BC hydro

Integrated Resource Plan

Appendix 3A-6

2013 Resource Options Report Update

Resource Options Mapping (ROMAP) Report

BC hydro

2010 Resource Options Update

Resource Options Mapping Update

Final Report
May 2011

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BC hydro

2010 Resource Options Update

Resource Options Mapping Update

Final Report
May 2011

KWL File No. 478.098-300

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STATEMENT OF LIMITATIONS

This document has been prepared by Kerr Wood Leidal Associates Ltd. (KWL) for the use and benefit of the BC Hydro.

This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

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EXECUTIVE SUMMARY

BC Hydro commissioned a study to update the existing resource option mapping database (ROMAP), a geographical information system (GIS) database, for their 2010 electricity generation resource options update and the 2011 Integrated Resource Plan (IRP).

The study compiled over 7700 potential resource options in BC. These sites have a potential installed capacity of over 60,000 MW and annual energy of nearly 200,000 GWh.

ROMAP is a spatially enabled GIS version of BC Hydro's Resource Option Database (RODAT), containing the key details about potential generation resources.

The energy resources data assembled in the resource options mapping database (ROMAP) as a part of this project include potential:

- Biomass (Biogas);
- Biomass (Municipal Solid Waste (MSW));
- Biomass (Wood Based);
- Geothermal;
- Large Hydro (Site C);
- Pumped Storage;
- Resource Smart;
- Run-of-River;
- Solar;
- Natural Gas Fired Generation;
- Coal Fired Generation with Carbon Capture and Sequestration (CCS);
- Tidal;
- Wave; and
- Wind (on shore and off shore).

Potential resources located in protected areas (exclusion zones) were not included in the analysis.

At gate costs were supplied by BC Hydro. Road and power line costs were estimated for each project taking the least cost route (avoiding exclusion areas). The estimated cost for each of the projects includes access roads and power lines interconnecting to the BC Hydro and Fortis BC grids.

As this study involved identifying a complete inventory of potential resource options, the unit energy costs (UECs) presented include economically feasible and economically infeasible UECs.

There is a large quantity of renewable energy resources potential in BC with approximately 4,500 MW and 24,000 GWh estimated to be under $100/MWh (6% discount rate).

This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.

Section 1

Introduction

1. INTRODUCTION

1.1 BACKGROUND

BC Hydro retained Kerr Wood Leidal Associates Ltd. (KWL) to update the existing resource option mapping database (ROMAP) GIS database for BC Hydro's 2010 electricity generation resource options update for the 2011 Integrated Resource Plan (IRP).

This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.

1.2 SCOPE

The scope of this study was the preparation of generation resource option data for BC Hydro optimization models. Specific tasks included:

- update of the ROMAP database of generation resources with data supplied by BC Hydro; and
- GIS analysis of access (roads and barge) and power line / interconnection costing.

The data prepared as a part of this project will be utilized as input to the resource options portfolio analysis. The Resource Option Map Database (ROMAP) updated for this study was provided electronically to BC Hydro.

Section 2

Resource Options Database & Mapping

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2. RESOURCE OPTIONS DATABASE & MAPPING

2.1 RESOURCE OPTIONS MAP DATABASE (ROMAP)

The Resource Options Map Database (ROMAP) is a spatially-enabled version of BC Hydro's Resource Option Database (RODAT), containing the key details about potential generation resources. ROMAP was constructed using ArcGIS 10, using the file geodatabase data model. This database format is interchangeable with other relational database formats, including dBase, MS Excel/Access, SQL Server and Oracle.

2.2 GENERATION RESOURCE OPTIONS UPDATED

This section describes the attribute fields in the generation resource datasets. This is the key dataset used in this study, and only includes sites where a project concept has been developed. There are currently 7,758 potential energy resource sites listed in the database.

All resource types that were not excluded as a part of the Clean Energy Act and could foreseeably generate energy at a utility scale commercial-level within the next thirty years were considered. Any existing or committed projects were not included in this analysis. Potential resources were not excluded on the basis of economic, environmental except where noted in this study.

The 2011 IRP included updates to most resource options. The energy resources data assembled in the resource options mapping database (ROMAP) as a part of this project include potential:

- Biomass (Biogas);
- Biomass (Municipal Solid Waste (MSW));
- Biomass (Wood Based);
- Geothermal;
- Large Hydro (Site C);
- Pumped Storage;
- Resource Smart;
- Run-of-River;
- Solar;
- Natural Gas Fired Generation;
- Coal Fired Generation with Carbon Capture and Sequestration (CCS);
- Tidal;
- Wave; and
- Wind (on shore and off shore).

