Clean Energy Association of British Columbia

Economic Impact Analysis of Clean Energy Projects in British Columbia, 2010

April 2011

PricewaterhouseCoopers

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We understand this report may be provided to Government representatives, members of the Clean Energy Association of British Columbia and to organizations and individuals involved with the electricity industry in British Columbia. This report uses information about clean energy projects from public and private sources that was known and available as of October 31, 2010.

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Table of Contents

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1 Executive Summary

The Clean Energy Industry in British Columbia

Clean energy projects in British Columbia generate electricity from clean energy sources using a variety of technologies, including run-of-river (small hydro), wind power, thermal power (including gas, biogas, and biomass). At present, most of the existing clean energy production comes from run-of-river projects, followed by biomass generated and wind power projects. These sources of electricity generation contribute towards achieving the Provincial government's policy objectives of energy self-sufficiency by 2016, reduction of green house gases and generation of power from renewable sources.

Clean energy projects that supply electricity to British Columbia's regulated electricity market have been active in the province since the late 1980s.[1] From that time and up to the present, clean energy producers have developed 60 projects that currently account for approximately 25% of British Columbia's electricity generation. Clean energy development continues to expand with construction and operation of projects in nearly every region of the province. Appendix B provides the list of clean energy projects.

In this study, the economic impacts of the clean energy industry are updated to reflect changes that have occurred in the since November 2009. Of importance to the development of the industry was the introduction of the provincial Clean Energy Act legislation in April 2010 and the awarding of EPAs to projects from the 2008 Call for Power. The analysis used in this study follows the methodology developed in an earlier report prepared for the industry in 2009 by PricewaterhouseCoopers LLP (PwC), *Economic Impact Analysis of Independent Power Projects in British Columbia*.

Existing Clean Energy Projects

In this study, the analysis of economic impacts of clean energy projects are separated into two categories: existing clean energy projects, and potential clean energy projects.

Existing clean energy projects are defined as run-of-river, wind and thermal projects that are currently operating and generating power in BC, having a signed Electricity Purchase Agreement (EPA) or equivalent agreement with BC Hydro to produce electricity to satisfy provincial electricity demand. Existing clean energy projects generate roughly 8,210 annual GWh of electricity in British Columbia. Excluded from this analysis are large, non-BC Hydro, storage projects and energy projects serving non-integrated areas.

Potential Clean Energy Projects

Potential clean energy projects are defined as run-of-river, wind, and thermal projects that may arise from electricity purchase agreements (EPAs) signed through previous BC Hydro power calls, projected future EPA from current BC Hydro power calls and projects assumed to be developed as a result of the Clean Energy Association of British Columbia's (Clean Energy BC) long-run demand forecast. These categories are outlined below:

1. **Projects arising from previous BC Hydro Power Calls**: this category includes clean energy projects that have been awarded EPAs through BC Hydro power calls occurring prior to or through the 2008 Clean Power Call but are not yet operational and are projected to be approximately 3,796 GWh of electricity.

2. **Projects arising from current BC Hydro Power Calls**: this category includes clean energy projects that may become operational as a result of the Bioenergy Phase 2 Call, and BC Hydro's Standing Offer Program. These power calls are projected to lead to EPAs for approximately 2,000 annual GWh of electricity.

[1] BC Hydro – About Independent Power Projects, Independent Power Projects (IPPs) currently supplying power to BC Hydro, October 1, 2010

3. **Additional clean energy projects arising from CEBC's forecast of future electricity demand**: In addition to clean energy projects defined in categories (1) and (2) above, our understanding is that Clean Energy BC has projected demand for future power generation equalling 33,487 annual GWh by 2020. This consists of an additional 21,487 GWh from future BC Hydro calls and 12,000 GWh through exports of power to the United States.

1.1 Summary of Existing and Potential Clean Energy Projects

If clean energy projects from previous and current BC Hydro calls for power reach the operational stage, the total power supplied by BC clean energy projects would increase from a current level of about 8,210 annual GWh to approximately 14,006 annual GWh.

