Clean Energy Act that need to be addressed.
 - Members suggested adding the 16 objectives as an appendix to the ToR.
 - One member felt this was not necessary, however, did not oppose the addition.
 - One member did not want wording to be consistent with energy objectives.

ACTION: The ToR mandate will remove mention of the five topic areas and instead refer to considering the 16 energy objectives attached to the ToR. Anne to circulate revised ToR for email confirmation.

3. PROCESS OVERVIEW – Randy Reimann

Randy Reimann presented the meeting objectives and a process overview. TAC was advised that the session was largely intended to provide an overview of the various inputs into the IRP process and the analysis intended to be undertaken to answer the key issues for the 2011 IRP. The intent is to seek TAC views on appropriateness of inputs/analysis and to assess if TAC believes factors have been missed or incorrectly represented.

The topics over the next two days were reviewed including the risk framework and market scenarios, resource options update, demand side management, wind integration cost, electrification, exports, portfolio analysis, and comparing portfolios. Questions were raised on the following issues:

- Members wondered what was included in electrification.
 - By electrification, BC Hydro is considering converting energy sources to electricity with incentives over and above what electrification is taking place on its own and already included in the current load forecast.
- One member wondered whether BC Hydro should be looking at other renewable energies, such as an illustrative example, solar car technology advanced faster than electric vehicles.

Regarding technology advancement and innovation:

- Members questioned where technology evolution fits into the IRP inputs. Not really addressed in an explicit way.
- Future technology is currently reflected in the DSM options, on the supply side in the emerging technologies and in the load forecast.
- A member commented that from past experience, the greatest changes have come from technology changes, but they don't see a technology component in the scenarios. There may be future game changes and that is not reflected and it is of concern.

ACTION: Randy to reflect on how technology evolution is considered in the IRP.

4. RISK FRAMEWORK – Basil Stumborg

Basil Stumborg provided a presentation on the risk framework and how uncertainty will be addressed within the IRP analysis. He outlined the key areas of uncertainty and explained that these uncertainty factors will be developed as scenarios, including gap scenarios and market scenarios. Gap scenarios address load growth uncertainty, and DSM savings uncertainty.

Points of clarification regarding the gap scenarios included:

- Each of the load growth uncertainty and the DSM savings uncertainty are looked at individually and then combined to come up with a probability for the size of the demand supply gap.
- Supply side uncertainties are not addressed in the same way but rather through planning criteria based upon 'critical water years' which provides BC Hydro with a conservative, single number for how much BC Hydro can count on hydro in the supply stack.
- The demand side uncertainty and load growth uncertainty are put together as branches of a probability tree which provides a wide enough range of possibilities but small enough number to test analytically.
- Using this probability tree, the planners can then look at policy options and test them against a wide range of different futures. For instance, planners can ask, 'should we pre-build transmission or wait and connect resources as they are needed?' The answer may depend on the size of the net gap.
- All portfolios will be built to achieve self sufficiency. The decision to pre-build transmission or not may depend on how these perform over different gap sizes; pre-build may be good for large gaps but might get punished in mid and small gap outcomes.

Market scenarios were introduced which address uncertainty regarding market price forecasts and the interrelationships between the GHG price forecasts, the Natural Gas price forecasts, the Spot Market electricity price forecasts; and renewable energy credit price forecasts. Five scenarios were chosen to test the potential range of market prices. Together these, along with an assessment of the likelihood of each scenario to occur will guide the portfolio analysis. These five market scenarios (and associated probabilities) combine with the three gap size scenarios (and associated probabilities) to come up with a 15 branch probability tree.

Key drivers of market scenarios examined by the consultant Black and Veatch (B&V) are global economic growth and government action on GHG emissions. The table below provides a description of the scenario assumptions.