Figures 2-1 through 2-14 show the mapped generation resource options according to type[1].

[1] Note: Figures 2-1 to 2-17 are provided in separate files on the BC Hydro Integrated Resouce Plan Website

2.3 RESOURCE OPTIONS DATASET SUMMARY

The tables below summarize the resource options in the ROMAP database before exclusions (e.g., legally protected areas and technically infeasible areas). Table 2-1 provides a summary of all the resource options by transmission region (see Figure 2-15[1] for the transmission regions). Table 2-2 provides a summary of all the projects by resource type. Table 2-3 provides a summary by transmission region of all resource options by type.

2.4 EXCLUSION AREAS

Legally protected areas and known undevelopable areas (e.g., glaciers) were identified as areas for exclusion consideration. The resource option generation sites (at-gate) were screened for whether they fell within following exclusion areas. Exclusions were also considered for roads and power lines. The exclusion and undevelopable areas used for this project are outlined in Tables 2-4 and 2-5.

Table 2-1: Energy Resource Potential in BC by Transmission Region

Transmission Region	Number of Projects	Average Annual Energy (GWh/yr)	Annual Firm Energy (GWh/yr)	Installed Capacity (MW)
Central Interior	644	7,460	4,090	2,540
East Kootenay	483	4,270	3,450	1,330
Kelly Nicola	371	15,920	9,980	9,240
Lower Mainland	375	16,130	13,350	108,160
Mica	191	3,010	2,640	1,380
North Coast	3,155	74,360	19,820	23,210
Peace River	1,126	27,710	11,090	8,370
Revelstoke Ashton Creek	286	5,360	3,300	2,310
Selkirk	275	3,420	2,620	1,010
Vancouver Island	837	30,820	13,390	87,850
Technically Inaccessible	15	9,090	280	2,660
Total	**7,758**	**197,550**	**84,010**	**248,060**

Notes:
1. This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.
2. Values summarized in this table have been rounded for presentation purposes.
3. Transmission region above is based on the potential interconnection locations of the resource options. See Table 2-6 for generation site locations of technically inaccessible resource options.

Technically inaccessible resource option locations are presented in Table 2-6 by transmission region.

Table 2-2: Energy Resource Potential in BC by Resource Type

Resource Name	Number of Projects	Average Annual Energy (GWh/yr)	Annual Firm Energy (GWh/yr)	Installed Capacity (MW)
Biomass (Biogas)	12	130	130	20
Biomass (MSW)	3	500	500	60
Biomass (Wood Based)	21	11,200	11,200	1,410
Geothermal	18	6,270	6,270	820
Large Hydro (Site C)	1	4,610	4,000	910
Ocean (Tidal)	13	1,460	0	630
Ocean (Wave)	16	2,510	0	1,080
Pumped Storage	194	0	0	188,500
Resource Smart	6	180	180	580
Run-of-River	7,282	62,860	49,890	17,400
Solar	10	60	0	50
Coal Fired Generation with CCS	1	3,900	3,900	750
Natural Gas Fired Generation	6	6,600	7,940	1,260
Wind (Offshore)	54	58,010	0	17,950
Wind (Onshore)	121	39,260	0	16,660
Total	**7,758**	**197,550**	**84,010**	**248,060**

Notes:
1. This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.
2. Values summarized in this table have been rounded for presentation purposes.

Table 2-3: Energy Resource Potential in BC by Transmission Region and Resource Type