Additionally, if Clean Energy BC forecasts for domestic and export demand are realized, by the year 2020 clean energy projects in BC could be generating a further 33,487 GWh of annual output to service demand domestically and for export to the United States.

Table 1.1 summarizes the output (GWh) and capacity (MW) of existing clean energy projects and potential clean energy projects that provides the basis for the economic impacts presented in this study.

Table 1.1 Summary of Output and Capacity from Existing and Potential Clean Energy Projects

Existing and Potential Clean Energy Projects	Category	GWh	MW
Potential projects from previous BC Hydro Power Calls	2006 and Prior Calls*	1,510	517
	2008 Clean Power Call*	2,286	818
Potential projects from current BC Hydro Power Calls	2008 Bioenergy 2 Call	1,000	135
	Standing Offer Program	1,000	135
Total potential project capacity available from BC Hydro Calls		**5,796**	**1,605**
CEBC forecast of future electricity demand	2020 Domestic Demand	21,487	6,018
	2020 Export Demand	12,000	3,361
Total future demand		**33,487**	**9,379**
Total potential projects		**39,283**	**10,984**
Total existing clean energy projects		**8,210**	**1,599**
Total existing and potential projects		**47,493**	**12,583**

*Note: GWh's noted from BC Hydro Power Calls are estimated net of attrition.

Capital Expenditures

The value of capital investment in existing clean energy projects across BC, at 2009 replacement cost, is estimated at $4.5 billion.[2] Capital investment in potential clean energy projects is estimated at $36.2 billion in 2009 constant dollars. It should be noted that these impacts are projected to occur over at least a 10-year time period. Also, while a significant portion of the projected capital expenditure is expected to flow outside of the province due to the specialized nature of capital equipment needed for these projects, a sizeable portion could be expected to occur within BC.

Table 1.2 below summarizes the estimated capital expenditures from all types of existing and potential clean energy projects in British Columbia.

[2] 2009 constant dollars are used to report results consistent with the previous year's report.

Table 1.2. Capital Expenditures, Existing and Potential Clean Energy Projects in BC ($2009 millions)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Estimated Existing Operations	$2,793	$240	$1,489	$4,522
Projected Potential Operations	$15,358	$16,555	$4,308	$36,221

Economic Impacts of Existing and Potential Clean Energy Projects

Construction Phase

Existing Clean Energy Projects – Construction Phase

The construction of existing clean energy operations is estimated to have created approximately $1.9 billion in provincial GDP, or $1.2 million per MW (at 2009 replacement cost). Most of the impact is estimated to have been generated by existing run-of-river and thermal projects and one wind project.

The majority of employment created by clean energy projects occurs during the construction phase, and should therefore be considered as person year impacts rather than full-time jobs. The employment impacts from the construction of existing clean energy operations is estimated to have been 18,000 person years of employment, or about 11 person years of employment per MW.

Government revenues generated through the construction phase of existing clean energy projects are estimated to have been approximately $378.0 million. Government revenues include corporate income taxes, personal income taxes, property taxes and special taxes such as water rentals paid by run-of-river operations.

Table 1.3 below summarizes the estimated impacts from all types of existing clean energy projects.

Table 1.3. Estimated Economic Impacts of Existing Clean Energy Projects – Construction Phase ($2009 millions)

	Direct	Indirect & Induced	Total Impacts	Total Impact per MW
GDP Impact ($2009 millions, replacement cost)	$1,061	$835	$1,896	$1.2
Employment (person years)	5,094	12,872	17,966	11.2
Government Revenue ($2009 millions)	$208.0	$170.0	$378.0	$0.24

Potential Clean Energy Projects – Construction Phase

The projected impact on GDP of potential clean energy projects is estimated at $11.7 billion or $1.1 million per MW. The impacts are projected to be largely generated by run-of-river and wind projects, reflecting the composition of recent BC Hydro clean power calls and BC's renewable energy resource potential. The impacts also include material impacts from investments in biomass and other thermal energy.

