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**2012 Integrated Resource Plan**

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**Appendix**

**3A-2**

**2010 Resource Options Report  
Resource Options Update  
Consultation Report**

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## 2011 Integrated Resource Plan



### 2010 Resource Options Update Consultation Report

February 2011



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## 1.0 Overview of the 2010 Resource Options Update (ROU) Consultation Process

In 2010, BC Hydro updated its database of resource options that are available to meet the electricity needs of the BC Hydro service territory in the next 20 years. The resulting 2010 Resource Options Report provides the underlying resource data for the different energy planning portfolios that are being considered in the Integrated Resource Plan (IRP). The 2010 Resource Options Report characterizes the demand-side and supply-side resource options in a manner that is consistent with the objectives of B.C.'s 2010 *Clean Energy Act*, B.C. Government policies, and related legislative initiatives.

The process of updating BC Hydro's resource options database is referred to as the Resource Options Update (ROU). A key component of the ROU is the consultation process whereby BC Hydro sought input from those with technical expertise to assist BC Hydro in updating the data on the resource potential in B.C.

This report describes:

- o the objectives of the ROU consultation process,
- o the process that was used during the summer and fall of 2010 to consult with people with technical expertise and information related to resource options,
- o the input BC Hydro received from these consultations, and
- o how BC Hydro considered the input that was provided.

### 1.1 Objectives of the ROU Consultation Process

Three objectives were identified at the outset of the ROU consultation process:

- o promote mutual understanding of the resource options data and continue to foster constructive working relationships with the resource options update participants,
- o seek input on methodology applied to updating the resource options data and attributes where appropriate, and
- o seek input to accurately reflect resource options potential in the B.C. provincial context.

### 1.2 Technical Focus of the ROU Consultation Process

This ROU consultation process consisted of working with people who have technical expertise to gather and review technical information on supply-side and demand-side resource options in B.C. The output of this consultation process was a more accurate and accepted inventory of resource option potential in B.C. This inventory of resource options is a foundational input into the integrated resource planning process.

No decisions were made, or opinions collected, during this consultation process on resource option preference or relative rankings of resource options. The IRP consultation program will gather public, stakeholder and First Nations input into the draft IRP, including input on future resource options. Further information can be found at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Get Involved.

### 1.3 Approach to the ROU Consultation Process

BC Hydro sought information and input from people in the province with technical expertise and information related to potential energy resources in B.C. in order to update its resource options database. This technical stream of consultation spanned from September until December 2010, and occurred over four broad steps.

- Launch consultation at the workshop on September 14 to introduce scope of update and information requirements. Secure commitment to engage in subsequent resource-specific conversations and solicit and consider written comment on material presented.
- Conduct individual and group conversations/meetings that examine the accuracy of resource data, and collect new information that is available.
- Seek input on methodology to be applied to environmental and economic development attributes. Conduct targeted conversations and meetings as appropriate with those people that have applicable technical expertise and interest in the methodology.
- Present updated data at session on December 8, and then solicit and consider written comments.

For updates to the demand-side management options, BC Hydro worked closely with the long-standing Electricity Conservation and Efficiency Advisory Committee to develop options for inclusion in the IRP.

Note: A summary of this process is provided in Section 3.1 of this report. These options were presented at the ROU Draft Results Session held on December 8, 2010.

The supply-side resource types considered in this technical stream of consultation include: biomass (biogas, municipal solid waste, wood-based), geothermal, hydrokinetic, miscellaneous distributed generation, pumped storage, run-of-river, solar, storage, thermal (coal with carbon capture and sequestration, natural gas-fired generation), tidal, wave, and wind (onshore and offshore).

A number of resource updates were also undertaken internally by BC Hydro staff, including transmission options, large hydro (Site C), and Resource Smart. Note: These resource updates were presented at the Draft Results Session held on December 8, 2010.

## 2.0 ROU Launch Workshop – September 14, 2010

A workshop was held on September 14, 2010, at the Sutton Place Hotel in Vancouver to introduce both the scope of the update and the information requirements, and to solicit participation to undertake the update work.

Invitations to the Launch Workshop were sent via email and fax to approximately 250 individuals and organizations. The invitation list was compiled from the following sources: 1) the participants list from the 2008 ROU technical sessions, 2) BC Utilities Commission intervenor lists for the regulatory review of BC Hydro's 2006 Integrated Electricity Plan, 2008 Long-Term Acquisition Plan, and the 2009 Long-Term Electricity Transmission Inquiry, 3) BC Hydro's registration lists from 2008 Long-Term Acquisition Plan and 2009 Long-Term Electricity Transmission Inquiry events, 4) BC Hydro's Aboriginal Relations & Negotiations department contacts, and 5) contacts from the BC Hydro technical leads working on the 2010 ROU.

Approximately 55 people attended the workshop. Attendees primarily included representatives of independent power producers (IPPs) and consulting companies, but also included municipalities, public interest and environmental groups, and representatives of three First Nations. The names of individual participants are not identified in this report, as consent was not sought or received for disclosure.

The Launch Workshop was divided into two parts. An overview section presented the IRP context, the proposed scope of the targeted update for each resource type considered, and a review of the attributes being updated including technical, financial, environmental and economic development. This was followed by breakout group discussions to probe data collection methodologies and identify people interested in participating in the update process.