Transmission Region	Resource Name	Number of Projects	Average Annual Energy (GWh/yr)	Annual Firm Energy (GWh/yr)	Installed Capacity (MW)
Central Interior	Biomass (Biogas)	1	20	20	0
	Biomass (Wood Based)	1	250	250	30
	Run-of-River	632	4,850	3,830	1,370
	Solar	1	10	0	10
	Wind (Onshore)	9	2,340	0	1,130
Central Interior Total		**644**	**7,460**	**4,090**	**2,540**
East Kootenay	Biomass (Wood Based)	2	320	320	40
	Run-of-River	478	3,690	3,130	1,140
	Solar	1	10	0	10
	Wind (Onshore)	2	250	0	140
East Kootenay Total		**483**	**4,270**	**3,450**	**1,330**
Kelly Nicola	Biomass (Biogas)	2	30	30	0
	Biomass (Wood Based)	2	540	540	70
	Geothermal	1	140	140	20
	Pumped Storage	4	0	0	4,000
	Resource Smart	1	80	80	30
	Run-of-River	338	3,860	3,010	1,070
	Solar	1	10	0	10
	Natural Gas Fired Generation	4	4,840	6,180	950
	Wind (Onshore)	18	6,420	0	3,090
Kelly Nicola Total		**371**	**15,920**	**9,980**	**9,240**
Lower Mainland	Biomass (Biogas)	3	30	30	0
	Biomass (MSW)	1	290	290	30
	Biomass (Wood Based)	2	3,360	3,360	420
	Geothermal	5	2,510	2,510	320
	Pumped Storage	105	0	0	105,000
	Run-of-River	253	7,340	5,560	1,730
	Solar	1	10	0	10
	Natural Gas Fired Generation	1	1,600	1,600	200
	Wind (Onshore)	4	1,000	0	450
Lower Mainland Total		**375**	**16,130**	**13,350**	**108,160**
Mica	Pumped Storage	1	0	0	500
	Run-of-River	189	3,000	2,640	870
	Solar	1	10	0	10
Mica Total		**191**	**3,010**	**2,640**	**1,380**
North Coast	Biomass (Wood Based)	7	2,040	2,040	260
	Geothermal	3	2,110	2,110	270
	Ocean (Wave)	1	420	0	140
	Run-of-River	3084	19,640	15,670	5,650
	Solar	1	10	0	10
	Wind (Offshore)	36	41,140	0	12,870
	Wind (Onshore)	23	9,010	0	4,020
North Coast Total		**3155**	**74,360**	**19,820**	**23,210**
Peace River	Biomass (Wood Based)	3	1,030	1,030	130
	Geothermal	1	140	140	20
	Large Hydro (Site C)	1	4,610	4,000	910
	Run-of-River	1074	2,500	2,020	830
	Solar	1	10	0	10
	Coal Fired Generation with CCS	1	3,900	3,900	750
	Wind (Onshore)	45	15,540	0	5,720
Peace River Total		**1126**	**27,710**	**11,090**	**8,370**
Revelstoke Ashton Creek	Biomass (Biogas)	1	10	10	0
	Geothermal	1	140	140	20
	Resource Smart	1	30	30	500
	Run-of-River	278	3,620	3,130	1,030
	Solar	1	10	0	10
	Wind (Onshore)	4	1,560	0	750
Revelstoke Ashton Creek Total		**286**	**5,360**	**3,300**	**2,310**
Selkirk	Biomass (Biogas)	2	30	30	0
	Biomass (MSW)	1	110	110	10
	Biomass (Wood Based)	2	310	310	40
	Geothermal	3	420	420	60
	Resource Smart	1	30	30	0
	Run-of-River	262	2,090	1,730	670
	Solar	1	10	0	10
	Wind (Onshore)	3	430	0	230
Selkirk Total		**275**	**3,420**	**2,620**	**1,010**
Vancouver Island	Biomass (Biogas)	3	20	20	0
	Biomass (MSW)	1	100	100	10
	Biomass (Wood Based)	2	3,360	3,360	420
	Geothermal	2	530	530	70
	Ocean (Tidal)	12	1,430	0	620
	Ocean (Wave)	15	2,090	0	940
	Pumped Storage	84	0	0	79,000
	Resource Smart	3	50	50	50
	Run-of-River	693	12,260	9,170	3,030
	Solar	1	10	0	10
	Natural Gas Fired Generation	1	160	160	100
	Wind (Offshore)	7	8,100	0	2,470
	Wind (Onshore)	13	2,710	0	1,140
Vancouver Island Total		**837**	**30,820**	**13,390**	**87,850**
Technically Inaccessible	Geothermal	2	280	280	40
	Ocean (Tidal)	1	40	0	10
	Run-of-River	1	0	0	0
	Wind (Offshore)	11	8,770	0	2,610
Technically Inaccessible Total		**15**	**9,090**	**280**	**2,660**
Total		**7758**	**197,550**	**84,010**	**248,060**

Notes:
1. This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.
2. Values summarized in this table have been rounded for presentation purposes.
3. Transmission region above is based on the potential interconnection locations of the resource options. See Table 2-6 for generation site locations of technically inaccessible resource options.