Total employment impacts from potential clean energy projects are estimated at 117,000 person years of employment, or 11 person years of employment per MW. While the majority of employment is expected to come from run-of-river projects, thermal projects such as biomass are estimated to have higher indirect and induced employment impacts.

Government revenues generated through the construction phase of potential clean energy projects are estimated at $2.3 billion.

Table 1.4 below illustrates the estimated impacts from all types of potential projects.

Table 1.4. Estimated Economic Impacts of Potential Clean Energy Projects – Construction Phase ($2009 millions)

	Direct	Indirect & Induced	Total Impacts	Total Impact per MW
GDP Impact ($2009 millions, replacement cost)	$6,481	$5,238	$11,719	$1.1
Employment (person years)	34,518	82,622	117,140	11
Government Revenue ($2009 millions)	$1,287	$1,039	$2,326	$0.21

Operations Phase

Existing and Potential Clean Energy Projects – Operations Phase

Clean energy projects continue to contribute to the provincial and local economies once operational. The estimated and projected annual GDP impacts from existing and potential clean energy projects are shown in Table 1.5.

Table 1.5 Annual GDP Impact from Spending by Clean Energy Projects – Operations Phase ($2009 millions)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Estimated Existing Operations	$14.7	$1.2	$113.5	$129.4
Projected Potential Operations	$80.1	$63.1	$488.2	$631.4

In addition to generating impacts during construction, clean energy projects also generate ongoing employment through operations. Employment impacts of ongoing operations are considered to be full-time jobs annually. Table 1.6 illustrates the estimated and projected annual employment impacts from existing and potential clean energy projects.

Table 1.6 Annual Employment Impacts from Clean Energy Projects – Operations Phase

	Small Hydro/Run-of-River	Wind	Thermal	Total
Estimated Existing Operations (FTE)	248	52	1,511	1,811
Projected Potential Operations (FTE)	1,563	2,406	7,720	11,689

2 Introduction

2.1 Introduction

Clean energy projects in British Columbia (BC) generate electricity from clean energy sources using a variety of technologies, including run-of-river (small hydro), wind power, thermal power (including gas, biogas, and biomass). At present, most of the existing clean energy production comes from run-of-river projects, followed by biomass and wind generated power. These sources of electricity generation contribute towards achieving the Provincial Government's policy objectives of energy self-sufficiency by 2016, reduction of green house gases and generation of power from renewable sources.

The Clean Energy Association of British Columbia (Clean Energy BC) engaged PricewaterhouseCoopers LLP (PwC) to update the economic impact analysis prepared and delivered in 2009, *Economic Impact Analysis of Independent Power Projects in British Columbia*. In this current report, we have followed the methodology developed in our earlier work to estimate the economic impacts of existing and potential clean energy projects on British Columbia's provincial economy.

Since the earlier report was released, the Province has introduced legislation through the Clean Energy Act to further promote the development and generation of electricity from clean energy sources.

2.2 Policy and Legislative Changes

On November 2, 2009, a Green Energy Advisory Task Force was appointed to provide input to ensure B.C. remains a leader in clean, renewable energy. The task force developed a total of 72 recommendations, and included the identification of impediments to and best practices for planning and permitting new clean, renewable-electricity generation as well as the identification of possible improvements to future clean power calls and procurement processes.

On the demand side, measures to increase export market access and measures to increase clean electricity demand within BC were recommended. For instance, it was recommended that BC provide incentives to attract clean technology industries. On the supply side, it was suggested that calls to clean power be regular and predictable to restore investor confidence. Other standardization of procurement processes was also advised. The task force also advocated a stronger role for BC Hydro, notably in expanding the Standing Offer Program.