Title	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E
Brief Description	High Global economic growth leads to high commodity demand and broad environmental regulation.	Slow but steady global economic growth sees regional leaders paving the way for national GHG markets	Low economic growth delays national GHG market development.	Delayed high economic growth and lower international cooperation stifles national action, leaving the regions to regulate GHG emissions.	Low economic growth and activity lead to lower GHG emissions and the absence of market prices.
Global Growth	High	Medium	Low	High	Low
Policy Maker	National	Regional / National	Regional / National	Regional	Regional / None
Electricity Load	▲▲	▶	▼▼	▲▲	▼▼
Renewables Targets	▲▲	▲	▼▼	▶	▶
Nuclear Penetration	▼	▲	▼	▶	▼
Target Stringency	Conservative	Base	Conservative	Base	Base
Compliance	Flexible	Flexible	Flexible	Flexible	Flexible
Fuel Prices	▲▲	▶	▼▼	▶	▼▼
Conservation/Efficiency	▲▲▲	▶	▼▼	▶	▼▼
CCS Costs	▼	▲	▲	▲▲	▲▲

Points of clarification regarding the market scenarios included:

- Market Scenario D can be characterized as not particularly aggressive government action and that it keeps natural gas prices lower. Scenarios A and D assumed high growth but in Scenario A with strong international cooperation was assumed while scenario D did not have international cooperation and this difference has impacted GHG prices.
- The five scenarios chosen spanned a range of government action on GHG emissions (none/low, regional/national, national) and global economic growth (hi, mid, low).

Member comments included:

- An environmental crisis (e.g., Valdez oil spill) may spur government action, which is not reflected in these scenarios.
 - That level of detail is not included; these scenarios are intended to boil down the key uncertainties that will impact market prices.
- A member raised concern that global economic growth does not necessarily reflect on the natural gas prices as is indicated with the scenarios; for example global economic growth is not uniform and natural gas prices are driven by local economies.
 - The scenarios do have different parts of the world such as Europe, NA, and the BRIC countries growing at different rates. Across the scenarios, these different growth rates are then either varied higher or lower.
- Member comments on adequacy of the scenarios:
 - A member was curious about the implications of not looking at all nine combinations, particularly the bookend option of national action on GHG emissions combined with low global economic growth; and generally the high level implications of leaving something out.
 - The implications of not looking at national action on GHG with low economic growth may be low, but it would be more comforting to have the implications.
 - Concern as to whether there are inconsistencies as to how the scenarios have been put together.
 - Time and other constraints required BC Hydro to seek a satisfying result rather than an optimal one.
- Regarding the slides showing the relative likelihood of these scenarios occurring (numbers here are illustrative only) a suggestion was made, to improve how the information is presented, to make the height of the bars correspond to the height of the most likely outcomes.
- Member questioned whether an assumption that the market and gap are independent may be false. Response was that could be tested through sensitivity analysis.
- Question was raised as to what is the percentage likelihood of scenarios that BC Hydro is not presenting. Currently, the sum of the percentage likelihood of the five scenarios occurring adds up to 100%. For example, what might be the percentage likelihood of a sixth scenario 'F' which included all of the scenarios that weren't considered.
 - The objective of developing the scenarios was to develop a range of market prices, understand how they may evolve, and to stress the portfolios. It would be difficult to assess overall likelihood of the scenarios modelled versus what wasn't modelled.

ACTION: *Address the concern about the implications of scenarios that have been missed.*

5. GHG PRICE FORECAST – Patrice Rother

Patrice Rother provided a presentation on the GHG price forecasts that are embedded in the 5 market scenarios and the importance of considering GHG price forecasts, the drivers of GHG prices, and the price forecasts. The consultant, Black and Veatch (B&V) was retained by BC Hydro to develop the GHG price forecasts and associated scenarios.