Table 2-4: Summary of Exclusion Areas

Exclusion Areas - Legally Protected Areas	Source	Screening Criteria ROADS	Screening Criteria POWER LINES	Screening Criteria RESOURCE OPTIONS
Biodiversity Areas	Province of British Columbia, Integrated Land Management Branch (ILMB),GeoBC, Land and Resource Data Warehouse (LRDW)	None allowed	None allowed	None allowed
Wildlife Management Areas *areas for which administration and control has transferred to the Ministry of Environment (MoE) via the Land Act due to the significance of their wildlife/fish values and designated as Wildlife Management Areas under the Wildlife Act*		None allowed	None allowed	None allowed
Conservancy Areas *conservancy areas designated under the Park Act or by the Protected Areas of British Columbia Act, whose management and development is constrained by the Park Act*		None allowed	None allowed	None allowed
National Parks		None allowed	None allowed	None allowed
Legally Protected Areas **Ecological Reserves, Protected Areas, Provincial Parks, Recreation Areas**		None allowed	None allowed	None allowed
Canadian Forces Bases	CFB Esquimalt (Navy) CFB Comox (Air Force)	None allowed	None allowed	None allowed
Migratory Bird Sanctuaries	Environment Canada	None allowed	None allowed	None allowed
National Marine Conservation Areas (NMCAs) No electricity generation is permitted	Province of British Columbia, ILMB, GeoBC, LRDW	Not applicable	None allowed	None allowed
Federal Marine Protected Areas (MPAs) 1. Bowie Seamount MPA, 180 km offshore of Gwaii Haanas; 2. Endevour Hydrothermal Vent MPA, 250 km offshore of Vancouver Island		Not applicable	None allowed	None allowed
Provincial Marine Protected Areas (MPAs) Provincial Park, Conservancy, *Environment and Land Use Act* Protected Areas, Recreation Area (128 are marine in total) and Ecological Reserves (20 marine, called Marine Ecological Reserves - e.g., Race Rocks)		Not applicable	None allowed	None allowed

Table 2-5: Summary of Undevelopable Areas

Exclusion Areas – Undevelopable Areas	Source	Screening Criteria ROADS	Screening Criteria POWER LINES	Screening Criteria RESOURCE OPTIONS
Glaciers	Province of British Columbia, GeoBC, Corporate Watershed Base (CWB)	None allowed	None allowed	None allowed

Table 2-6: Technically Inaccessible Energy Resource Potential in BC by Transmission Region

Transmission Region	Resource Name	Number of Projects	Average Annual Energy (GWh/yr)	Annual Firm Energy (GWh/yr)	Installed Capacity (MW)
Central Interior	Geothermal	1	140	140	20
Central Interior Total		1	140	140	20
Lower Mainland	Ocean (Tidal)	1	40	0	10
	Wind (Offshore)	1	970	0	280
Lower Mainland Total		2	1,000	0	290
North Coast	Run-of-River	1	3	2	1
	Wind (Offshore)	6	4,300	0	1,300
North Coast Total		7	4,300	0	1,300
Peace River	Geothermal	1	140	140	20
Peace River Total		1	140	140	20
Vancouver Island	Wind (Offshore)	4	3,500	0	1,030
Vancouver Island Total		4	3,500	0	1,030
Total		**15**	**9,090**	**280**	**2,660**

Notes:
1. Transmission region stated above is based on generation site location for technically inaccessible resource options.
2. Values summarized in this table have been rounded for presentation purposes.

2.5 DENSITY OF RESOURCE OPTIONS

The density of the capacity and energy of the resource options was mapped to identify regions of high energy and capacity. The density analysis was achieved using the kernel density function of ArcGIS described in more detail in Appendix A.

A 'kernel density' function was used to convert the discrete energy resource options data into a smooth, continuous surface of energy resource density. This method creates a geographic surface, under which the volume of energy or capacity is equal to the sum of the inputs.

The density analysis was conducted excluding all projects in legally protected areas or in otherwise undevelopable areas (glaciers). In addition to that, the following resource options were excluded from the density analysis to avoid spatially skewing the results:

- Pumped Storage;
- Natural Gas;
- Site C;
- Coal with Carbon Capture and Sequestration; and
- Resource Smart.

Figures 2-16 and 2-17 provide a plot of the density of the energy and capacity respectively.[1]

Section 3

Individual Roads and Power Line (R_1T_1) Costing

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3. INDIVIDUAL ROADS AND POWERLINE (R_1T_1) COSTING

Access roads and power lines often comprise a significant portion of project cost and environmental and economic impact. As a part of this project, individual access road or barge (R1) and power line including interconnection, (T1) costs were estimated for each potential resource option based on least-cost routing, avoiding legally protected areas and extreme construction conditions (e.g., glaciers and very steep terrain) utilizing GIS.