The agenda, presentation materials and meeting summary notes are posted on BC Hydro's website at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

During the breakout meetings, handouts of draft summaries of assumptions and proposed update methodologies were provided to participants. These summaries are posted on BC Hydro's website at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

### 3.0 ROU Consultation by Resource Type

The engagement process undertaken to update the resource option data varied by resource type depending on the update methodology agreed upon at the Launch Workshop, the level of participant interest, and the complexity and breadth of the update for each resource type.

This section provides the following for each resource type: a summary of the engagement process that was used, the comments that were received, and BC Hydro's consideration of that input.

#### 3.1 Demand-Side Management (DSM) Resource Options

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Technical Lead	John Duffy (BC Hydro Staff)
Engagement Method	BC Hydro Electricity Conservation and Efficiency (EC&E) Advisory Committee meetings

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April 7, 2010: EC&E Advisory Committee received a presentation on the proposed development approach for the next DSM Plan. The Committee provided input into the breadth of DSM options to be analyzed, and the way in which they would be characterized. Input on the methodology for determining the cost effectiveness of DSM was also received, along with views on risk management and evaluation issues.

June 23, 2010: EC&E Advisory Committee received an update on the timeline for DSM options development and opportunities for engagement.

October 6, 2010: EC&E Advisory Committee received a presentation on the proposed concepts for the DSM options. Through the presentation, clarification of the options under consideration was provided, and numerous comments were received regarding positioning and explanations to be included in the portrayal of the options. These comments were incorporated into the write-up to support and describe the DSM resource options.

December 2, 2010: EC&E Advisory Committee received a presentation on the draft DSM options. Points of clarification were provided for each of the five energy-focused and three capacity-focused options. Comments were received regarding factors and viewpoints to consider when planning implementation. Interest was expressed at being apprised of any future regulatory reviews of the Power Smart program.

### 3.2 Biomass – Biogas

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Technical Lead	Ellen Feng (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Individual and working group meetings

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Four people attended the biomass-biogas meeting on September 14, and expressed interest in participating in a working group. BC Hydro's technical lead described the proposed approach to updating the biogas resource. Highlights of this meeting included:

- o Discussion concerning the reliability of biogas resource, and trends in regional government policies towards diverting organics from the waste streams.
- o New provincial emissions regulations next year may affect future resource potential.
- o Based on input received, the update process mainly included:
  - Review/update new potential landfill sites.
  - Review methodology on landfill gas generation potential.
  - Review landfill gas project cost estimation.
- o It was agreed that another meeting would be held on September 28 to review preliminary results.

Prior to the meeting on September 28, preliminary results were circulated to four interested stakeholders, including representatives from Terasen Gas, Metro Vancouver, GeoBC, and the BC Sustainable Energy Association.

Those parties who expressed interest at the September 14 meeting were invited to the meeting on September 28. One person attended from Metro Vancouver. The methodology of calculating resource potential and cost estimation was reviewed at the meeting. The participant provided suggestions and comments, and overall supported the proposed methodology of the study. After the meeting, the participant also provided additional information on one of the potential projects via email.

The following table describes how key input was considered during the update of the biomass-biogas resource option.

RESOURCE TYPE: BIOMASS – BIOGAS	
Input Received	BC Hydro Consideration of Input
Participants suggested that the cost from the U.S. Environmental Protection Agency study should be a recent quote and not escalated from an old quote.	As a result, BC Hydro confirmed the costs used reflect 2008 costs which were escalated to 2010 dollars.
Participants thought 90% annual availability might be on conservative side. (The availability can reach 98% if only capture and flare system are considered.) Suggestion was to check the Vancouver Landfill generator availability.	As a result, BC Hydro checked the Vancouver Landfill generation, and the annual average energy was 90% of max capacity. The same assumption is used for other landfill projects as well.
Participants suggested that 75% recovery rate for gas collection system is achievable going forward, but it is very dependent on the amount of investment.	The 75% recovery rate is referenced both from the Environment Canada Report and the Golder Report. Also to confirm with the B.C. Ministry of Energy that 75% recovery rate is reasonable to use.
At the ROU Draft Results Session (December 8), verbal input was received from one representative from Metro Vancouver that there is another model (CRA model) that might be available to estimate methane production potential.	This new methodology will be reviewed for the next ROU.

### 3.3 Biomass – Municipal Solid Waste (MSW)

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Technical Lead	Magdalena Rucker (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Working group meeting

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Six people attended the biomass-MSW meeting on September 14, and expressed interest in participating in a working group. BC Hydro's technical lead described the proposed approach to updating the municipal solid waste resource. Highlights of this meeting included:

- o Discussion as to whether MSW constitutes clean and renewable.
- o Comments that it was an improvement to look at fuel source potential (rather than identified projects).
- o Discussion around how Metro Vancouver's waste diversion program may affect the biomass-MSW potential.
- o It was agreed that a follow-up meeting would occur on September 23.

The working group meeting was held on September 23, 2010. Two stakeholders participated, including a representative from Metro Vancouver, and an IPP representative. During this meeting, the methodology



for determining the biomass-MSW potential as well as the cost and energy conversion assumptions were reviewed and discussed. All suggestions were incorporated in the analysis.

Some email correspondence was conducted to follow up on points made during the working group meeting.

The following table describes how key input was considered during the update process of the biomass-MSW resource option.