On April 28, 2010, the Government of British Columbia introduced Bill 17 – the Clean Energy Act. The Clean Energy Act built on the results of the Green Energy Advisory Task Force and was focused on three areas of priority:

1. Ensuring Electricity Self-Sufficiency at Low Rates

The act aimed to fulfil B.C.'s goal of electricity self-sufficiency by 2016 by providing a regulatory framework for "long-term electricity planning, bold commitments to clean and renewable electricity generation, streamlined approval processes, and new measures to promote electricity efficiency and conservation". This included new investments in clean, renewable power. The act also emphasized protection for British Columbians by implementing new measures to promote competitive rates.

2. Harnessing B.C.'s Clean Power Potential to Create Jobs in every Region

The act aimed to establish British Columbia as a leader in clean energy, enabling economic growth and job creation in all regions. The act provided BC Hydro and clean energy power producers the tools necessary to secure long-term export power sales to other jurisdictions seeking clean power, while maintaining low rates for British Columbians.

3. Strengthening Environmental Stewardship and Reducing Greenhouse Gases

The act requested measures to reduce greenhouse gas emissions, enhance conservation and protect the environment. For instance, the act required BC Hydro to meet 66% of future incremental demand from conservation measures by 2020, an increase from the previous target of 50%.

Specifically, the measures in the Clean Energy Act are intended to advance six objectives:

- Use and foster the development in British Columbia of innovative technologies that support energy conservation and efficiency and the use of clean or renewable resources.
- Ensure BC Hydro's rates remain among the most competitive of rates charged by public utilities in North America.
- Reduce BC greenhouse gas ("GHG") emissions.
- Encourage economic development and the creation and retention of jobs.
- Foster the development of First Nation and rural communities through the use and development of clean or renewable resources
- Reduce waste by encouraging the use of waste heat, biogas and biomass.[3]

2.3 Calls for Power and Future Resource Planning

BC Hydro has implemented a series of calls for power in order to attract future electricity capacity from clean energy projects. Under a call for power, clean energy providers are encouraged to submit a proposal outlining potential energy project and the amount of electricity and source of power to be produced. BC Hydro assesses each proposal and awards EPAs to successful bidders. Currently outstanding are calls for power under the Standing Offer Program and the Bioenergy Phase 2 Call.

2.3.1 Standing Offer Program

Launched on April 11, 2008, the Standing Offer Program is intended to provide a process to purchase energy from small projects with a capacity between 0.05 and 15 megawatts. At the time of this report, BC Hydro had received 24 applications of which six applications had resulted in Electricity Purchase Agreements (EPAs). Through stakeholder engagement undertaken from October 2009 to July 2010, BC Hydro obtained input on potential modifications to improve the Program. Based on these recommendations, BC Hydro announced revisions to the Standing Offer Program in early 2011.

2.3.2 Bioenergy Calls

BC Hydro issued the Bioenergy Phase I Request for Proposals (RFP) on February 6, 2008 and received 20 proposals for a total energy output of 4,100 GWh/year. The Bioenergy Phase 2 Call issued on March 31, 2010 was a competitive call for larger scale biomass projects with a target to acquire up to 1,000 GWh per year of electricity. BC Hydro received proposals for 13 projects from 10 proponents for the Phase 2 Call representing more than 400 MW of aggregate capacity and over 3,300 GWh per year of firm energy.

2.3.3 Integrated Resource Plan (IRP)

BC Hydro is currently preparing a 20-year integrated resource plan (IRP) that will outline how BC Hydro will meet the future demand in electricity growth. Included in the plan will be how BC Hydro plans to manage electricity growth through electricity conservation and clean energy generation remaining consistent with the overall objective of providing reliable and cost-effective electricity to residential, commercial and industrial customers. Additional objectives being considered in the plan are ways to align future electricity demand and supply with the objectives of BC's Clean Energy Act.[4]

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[3] Bill 17 – 2010 Clean Energy Act
[4] BC Hydro, www.bchydro.com/planning_regulatory/long_term_electricity_planning/irp/

2.4 Project scope

The project scope included updating and verifying the database of existing and potential clean energy projects to reflect changes in project status from potential to operational that may have occurred in the industry since October 2009.