Since this assessment is an inventory level study, the analysis and estimates of costs are intended to provide the magnitude of costs; suitable for ranking options being considered. The estimated costs represent KWL's judgment in light of experience, knowledge and available information for this inventory study.

The cost estimates include:

- Access costs (road and or barge);
- Power line including connection to existing grid;
- Allowance for environmental and engineering costs;
- Bonding and insurance;
- Land allowance;
- Land taxes;
- Interest during construction; and
- Operation and maintenance.

The cost estimates do not include the following site-specific considerations:

- Permitting, licensing or environmental assessment;
- Geotechnical allowances;
- Market shortages of labour and/or materials; and
- Delays due to difficult construction conditions, terrain or weather.

The cost estimates include a 30% contingency allowance. All costs are presented in 2011 dollars (Canadian), and do not include local, provincial or federal taxes.

BC Hydro supplied at-gate costs for the generation site without access roads or power lines and interconnection.

3.1 CAPITAL COSTS

ROAD, POWER LINE AND INTERCONNECTION COSTS

Information relating to the estimation of the cost for roads, power lines, and interconnection can be found in Appendix B.

CONSTRUCTION CAMP AND TRANSPORTATION

No additional allowance was made for construction camp and transportation for the generation site in the ROMAP process for roads and powerlines.

ENGINEERING, ENVIRONMENTAL AND OTHER

Project specific costs such as those for engineering or environmental management require detailed site information to determine. For inventory level estimates in this report, typical allowances expressed as a percentage of total capital cost are given to account for these cost items. In this study, allowances for each site category were as follows:

- Bonding and Insurance - 2% of Capital Cost;
- Environmental - 5% of Capital Cost; and
- Engineering - 15% of Capital Cost.

LAND ALLOWANCE

A land allowance cost in the form of a one-time cost that was included in consideration of the cost to purchase, lease or obtain permission through negotiations to use the land for construction and operation. A cost of 5% of the capital cost was included as an allowance for these highly variable, and difficult to predict costs.

3.2 UNIT COST ESTIMATES FOR ROADS AND POWER LINES

This section summarizes the dependant variables and assumptions used to determine unit costs for the following project components.

Power Line

Dependent variables:

- Voltage of power line;
- Capacity; and
- Terrain for construction.

Assumptions:

- All power lines constructed at 25 kV or above;
- 25 and 69 kV lines may be single pole, roadside construction; and
- Slope of terrain ranges from 0 to 75%.

Access Road(s)

Dependent variables:

- Availability of materials;
- Terrain for construction; and
- Difficulty of construction.

Assumptions:

- All new roads are 6 m wide;
- Includes clearing and decking of timber;
- Forestry type road construction with 0.3 m gravel topping;
- Portion of cut volume requires blasting; and
- Road grade ranges from 0 to 30%.

3.3 ANNUAL COST ANALYSIS

This section includes estimates of annual costs for operations and maintenance.

Estimated O&M Cost

Operations and maintenance costs were estimated to be 2% of total capital costs for access roads and 1.1% of total capital costs for power lines.

Land Taxes

Property taxes were estimated to be 3% of the assessed property value, which was assumed to be 80% of the capital cost of the road and power line infrastructure.

Interest during Construction

Project lead-time interest was calculated by taking all development costs and dividing them into equal annual payments. Interest was than calculated annually until project COD is reached.

Project construction period interest was calculated by taking all construction costs (including equipment) and dividing them into equal annual payments. Interest was then calculated annually until project COD is reached.

3.4 UNIT ENERGY COST

Unit energy costs were calculated by amortizing the total capital cost as described in Section 3.2 for each project at a 6% real discount rate (and 8% as sensitivity) over the resource option project life, adding the annual costs described in Section 3.3 and dividing by the annual energy estimate for the site.

3.5 ROAD AND POWER LINE EXCEPTIONS

There were a number of exceptions made to the road and power line costing:

1. The following resource options had no roads, no power lines, and no interconnection costs calculated from GIS methods:

   - Site C; and
   - Resource Smart.

   This is because there is more detailed and accurate data available at BC Hydro for these resources.

2. The following resource options will have no roads or power lines, but were allowed to potentially have interconnection (T1) costs:

   - Biomass (Wood Based);
   - Biomass (Biogas);
   - Biomass (MSW); and
   - Pumped Storage at Mica.