RESOURCE TYPE: BIOMASS – MSW	
Input Received	BC Hydro Consideration of Input
A participant suggested BC Hydro should validate with the B.C. Ministry whether MSW is a clean and renewable resource.	The determination by the Ministry of Energy if a waste to energy facility can be classified as clean or renewable occurs on a case by case basis. For the purpose of this assessment, it is assumed that each project would meet the requirements for clean or renewable.
Participants commented that a combined electricity/heat recovery waste to energy facility would provide additional electricity savings by offsetting space heating. This benefit is not captured in the current analysis.	For the purpose of the ROU, heat recovery has not been considered in the analysis since it very much depends on the location of the facility. It is recognized that the omission of heat recovery will make the waste to energy facilities less cost effective, and it also does not take into account additional electricity savings by offsetting space heating. This short coming will be noted in the MSW write-up.
Participants commented that waste incineration is usually only considered as an option when landfills are closed, and questioned whether this taken into account in the analysis.	Landfill closure dates are not being considered in the analysis. As a result, there is also an overlap with the biomass-biogas resource option as it assumes that biogas production rates will increase as long as a landfill is operating whereas a waste to energy plant would reduce the biogas production rate. This issue will be addressed in the portfolio analysis whereby only a biogas OR a MSW project will be selected in each transmission area.
It was discussed if tipping fees should be included in the cost analysis.	Tipping fees have been included in the unit energy cost calculations.
Participants suggested that the cost assumptions should be based on capital and operational and maintenance estimations by Ramboll (2007) as presented in the Stantec 2010 Report titled, <i>A Technical Review of Municipal Solid Waste Thermal Treatment Practices</i> .	The Ramboll cost assumptions, adjusted to January 1, 2011 numbers, have been used in this analysis.

### 3.4 Biomass – Wood-Based

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Technical Lead	Kathy Lee (BC Hydro Staff)
Engagement Groups	Biomass Working Group  Government Working Group (representatives from the Ministry of Energy and Ministry of Forests, Mines and Lands)
Engagement Method	Biomass Working Group - Meeting on Sep 14 - Email correspondence  Government Working Group - Conference call - Email correspondence

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BC Hydro engaged a team of consultants including Industrial Forest Services Ltd. (IFS) together with M.D.T. Ltd. and Murray Hall Consulting Ltd., to conduct a modelling study to estimate the long-term availability potential, cost and most logical locations of wood-based biomass energy potential in B.C. This study is referred to as the IFS study.

#### **Government Working Group: Conference Call #1**

##### Review of Study Approach and Assumptions

On August 30, 2010, the government working group discussed the approach and reviewed the assumptions used in the IFS study. The approach and assumptions reflecting the input from this discussion was documented in the methods document handed out at the September 14 meeting, and is available on the BC Hydro website at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

#### **Biomass Working Group: Meeting #1 and Email Correspondence #1**

##### Review of Study Approach and Assumptions

Nine people attended the wood-based biomass meeting on September 14, and expressed interest in participating in a working group. Attendees represented government agencies, regional district, IPPs, First Nations, wood industries, and other utilities. BC Hydro's technical lead described the proposed approach to updating the wood-based biomass resource. Highlights of this meeting included:

- o Recommendations for the IFS study to consider bark material from log exports, which were subsequently incorporated into the IFS study.
- o There were also comments about fuel risk allocation affecting cost uncertainty; uncertainties are documented in the IFS report. Comments were also made regarding the need to offset wood-based biomass fuel risk by combining with other fuel.
- o The biomass working group indicated its preference to have future correspondence via emails. This preference was confirmed on September 15 via an email to the participants who signed up.

**Government Working Group: Conference Call #2**

Review of Draft Results

On October 12, 2010, the government working group reviewed the draft results from the IFS study. General comments were that the results and trends seem reasonable. Uncertainties of the availability of standing timber and pulp log as electricity potential were raised. Based on this input, IFS subsequently undertook a sensitivity test on the biomass energy potential, which included with and without the potential from standing timber and pulp log. Results are included in the material provided to the biomass working group in the second email correspondence, as well as in the IFS report.

**Biomass Working Group: Email Correspondence #2**

Review of Draft Results

On October 14, 2010, the biomass working group was sent, in the form of Powerpoint slides, a summary of the preliminary results of the IFS study. One comment was received. The comment received noted the results seem reasonable and predictable and it indicated that perhaps a study was not necessary.

On November 23, 2010, the biomass working group was sent the draft IFS study report. No comments were received.

**Report**

The final IFS study report is found in Appendix 7 of the draft Resource Options Report and is available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > document centre.

The following table describes how key input was considered during the update of the wood-based biomass resource option.

RESOURCE TYPE: BIOMASS – WOOD-BASED	
Input Received	BC Hydro Consideration of Input
Participants suggested that bark material from log exports be considered as potential.	As a result of this input, this material was included in the estimates in the study.
Participants pointed out that fuel risk allocation can significantly change the cost for biomass projects.	As a result of this input, cost uncertainty for wood-based biomass projects were described as “medium” and “high”.

### 3.5 Geothermal

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Technical Lead	Alex Tu (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence

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Four people attended the geothermal resource option update on September 14. Based on the discussion during this meeting, it was agreed that the 2009 data compiled by GeothermEX for the Western Renewable Energy Zones form the basis of the geothermal estimate from conventional geothermal resources in B.C.

It was recognized that this represents a conservative estimate, as it does not include resources from enhanced geothermal or co-produced fluids, which are likely to be found in B.C.

It was agreed that no further meetings would be required, and that email correspondence would be sufficient.

The following table describes how key input was considered during the update of the geothermal resource option.