Points of clarification regarding the GHG price forecast included:

- The Black and Veatch consulting report on the GHG price forecasts will be made available to TAC.
- To clarify what is meant by emissions trading influencing cost on BC Hydro resource mix, this refers to potential cap and trade emissions trading within the Western Climate Initiative, or within North America, depending on which “government policy maker” is being considered in the scenario.
- This model assumes a North American wide cap and trade system for the scenarios where National action is included as a government policy.
- The way the model works is that broad scenarios are defined, and then adjustments are made to the various policy levers to test the impact on price.
- The consultant only assumed nuclear use in areas where it exists or where it is allowed – as a low-emitting electricity resource option it impacts the market price on GHG.
- Scenario B assumes regional market in the short term to 2020, and then a national system – - Western Climate Initiative in short-term and in the national it assumes larger markets. Scenario A assumes a broader, international market, so for example, offsets could be sourced world-wide.
- The targets are built into the market, with the Waxman-Markey trajectory included as the base. Then there are more aggressive and more conservative targets for some scenarios. This is described in the report and summarized at the end of the summary brief.
- Targets are used to set the cap in the model. Then abatement options for the electricity sector, such as efficiency improvements, additional renewable energy, replacing old coal generation with gas, are built from the lowest cost to highest and the price is iterated until it meets the annual cap.
- It was confirmed with respect to prices in B.C., a “zero” GHG price will not be used, even for Scenario E. Because B.C. has regulation for net-zero electricity generation, the purchase of offsets for thermal generation will be assumed and assume GHG prices as proxy for offset. For Scenario E, the price forecast from Scenario B will be used, a mid-range level, for the price of offsets in B.C. Scenario B prices will be tested with sensitivity analysis, recognizing that.
 - The prices B&V has forecast are based on the cost of allowances under various approaches to cap and trade. If B.C. is requiring the electricity sector to offset emissions to net zero, we will need to compare this assumption to offset supply curves, because we would assume that cap and trade is not moving forward. We did some sensitivity review for the 2008 LTAP using supply curves for a sensitivity case that assumed the use of B.C. compliance instruments only and compared this to a sensitivity case where we were allowed to buy offsets in WECC region. The assessment was based on supply curves which reflect the marginal abatement costs of GHG reduction in those geographic areas.
 - Some reviews of the proposed cap and trade system in California are placing the cost of allowances at about \$20 in 2012 which isn’t that far off in Scenario B. Those studies are looking at offset costs being \$5 – \$10 dollars less. However, these are emerging markets and so it is difficult to predict what will happen, and little data is available on historical CO2 markets, as even the European Union’s system is relatively new.

- In terms of current rules for offsetting thermal, in B.C., any new thermal generation must be offset starting now, but for existing generation, the requirement starts in 2016. Examples of existing thermal in B.C. are Burrard and Fort Nelson Generating Stations.
- Regarding Burrard, it is considered in the planning horizon only in the short term. By regulation BC Hydro is only allowed to consider it for planning purposes until ILM and other capacity resources come on line – probably will be out by 2015.
- The connection to carbon capture and storage is that it is built in to the model as one of the GHG abatement options so it gets considered. If the costs of carbon storage is high it will increase GHG price; if investments are made to lower the costs, the price is adjusted accordingly.

Member comments regarding the GHG price forecasts included:

- A member commented that these scenarios were based on foreseeing a cap and trade system but the most likely federal U.S. approach is regulatory. Curious about whether this approach can be considered a proxy.
 - Confirmed that the U.S. is taking a regulatory approach and a next step identified with this project is to check what has changed since 2009 when the modeling was started; and there is a need to understand how that impacts the assumptions that have been made in the short-term, whether this is still applicable and what, if anything is missing.
- One member wanted to understand more about targets, compared with what emission trajectories actually look like.
- One member expressed the need to look at the forecast report. One member expressed an observation that it seems GHG and gas prices are correlated and was uncertain as to the truth of that observation. There was a need expressed to go back to the consultant and check this for relevance.
 - The GHG price forecast links into the electricity marketing forecasting and that is used for the market prices in the portfolios.
- A member questioned how the B&V numbers compared with other work, such as the electricity sector model in the U.S.
 - There was a need expressed by BC Hydro to benchmark these results and look at what other utilities and agencies are projecting based on current policy trends.
 - The National Roundtable (Canada based) has also recently done some work with GHG prices; BC Hydro has not undertaken a comparison of this work.
 - Updated economic modeling for Western Climate Initiative was undertaken and in the early years these results were in the ballpark range.