   These resources were assumed to be in very close proximity to existing roads and power lines as they would be constructed at existing facilities, and hence should have minimal costs for roads and power lines.

   The interconnection cost would be based on the interconnection location that the GIS selected. It would use the same interconnection cost methodology as the other resource options, just no power line cost.

3. There are two exceptions to the above for the following resource options in non-integrated areas:

   - Biomass (Wood Based) in Fort Nelson (WBBio_ST_LT_NE):
     - Will not have a road because it is near an existing road; and
     - Will have a T1 power line and potentially T1 interconnection costs. The interconnection cost would be based on the interconnection location from

GIS. It would use the same interconnection cost methodology as the other resource options.

- Biomass (Wood Based) in Dease Lake (WBBio_ST_LT_NW)
  - Will not have a road because it is near an existing road; and
  - Will have a T1 power line and potentially T1 interconnection costs
    The interconnection cost would be based on the interconnection location from GIS. It would use the same interconnection cost methodology as the other resource options.

Section 4

Summary of Results

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4. SUMMARY OF RESULTS

The study compiled over 7,700 potential resource options in BC. These sites have a potential installed capacity of over 60,000 MW and annual energy of nearly 200,000 GWh.

4.1 RESOURCE OPTION UNIT ENERGY COST ESTIMATES

At Gate costs were supplied by BC Hydro. Road and power line costs were estimated for each project taking the least cost route (avoiding exclusion areas). The estimated cost for each of the projects includes access roads and power lines interconnecting to the BC Hydro and Fortis BC grids.

A supply curve for energy resource potential in BC is presented in Figures 4-1 and 4-2). The inventory identified potential sites that could contribute over 24,000 GWh/a of new green energy in BC for under $100/MWh.

The unit energy costs do not reflect what an independent power producer may offer to sell electricity to BC Hydro due to factors such as:

- Cost of capital;
- Contract terms;
- Taxation; and
- Other factors.

UNIT ENERGY COST SENSITIVITY

The unit energy costs (UECs) were calculated using 6% and 8% real discount rates. The 6% UEC values are used to report the results.

4.2 RESOURCE OPTION POTENTIAL BY TRANSMISSION REGION

As this study involved identifying a complete inventory of potential resource options, the unit energy costs presented include both the most cost-effective and least cost-effective projects.

Table 4-1 lists 61 projects with estimated unit energy cost under $100/MWh. These projects total nearly 4,500 MW of capacity and over 24,000 GWh/year of average annual energy.

Table 4-1 below presents the potential for sites under $100/MWh by transmission region.

Table 4-1: Resource Option Potential in BC for Under $100/MWh (Total UEC at 6%)

Transmission Region	Resource Name	Number of Projects	Average Annual Energy (GWh/yr)	Annual Firm Energy (GWh/yr)	Installed Capacity (MW)
Central Interior	Biomass (Biogas)	1	20	20	0
Central Interior Total		**1**	**20**	**20**	**0**
East Kootenay	Run-of-River	3	260	240	80
East Kootenay Total		**3**	**260**	**240**	**80**
Kelly Nicola	Biomass (Biogas)	2	30	30	0
	Run-of-River	6	870	660	230
	Natural Gas Fired Generation	2	4,390	5,640	790
Kelly Nicola Total		**10**	**5,300**	**6,330**	**1,030**
Lower Mainland	Biomass (Biogas)	3	30	30	0
	Geothermal	4	2,370	2,370	300
	Run-of-River	17	1,330	1,030	320
	Natural Gas Fired Generation	1	1,600	1,600	200
Lower Mainland Total		**25**	**5,330**	**5,020**	**830**
North Coast	Geothermal	3	2,110	2,110	270
	Run-of-River	2	150	120	40
North Coast Total		**5**	**2,260**	**2,240**	**310**
Peace River	Geothermal	1	140	140	20
	Large Hydro (Site C)	1	4,610	4,000	910
	Coal Fired Generation with CCS	1	3,900	3,900	750
	Wind (Onshore)	2	1,110	0	310
Peace River Total		**5**	**9,750**	**8,040**	**1,990**
Revelstoke Ashton Creek	Biomass (Biogas)	1	10	10	0
	Run-of-River	1	70	50	20
Revelstoke Ashton Creek Total		**2**	**70**	**60**	**20**
Selkirk	Biomass (Biogas)	2	30	30	0
	Geothermal	1	140	140	20
	Resource Smart	1	30	30	0
Selkirk Total		**4**	**190**	**190**	**20**
Vancouver Island	Biomass (Biogas)	2	10	10	0
	Resource Smart	2	50	50	20
	Run-of-River	2	780	570	170
Vancouver Island Total		**6**	**840**	**640**	**200**
Total		**61**	**24,020**	**22,760**	**4,470**

Notes:
1. This report reflects the resource options data as of February 3, 2011, however the BC Hydro database may have been modified by the integrated resource planning (IRP) process which may not be reflected in this report.
2. Values summarized in this table have been rounded for presentation purposes.