RESOURCE TYPE: GEOTHERMAL	
Input Received	BC Hydro Consideration of Input
Email correspondence with the Canadian Geothermal Energy Association (CanGEA) indicated their discomfort with the GeothermEX data. However, no new data was submitted in time for review.	As an outcome of discussions, it was determined that a representative from CanGEA would be invited to future engagement. As a result, a representative was invited to the ROU Draft Results Session (December 8).

### 3.6 Hydrokinetic

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Technical Lead	Alex Tu (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence

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Nine people attended the hydrokinetic resource option update meeting on September 14. BC Hydro's technical lead described the proposed approach to updating the hydrokinetic resource. No interest was expressed to participate in a hydrokinetic resource option working group.

Based on the discussion during this meeting, it was agreed that there is insufficient resource data at this time to complete an assessment of the hydrokinetic resource in B.C. BC Hydro will proceed in collaboration with Natural Resources Canada and the Canadian Hydraulics Centre to develop a methodology to assess the resource in place, and to execute the methodology for all Canadian provinces.

The following table describes how key input was considered during the update of the hydrokinetic resource option.

RESOURCE TYPE: HYDROKINETIC	
Input Received	BC Hydro Consideration of Input
Participants suggested that BC Hydro can develop a resource assessment without waiting for Natural Resources Canada (NRCan) by working directly with independent consultants to estimate the resource in place in selected B.C. rivers.	This is a viable option; however, neither route (with NRCan or through an independent consultant) will deliver credible results within a timeframe necessary for this IRP. Collaboration with NRCan has the additional benefit of developing a robust hydrokinetic modelling tool that can be used for all rivers across Canada. BC Hydro will proceed with collaborative work with NRCan and will seek to have the B.C. assessment completed in time for the subsequent IRP.
Participants suggested, in advance of the next IRP, BC Hydro should incorporate at least an initial assessment into the cluster definition efforts, or focus an analysis on whether addition of the hydrokinetic resource changes the value of any critical clusters.	At this time, there is insufficient resource data available to complete even an initial assessment. A literature review show the only available B.C. assessment examines only a small stretch of the Fraser River. At this time, no hydrokinetic assessment will be included in the IRP, though efforts will be made to ensure this data gap is resolved for subsequent IRPs.

### 3.7 Miscellaneous Distributed Generation

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Technical Lead	Joanne McKenna (BC Hydro Staff)
Engagement Method	Meeting on September 14

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Five people attended the miscellaneous distributed generation meeting on September 14. BC Hydro's technical lead clarified that distributed generation is not a resource option that will be updated during this ROU process.

The resulting discussion included providing interested parties with information about BC Hydro's integrated power offer and pilot distributed generation projects. It was confirmed with attendees that no follow up from this meeting was required.

### 3.8 Pumped Storage

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Technical Lead	Sanjaya De Zoysa (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Conference calls Individual and working group meetings

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An independent consultant, Knight Piesold, was retained to assess greenfield pumped storage hydro potential in the Lower Mainland / Vancouver Island (LM/VI) area. Hatch consulting was retained to estimate the cost of installing a pump or a pump-turbine at BC Hydro's Mica generating station. Stakeholder input to the greenfield study led to salmon bearing lakes being included in the assessment. Input also resulted in a few additional sites being assessed.

**Working Group: Meeting #1**

Fifteen people, including representatives from IPPs and consulting firms, attended the pumped storage meeting on September 14, and expressed interest in participating in a working group to update the resource option data. BC Hydro's technical lead described the proposed approach to updating the pumped storage resource. Highlights of the meeting included:

- o Questions regarding sites considered for pumped storage.
- o It was clarified that pumped storage is being looked at as a capacity resource only.
- o It was further clarified that capital costs are being looked at and not operating costs.
- o It was agreed that a subsequent meeting would be set up.

**Working Group: Meeting #2**

On October 6, 2010, a meeting with stakeholders was held to review the Knight Piesold study methodology and preliminary results. Thirteen people attended the meeting, including representatives from IPPs and consulting firms. Participants provided suggestions and comments, including thoughts on the inclusion of salmon bearing lakes and drinking water reservoirs in the study.

Participants were invited to provide information on potential pumped storage sites that they might have investigated. It was noted that the information would be treated on a confidential basis.

**Meetings with Individual Developers**

A series of meetings was held with individual developers during the period July through September 2010. Four individual developers accepted BC Hydro's invitation to discuss work they have done in assessing potential pumped storage sites. Participants were encouraged to share information on the sites, including details of technical studies they have carried out, permits obtained, etc. with BC Hydro to assist in the update of pumped storage potential. Some developers provided information on a confidential basis. This information will be used in validating the results from the Knight Piesold study.

**Reports**

The final reports on the studies carried out by Knight Piesold and Hatch are available in Appendix 10 of the Resource Option Report available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

The following table describes how key input was considered during the update of the pumped storage resource option.

RESOURCE TYPE: PUMPED STORAGE	
Input Received	BC Hydro Consideration of Input
Salmon bearing lakes and drinking water reservoirs should be included in the studies identifying pumped storage potential.	As a result of this input, sites on salmon bearing lakes and drinking water reservoirs were included and flagged as such.
Technical and financial data on sites studied by IPPs (provided on a confidential basis) should be used within this update.	As a result of this input data were used to validate the results of the study carried out by Knight Piesold.