ACTION: Anne to advise TAC when the GHG price forecast report is available.

6. NATURAL GAS PRICE FORECAST – Dave Ince

Dave provided a presentation on the natural gas price forecasts, how it is derived and the changes since 2008. The probability weighting of high, mid, and low forecasts (likelihood of occurrence) has not been undertaken yet.

Member comments:

- A member commented that the prices seem within a pretty tight range. It appears to be economical to generate with combined cycle gas – that it looks like one of the cheapest costs of generation.
- A member questioned the sense of this policy planning, and asserted that variable heritage hydro water could be firmed up with low cost gas to rely upon in B.C., instead of having to export it.
 - BC Hydro is required to plan upon critical water to meet self-sufficiency requirements.

7. SPOT MARKET ELECTRICITY PRICE FORECAST – Dave Ince

David Ince provided a presentation on the spot market electricity price forecast, its applications, the electricity price inputs (GHG price forecast, natural gas price forecast), and forecast results. Spot market prices are based on variable costs rather than including capital costs so that spot market electricity prices will vary from the costs of acquiring new generation.

Points of clarification regarding the spot market electricity price forecast included:

- Average prices are being shown in the forecast, not peak pricing.
- Looking at the results of Scenario A, one member asked what the price in the forecast is compared to current prices. It was confirmed that current prices are about \$40 – \$50/MWh, and the difference is shown with the forecast price is due to additional GHG prices. It was noted that there is quite a difference.
- The difference between Scenario A and B when the GHG prices are the same is due to high natural gas prices.
- GHG prices have a significant effect on prices at \$100/tonne – this impacts electricity prices by \$40/MWh – it is the second most important driver of electricity prices.
- In terms of where these prices will impact resource allocations, portfolios are run against market pricing and that will influence the role of gas and the ability to select it.
- The 2X12 tables electricity prices are close to gas prices, however in freshet (spring runoff) prices do disconnect from gas prices and sometimes they go to zero or below zero. Freshet time does vary – between April and July, and freshet pricing does break away (from gas prices) but the impact is spread out over the months.
- Regarding renewable energy credit (REC) prices, the REC prices and electricity prices are inversely correlated – the higher the market price the less uplifting required from the REC price.
 - The electricity prices are stripped of REC attributes.
 - In terms of the separation of electricity and REC markets, if the spot market with the GHG adder becomes sufficient high, Renewable Portfolio Standard (RPS) compliant construction will occur without requiring RECs. Alternatively, if spot market prices with GHG adders are inadequate to economically justify RPS resources and if the U.S. continues to support an RPS requirement, then carbon and REC markets will stay separate.

8. RENEWABLE ENERGY CREDITS (REC) – Patrice Rother

Patrice Rother provided a presentation on Renewable Energy Credit price forecasts. This information is new as the consultant report is still in draft form.

Points of clarification regarding renewable energy credits included:

- RECs are traded now or purchased mainly through bi-lateral agreements where a load serving utility contracts for its required amounts from a supplier (generating utility) and then uses that to meet the state RPS.
- Restrictions placed on B.C. based clean resources will depend on the specific RPS requirements for various states. Some RPS rules in the WECC will allow supply to be provided by out-of-state. There is also some allowable use of unbundled RECs. BC Hydro will assess what is emerging in terms of allowable technologies – different states have different eligibility, and then assess where opportunities exist.

9. EXPORTS – Rohan Soulsby

Rohan Soulsby provided a presentation on exports, making a distinction between traditional exports and exports of clean energy generation solely for the purpose of export, and how exports will be handled in the IRP.