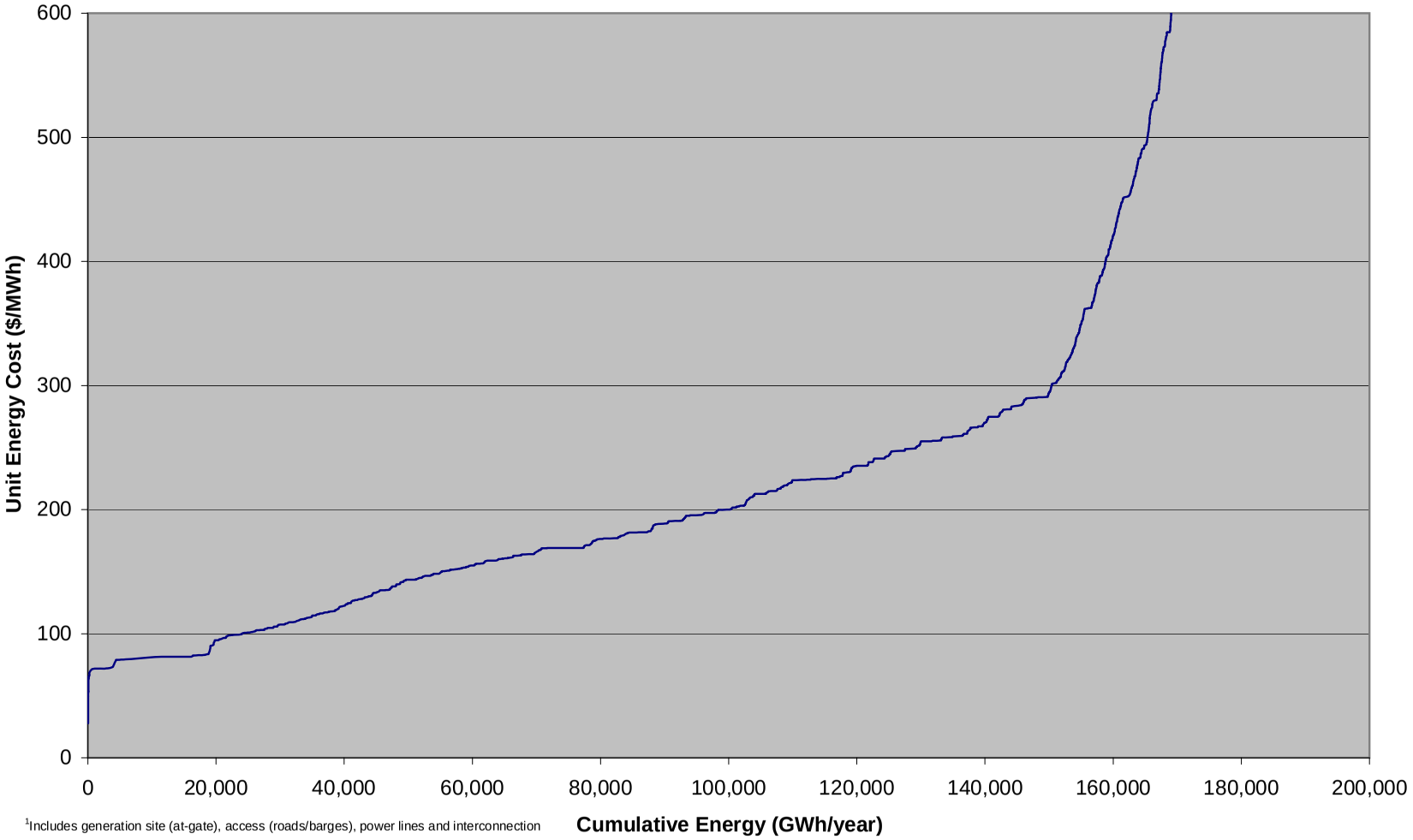
4.3 CLOSING

There is a large quantity of renewable energy resources potential in BC with nearly 200,000 GWh, of which 24,000 GWh is estimated to be available at under $100/MWh (6% discount rate).