### 3.9 Run-of-River Hydro

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Technical Lead	Goran Sreckovic (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Individual and working group meetings

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Twenty people attended the run-of-river breakout meeting on September 14, and expressed interest in participating in a working group. Attendees included IPPs and consultants. A representative from Kerr Wood Leidel, the company undertaking the run-of-river resource option update work was also in attendance. BC Hydro's technical lead described the proposed approach to updating the run-of-river resource option. Highlights of the meeting included:

- What is included (or not) within the modelling assumptions, and as well a discussion regarding data sources.
- Concern was expressed that with such a large number of sites (8000 sites) how a review of these sites is undertaken. Clarification was made between this high level planning exercise and the acquisitions process.
- It was clarified that various costs are considered, including transmission costs.
- The participants expressed a need for additional meetings that would allow them to get more insight into the run-of-river update study.

A follow-up meeting was held at BC Hydro premises on September 20, 2010. The follow-up meeting was attended by IPPs. A representative from Kerr Wood Leidel was present to comment on specific technical questions. The meeting attendees expressed interest in details related to the study methodology in the following areas:

- exclusion areas,
- transmission lines,
- new vs. old site selection approach, and
- potential project costs vs. revenue.

The attendees decided that there would be no need for additional meetings related to the run-of-river update, and were interested in where the information would be made publically available.

The report *Run-of-River Hydroelectric Resource Assessment 2010 Update* describing the work undertaken by Kerr Wood Leidel is Appendix 9 of the draft Resource Options Report available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

### 3.10 Solar

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Technical Lead	Bruce Henry (Consultant to BC Hydro)
Engagement Method	Meeting on September 14 Email correspondence

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Seven people attended the solar resource option update meeting on September 14, and expressed interest in participating in a working group to update the solar resource option data. Participants included representatives of IPPs, ministry staff, consulting companies, and Terasen Gas. BC Hydro's technical lead described the proposed approach to updating the solar resource. Participants expressed interest in meeting to discuss the preliminary results of the solar resource option update.

An invitation to meet was sent to interested parties on September 29, 2010, with a proposal to meet on October 7, 2010, to review the preliminary results. A request was made in this communication to indicate if the interested party would attend. With no response received, a follow-up note was sent on October 1, indicating that no responses had been received and that if there was no interest in meeting expressed by October 6 that the meeting scheduled for October 7 would be cancelled. In the October email, an option to review the preliminary results by email was offered. Three parties expressed an interest in reviewing materials by email. The October 7 meeting was cancelled.

A draft presentation on the solar resource option update was sent on October 11 with a request to provide feedback by October 14. Feedback was received from one party and this was considered in finalizing the solar resource option update.

### 3.11 Storage

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Technical Lead	Helen Whittaker (BC Hydro Staff)
Engagement Method	Meeting on September 14

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Two people attended the storage meeting on September 14, both of whom intended to attend the pumped storage meeting rather than the storage meeting. There was no interest expressed to participate in a working group to update information on the storage resource option.

The update work was completed by the BC Hydro technical lead.



### 3.12 Thermal – Coal with Carbon Capture and Sequestration

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Technical Lead	Sanjaya De Zoysa (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence

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Two people, representing industry and IPPs, attended the coal meeting on September 14, and expressed interest in current information on coal technologies rather than being interested in participating in a working group.

Information available from a National Energy Technology Laboratory report on coal-fired generation with carbon capture and sequestration was used in characterizing this resource option.

### 3.13 Thermal – Natural Gas-Fired Generation

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Technical Lead	Sanjaya De Zoysa (BC Hydro Staff)
Engagement Method	Meeting on September 14

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Eight people attended the natural gas meeting on September 14, representing IPPs, consumer organizations and consultants. The group saw no need to establish a working group or for further meetings. BC Hydro's technical lead described the proposed approach to updating the natural gas resource option. Highlights of the meeting included:

- o Stakeholders were interested in the natural gas price forecasts that would be used in the IRP.
- o Information from past BC Hydro studies on gas-fired generation and latest cost and performance information from industry literature was used in characterizing this resource option.

### 3.14 Tidal

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Technical Lead	Alex Tu (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Working group meeting

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Nine people attended the tidal resource option update meeting on September 14, and expressed interest primarily in the tidal resource option. BC Hydro's technical lead described the proposed approach to updating the tidal resource.

The following items form the basis of the tidal resource option assessment: the scope and methodology confirmed in the meeting held on September 14, the tidal energy data and specific location of interest identified in reports from Triton consultants, as well as the cost estimates from a 2004 Carbon Trust report.

Two reports were submitted by the Ocean Renewable Energy Group (OREG) outlining the basic assumptions used by a European and South American tidal energy assessments. The reports have a similar approach to estimate the achievable wave energy resource within a given tidal regime, which informed this methodology.

A workshop was held by OREG in October to discuss global best practice in estimating the optimal resource extraction within the B.C. Inside Passage. The outcome of this workshop resulted in an agreement to propose a resource assessment modelling project to BC Hydro for consideration.

Preliminary energy and cost assessment results were shared with OREG and generally accepted.

The following table describes how key input was considered during the update of the tidal resource option.