Points of clarification regarding exports included:

- The 3000 GWh/year insurance requirement falls within the category of traditional exports (and not clean energy generation solely for the purpose of export).
- In the absence of a self sufficiency policy, BC Hydro relied on historic planning criteria, planned to critical water years and allowed a reliance on 2500 GWh of non firm energy. There was also a reliance on Burrard Thermal.
- Regarding who will buy this surplus energy, there is always a market for energy, and the question is how good that market is going to be, which will depend on whether it is a gas equivalent cost, a GHG trade off costs included, and/or REC included.
- For traditional energy, the Clean Energy Act confirms BC Hydro has ability to sell traditional energy in the long term. Although BC Hydro wasn't precluded from doing that before, it is now clear that it has the mandate to pursue long-term contracts for consideration by the Province.
- It was confirmed that in order to look at the cost of producing energy for export, the cost of supply includes transmission costs which are considerable and need to be looked at.
- The Clean Energy Act tells the IRP to do an assessment of the market of renewable energy, estimate share of the market and estimate expenditure for exports from aggregation.
- If the estimate is wrong, it is the shareholder who will bear the costs.
- Any risk to the exporting power producer would depend on the terms of the contract.
- Regarding where the independent power producers would come from to provide exports there would be a need to have a process and award contracts when the transmission is ready and determined. Understanding the impacts and the needs of the province for the various requirements is being undertaken.
- Regarding a firming tariff, any tariff would be subject to approval by BCUC and would include the opportunity cost of using that storage for export. This firming tariff has yet to be determined. There was some interest among committee members about what would be comprised within a firming tariff.

Member comments:

- Concern was raised that with the self sufficiency policy now in place there will be surplus power in the future, and now in addition to that government policy is saying to go out and look for more.
 - It was clarified BC Hydro will not be analyzing the cost of meeting the legislated self sufficiency directive.
- A concern was raised by a member that selling off insurance means that it is no longer insurance
- A comment was made that BC Hydro should pursue long-term contracts that BC Hydro wouldn't have to deliver in instances of a drought.
- A member expressed a need to be very explicit with what the economic conditions of export are. The long term projects could lose money at some point, so there is a need to be clear that the ratepayer does not take the risk, the shareholder does.
- A member expressed concern that, as transmission is an integrated system so there could be difficulty in determining who is responsible for the costs of various portions of transmission.
 - Export assessment work is being undertaken by Black and Veatch, and as well by BC Hydro in the IRP. All work associated with export potential is being tracked separately.

- One member questioned whether B.C. resources would be competitive given the distance in transmissions between B.C. and California.
 - The cost of a wind turbine in B.C. or in California is the same. It may be that the distance disadvantage due to transmission losses is offset with the BC Hydro system ability regarding firming and shaping.
 - BC Hydro is considering certain scenarios such as carbon pricing, tax credits and so on as a way of assessing competitive status.
- A member expressed the view that all things being equal, it should be cheaper for local generation (i.e., for California to buy more locally), based on the transmission distance, and as well from an environmental view, it is better to have a local source.

10. WRAP UP / ROUNDTABLE – Anne Wilson

The following comments arose from members during the reflection on the day:

- Members expressed the desire to have the Public Interest Advocacy Centre representative at the table.
- A suggestion was made to increase the per diem allotted to members or change the protocol. There is a need to increase face time at TAC.
- There is a lot of material to go through, and trying to understand how to provide input.
- A suggestion to get review materials earlier.
- A member wanted clarity around the timing of feedback and expectations.
- A number of members wanted more time for constructive input and group exchanges.
- Desire to see how risks of technology can be involved in scenario planning.
- Desire to look at GHG, and to take care when embedding these GHG prices in the electricity price forecasts.
- There was a question posed to members to reflect about how they wanted to handle input, for example, will input be reflected on by TAC or left with BC Hydro... essentially to what extent do TAC members want to comment on the comments.

ACTION: TAC agreed to meet again on February 14, 2010.

The meeting ended at 5:00 p.m.