There are several regions around the province with concentration of energy and capacity of resource options.

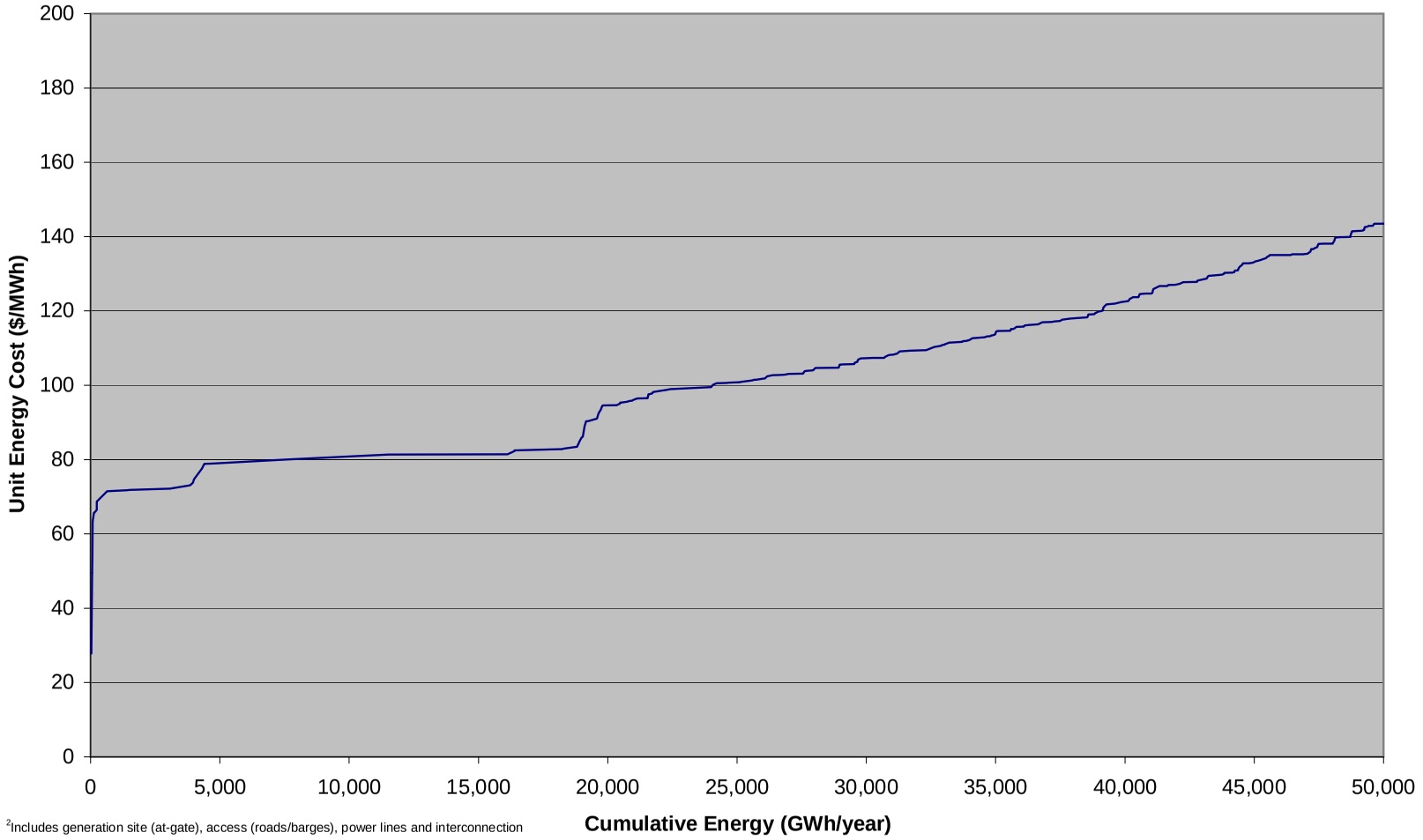
The data prepared as a part of this project will be utilized as input to the resource options portfolio analysis of the 2011 IRP.

Figure 4-1: Supply Curve for Resource Potential - Total UEC (6%[1])



[1]Includes generation site (at-gate), access (roads/barges), power lines and interconnection

Figure 4-2: Supply Curve for Resource Potential - Total UEC (6%[2])



[2]Includes generation site (at-gate), access (roads/barges), power lines and interconnection

Section 5

Report Submission

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5. REPORT SUBMISSION

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