RESOURCE TYPE: TIDAL	
Input Received	BC Hydro Consideration of Input
Participants suggested BC Hydro develop a scenario based approach that would see development towards a 2 GW target of ocean energy (0.5 GW of tidal) by 2050.	In the absence of policy targets for ocean energy, a scenario-based approach will not be included for this IRP process.
European and South American harvestable energy estimates are based on the stated power matrix of a particular tidal energy converter within a given tidal regime.	This approach was taken to estimate the harvestable energy from the best tidal development sites. This is a change from the approach used in the 2009 Long-Term Electricity Transmission Inquiry analysis.
OREG and the resource assessment community will propose to BC Hydro a regional resource assessment modelling project for the B.C. Inside Passage.	BC Hydro will assist the development of a proposal that will help meet BC Hydro's need to properly assess the total harvestable resource from the Inside Passage.

### 3.15 Wave

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Technical Lead	Alex Tu (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence

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Three people attended the wave resource option update meeting on September 14, and expressed interest in participating in a working group to update the resource option data. BC Hydro's technical lead described the proposed approach to updating the wave resource.

Based on the scope and methodology confirmed in the September meeting, the wave energy data from the Canadian Hydraulics Centre, the existing sites where developers have signaled their interest, and the cost estimates from a 2004 Carbon Trust report form the basis of the resource assessment.

Two reports were submitted by the Ocean Renewable Energy Group (OREG) outlining the basic assumptions used by a European and South American wave energy assessments. The reports have a similar approach to estimated the achievable wave energy resource within a given wave regime, which informed this methodology.

Preliminary energy and cost assessment results were shared with OREG and generally accepted

The following table describes how key input was considered during the update of the wave resource option.

RESOURCE TYPE: WAVE	
Input Received	BC Hydro Consideration of Input
Participants suggested that considering the potentially conservative wave energy resource estimate based on existing expressions of interest from the development community, and suggest BC Hydro develop a scenario-based approach that would see development towards a 2 GW target of ocean energy (1.5 GW of wave) by 2050.	Although existing expressions of interest is an imperfect estimate of development potential, it is not necessarily a conservative or aggressive estimate. In the absence of policy targets for ocean energy, a scenario-based approach will not be included for this IRP process.
European and South American harvestable energy estimates are based on the stated power matrix of a particular wave energy converter ("Pelamis") within a given wave regime.	This approach was taken to estimate the harvestable energy from the existing sites where developers have indicated an interest. This is a change from the approach used in the 2009 Long-Term Electricity Transmission Inquiry analysis.

### 3.16 Wind – Onshore & Offshore

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Technical Lead	Magdalena Rucker (BC Hydro Staff)
Engagement Method	Meeting on September 14 Email correspondence Individual and working group meetings

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Twenty-three people attended the wind meeting on September 14, and expressed interest in participating in a working group to update the wind resource option data. An additional six people were subsequently added to the working group. BC Hydro's technical lead described the proposed approach to updating the wind resource. Highlights of this meeting included:

- Discussion about reviewing IPP bids to get more accurate information, recognizing the need for confidentiality.
- Discussion of resolution of data and the uncertainty between study data and what you might find on the ground.
- Questions arose regarding how the resource options would get into the portfolio modelling.
- It was agreed that a follow-up meeting would occur on September 24.

A working group meeting, including ten participants, was held on September 24, 2010. During this meeting, the results for the onshore wind resource option were reviewed, as well as the methodology and assumptions for determining the offshore wind potential.

A draft report by Garrad Hassan on the onshore/offshore cost assumptions was circulated on October 7, 2010, for comments to all 29 stakeholders who had initially expressed interest in participating in the

update. As well, preliminary results for offshore wind were circulated for comments to the 29 working group participants on October 8, 2010.

An individual meeting was held with in IPP on October 13, 2010, to review modelling and cost assumptions for offshore wind.

The Garrad Hassan wind cost review report is found in Appendix 8 of the draft Resource Options Report available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

The following table describes how key input was considered during the update process of the wind resource option.

RESOURCE TYPE: WIND	
Input Received	BC Hydro Consideration of Input
Stakeholders requested to review the Garrad Hassan cost update study.	A draft report on the cost assumptions was circulated to all the participants.
Concerns were expressed that the costs assumptions may not reflect B.C. conditions, and may underestimate the construction costs in B.C.	Due to these concerns, the unit energy costs (UECs) for onshore wind were calculated using high cost assumptions for turbine costs and parameters that are terrain-sensitive. The calculated UECs have been compared against the levelized plant gate prices for wind projects with EPA awards. The lowest modelled UECs are in agreement with actual levelized plant gate prices, and hence it has been judged that the onshore cost assumptions yield reasonable results.
It was noted that the Canadian Wind Atlas underestimates offshore wind by about 20%.	Wind speeds from the Canadian Wind Atlas were compared against long-term wind speed estimates based on observations. As a result of this comparison, the wind speeds from the Canadian Wind Atlas were uniformly increased by 0.6 m/s.
During the working group meeting, it was suggested that a minimum wind speed threshold of 8 m/s at 80m, and a maximum water depth threshold of 40 m be used to estimate the offshore wind resource potential.	These suggestions were implemented in the analysis.
Many of the identified squares in the Hecate Strait are not constructible due to seabed substrate, extreme waves, etc. Other sites are too remote. Reserve/park designations are missing.	There is not enough information available to access the constructability of offshore wind farms, nor is the issue of constructability taken into account in the other resource options. The cost estimations do assume certain building characteristics, and hence the costing would be off if more difficult conditions were encountered. This will be noted in the write-up. The remoteness of some sites will come into account when determining the transmission costs. Reserve/park designations have not been included at this stage, but will be considered at a later stage.

RESOURCE TYPE: WIND (continued)	
Input Received	BC Hydro Consideration of Input
Assumed wake losses of 10% for offshore are too high.	The assumed wake losses of 10% for offshore are higher than what has been assumed by B.C. IPPs. However, it is in line with what is assumed in other studies which range from 10 to 20%. Furthermore, the total losses of 18.3% for offshore are in line with the losses assumed for onshore wind (18.5%).
Direct current losses are significantly higher than alternating current losses due to converter losses.	Transmission losses have not been included in the analysis as the UEC values are at gate.
Net capacity factors (before transmission losses) are too low.	The net CF (before transmission losses) may be conservative estimates, due to the larger wake losses that are being assumed.
Offshore turbine installation costs are too high.	This comment was forwarded to Garrad Hassan.
Include a low case in addition to the base and high case in the cost assumptions.	Due to comments from other stakeholders that the costs may be underestimated in B.C., a low base has not been added.
Include that turbines and/or components may become less expensive in the future (more supply from China, driving turbine prices downward).	The assumption that turbine and/or component costs may come down over time has not been included in the analysis, as there are many influencing factors that cannot be predicted (supply-demand, price of steel, etc.). A decrease in cost is considered for emerging technologies, but wind energy is considered an established technology.

#### 4.0 ROU Draft Results Session – December 8, 2010

A session was held on December 8, 2010, at the Sutton Place Hotel in Vancouver to report out on the draft results of the 2010 Resource Options Update and to provide people with notice of a written comment period from December 8 until December 31, 2010, on the draft Resource Options Report posted on the BC Hydro website.

Invitations to this session were sent via email and fax to approximately 250 individuals and organizations. The invitation list was compiled from the invitation list used for the ROU Launch Workshop (September 14) with the addition of people and organizations who expressed interest during the ROU consultation process.

Approximately 60 people attended the session. Attendees primarily included representatives of IPPs and consulting companies, but also included municipalities, First Nations, public interest and environmental groups. Participant individual names are not identified as consent was not sought or received for disclosure.

At this session, draft results for cost and resource potential were reported out on supply-side options, including transmission and resource smart options, and demand-side options developed in conjunction with the Electricity Conservation and Efficiency Advisory Committee. Updates for the environmental and economic development attributes were also reported out on. The agenda, presentation materials and meeting summary notes are posted on BC Hydro's website at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

## 5.0 Environmental Attributes Consultation

The consultants Kerr Wood Leidel, Hemmera, and HD Lanarc were retained by BC Hydro to develop the set of environmental indicators to be used for the IRP. Consultation on the methodology included a meeting with Ministry staff, targeted meetings with a number of environmental organizations, and updates at the ROU Launch Workshop on September 14 and the ROU Draft Results Session on December 8.

### Meeting with Ministry Staff: August 17

On August 17, 2010, BC Hydro met with staff members from the Ministry of the Environment and the Integrated Land Management Bureau to review the methodology for the environmental indicators. Key themes emerging from at meeting were:

- Questions arose as to how these indicators were going to be used in decision-making.
- Attendees urged Hydro to use source data where possible to develop the land and freshwater metrics.
- Participants thought BC Hydro should be looking at airshed quality when assessing the air contaminants metric. If not, BC Hydro needs to clearly articulate reasons for omission.
- It was noted a mix of condition indicators and stress indicators. It was clarified that development risk is not within scope of the IRP.
- Suggestion if possible to use pipeline and seismic line data for the linear density indicator.

### Meetings with Environmental Organizations: September 22 & 23

BC Hydro met with representatives of various province wide environmental organizations on September 22 and 23, 2010 to provide an overview of the environmental attributes and allow opportunity to comments and follow up if interested. Environmental organizations included: Nature Trust of Canada, Ducks Unlimited, BC Sustainable Energy Association, David Suzuki Foundation, West Coast Environmental Law Association, Westcoast Wilderness Committee, Watershed Watch Salmon Society, Sierra Club, and Pembina Institute. Key themes emerging from these meetings included:

- Attendees, although noting that the indicators were important, were focused on how the metrics would be used in decision making.
- Questions arose as to how the indicators would be rolled up.
- Attendees were supportive of the approach.
- Concern was raised regarding the valued ecosystem components and what happens where these features exist but were not identified. It was clarified that these were the marine indicators and it is recognized that this is early stages for marine indicators.
- Suggestion not to sum the indicators up but to keep them discrete so portfolios can be examined a number of ways.
- Attendees suggested using the indicators as a screening tool when developing portfolios.
- With the freshwater indicator, there is a concern that just looking at just fish would lose other ecological aspects that are important.
- Question regarding where wetlands is being considered in the indicators.
- It was clarified with the land metric, finer detail is being looked into, however a criteria for development of the attributes is that province wide data is available.
- Did not see a further need to have input at the technical level on the methodology.

**Updates at the ROU Launch Workshop & ROU Draft Results Session**

Updates regarding the environmental attributes were presented at the ROU Launch Workshop on September 14 and the ROU Draft Results Session on December 8. Key themes from the question and answer period of these events included:

- o Participant wanted to use the environmental attributes as a screen to choose portfolios.
- o Questions were raised as to how these attributes would be used in decision making.
- o Participant wanted the draft report available for public comment.
- o Questions were raised about the ability to measure specific impacts such as effluent impacts on water quality, and impacts on bird migrations through windmills and the ability to assess freshwater impacts with so many run-of-river projects identified. It was clarified that the environmental indicators are very coarse and are provincial in scale, and are useful in making relative comparisons between portfolios rather than for analysis of project impacts.
- o Individual wanted to see further details on the environmental attributes (written feedback).

The environmental attributes report can be found in Appendix 4 of the draft Resource Options Report and is available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

The following table provides a summary of the key input regarding the environmental attributes and how this input was considered by BC Hydro.

ENVIRONMENTAL INDICATORS	
Input Received	BC Hydro Consideration of Input
Use source data where possible to develop indicators.	BC Hydro used source data where possible, and when not possible, stated the reasons for using the specific database.
Suggestion to include air shed quality in the air contaminant metric.	Due to the fact that air shed quality does not exist as a provincial scale dataset, it is not included. However, considering the importance of air shed quality BC Hydro will consider a post analysis commentary that considers air shed quality.
Suggestion not to sum up the indicators but to leave them as discrete measures.	BC Hydro is leaving the indicators as discrete measures, with the flexibility of rolling them up post analysis, as appropriate.
Suggestion that the indicators be used as a screening tool to develop portfolios.	At this time, the indicators are going to be used characterize the portfolios to provide a basis for high level comparison of environmental comparisons between portfolios.
How are wetlands being considered?	Wetlands are not explicitly measured, however they are covered indirectly through the net primary productivity measure will take into account wetlands have a higher productivity measure.
Provide the draft report for public comment.	Comments were solicited on methodology through the development process. Although further comment will not be provided on the report per se, the public will have opportunities to comment on the environmental attributes throughout the consultation process.

ENVIRONMENTAL INDICATORS (continued)	
Input Received	BC Hydro Consideration of Input
Request to see further details on the environmental attributes.	Further details to be shown in the environmental attributes report in Appendix 4 to the draft Resource Options Report. In addition, increased upfront engagement will be considered for next IRP.

## 6.0 Economic Development Attributes Consultation

The economic development indicators were developed by BC Hydro's energy planning department in conjunction with BC Hydro's economic and business development group. Updates on the indicators were presented at the ROU Launch Workshop on September 14 and again at the ROU Draft Results Session on December 8.

Questions and comments that arose from the question and answer period of these events included:

- Questions were raised as to how First Nations community economic development issues would be addressed with these indicators that are provincial in scale and may overlook some of the more regional or local considerations. It was noted that this is an important issue and the regional public and First Nations consultation program will hopefully collect information on how these can be considered.
- Questions were raised as to whether the indicators will identify who would be receiving the benefits of the job creation objective. It was clarified that the BC Stats Input/Output Model (BCIOM) being used does not look at the distributional effects across consumer groups.
- A number of questions were also raised as to the application demand-side management options within the BCIOM.
- There were questions regarding the ability for the analysis to look at the effects of higher cost portfolios on the depression of the provincial economy. It was clarified that the modelling would not be able to determine that.

The write up of the economic development attributes methodology is found in Appendix 5 of the draft Resource Options Report and is available at [www.bchydro.com/irp](http://www.bchydro.com/irp) > Document Centre.

The following table provides a summary of the key input regarding the economic development attributes and how this input was considered by BC Hydro.

ECONOMIC DEVELOPMENT INDICATORS	
Input Received	BC Hydro Consideration of Input
Consider First Nations and non First Nation community economic development at a regional and local level.	BC Hydro recognizes the limitations of the economic model used for these indicators, and welcomes input during the public consultation process on ideas and thoughts on community development issues.
Concern over limitations to the approach to economic development indicators.	BC Hydro recognizes the limitations to the model being used, and sees this as the best approach at this time and looks to continue to improve the methodology in future IRPs.



## 7.0 Written Comments on the Draft 2010 Resource Options Report

Participants were invited to provide written comments on the draft 2010 Resource Options Report following the ROU Draft Results Session on December 8. The written comment period extended from December 8 to December 31, 2010.

Written comments were received from two individuals and a representative from the Ocean Renewable Energy Group. The following table provides a summary of the key input from the written comments and how this input was considered by BC Hydro.

WRITTEN COMMENTS ON THE DRAFT RESOURCE OPTIONS REPORT	
Input Received	BC Hydro Consideration of Input
Suggestion to include nuclear power within the inventory.	At this time, nuclear will continue to be excluded from the inventory as per provincial policy.
Suggestion to review earliest in-service dates for wind resource.	BC Hydro considered this input and decided to leave the earliest in-service date at 2016 and does recognize that there may be specific projects that could be brought on sooner.
Accept the reported methodologies for wave and tidal provided that it is acknowledged that values are based on rough data.	BC Hydro has provided within the final Resource Options Report, a reference showing the data certainty level.
Support the inclusion of hydrokinetic energy even though no specific values can be provided.	BC Hydro has included hydrokinetic energy within the final Resource Options Report.

## 8.0 Feedback on the ROU Consultation Process

On December 8, 2010, a feedback form was distributed at the ROU Draft Results Session inviting people to comment on the ROU consultation process. Four individuals responded who had participated in the update process from September to December. Two rated the engagement process as excellent, one rated it good, and one rated it fair.

Associated comments were provided with the ratings. For the more valuable components of the process, comments included: high quality presentations from specialists, solid base to support the next step in the IRP process, and guidance on reality in regards to expected cost and resource size and location. A suggestion for the next ROU process was for BC Hydro to be stronger in the area of soliciting input.