Clean Energy BC has revised their 2020 electricity demand forecast for British Columbia to take into account the changes and advancements in technology (electric cars) and economic development initiatives (Northwest Transmission Line).

Using the revised project database, economic impact estimates for contributions to provincial GDP, employment and government tax revenues for existing and potential clean energy projects were generated. For consistency, the model developed for the 2009 report was used to update the findings for this study. The economic impact model was developed using BC Stats input-output multipliers.

Since the last report, Clean Energy BC has expanded its membership to include all types of clean energy projects generating electricity and directly contributing to the electrical grid. In response, the study's definition of projects has expanded to include all projects that are currently operating and generating power in BC, having a signed Electricity Purchase Agreement (EPA) or equivalent agreement with BC Hydro to produce electricity to satisfy provincial electricity demand including co-generation projects. However, certain project types continue to be excluded because of their size and / or ownership structure which would require significant adjustments to the modeling methodology. To remain consistent with the prior year's report and to enable comparability, these projects remain outside of the analysis and include:

- Alcan Long-Term Electricity Purchase
- Arrow Lakes Hydro
- Brilliant Expansion 1 & 2

In addition, projects supplying electricity to areas that are not connected to the provincial electrical grid are excluded and include:

- Ocean Falls
- Hluey Lake Project
- Queen Charlotte Power Corporation
- Pine Creek

2.5 Report Outline

The report is structured as follows:

Section 3 provides an overview of the clean energy industry in British Columbia and the most recent Clean Energy BC energy demand forecast to 2020.

Section 4 presents the estimated economic impact of expenditures of clean energy projects in BC for existing and potential projects.

Section 5 provides a high-level summary of the community benefits and opportunities of clean energy projects to BC and First Nation communities.

3 Industry Overview

Profile of the clean energy ndustry in British Columbia as of October 1, 2010

60 operating clean energy projects spread across British Columbia

36 small non-storage hydro projects @ 9 MW (average size)

6 large non-storage hydro projects @83 MW (average size)

3 large storage hydro @ 400 MW (average size)

5 biomass projects @ 55 MW (average size)

4 biogas projects @3 MW (average size)

2 biogas projects @ 175 MW (average size)

2 energy recovery generators @ 5 MW (average size)

1 municipal waste recovery unit @ 22 MW

1 wind project @ 102 MW

Clean energy projects supply 25% of British Columbia's electricity generation

3.1 Current industry profile

At the time of this report, Clean Energy BC included 60 clean energy projects operating in British Columbia as part of the clean energy industry, with total installed generating capacity of just over 2,819 MW and total annual firm energy output of close to 11,420 GWh.[5] Power supplied by clean energy projects amounts to approximately 25% of BC's electricity requirements. Appendix B provides the list of these clean energy projects.

The clean energy industry has contributed to BC's electricity supply for many years. As the electricity needs of the province increase, and as provincial government policy supports sustainable and clean energy technologies, the role of clean energy in supplying electricity is expected to grow.

Existing Clean Energy Projects

In this study, the analysis of economic impacts of clean energy projects has been separated into two categories: existing clean energy projects, and potential clean energy projects.

Existing clean energy projects are defined as run-of-river, wind and thermal projects that are currently operating and generating power in BC. In contrast to the 2009 report, this study takes into consideration biomass, self-generation projects but continues to exclude non-BC Hydro large-scale hydro projects including Alcan's project, Arrow Lakes Hydro and Brilliant Expansion Phase 1 and 2. For purposes of this report, existing clean energy projects generate roughly 8,210 annual GWh of electricity in British Columbia.

Potential Clean Energy Projects

Potential clean energy projects are defined as run-of-river, wind, and thermal projects that may arise from electricity purchase agreements (EPAs) signed through previous BC Hydro power calls, projected

[5] As of October 1, 2010 and including the Alcan Long-Term Electricity Purchase, Arrow Lakes Hydro and the Brilliant Expansion.

future EPA from current BC Hydro power calls and projects assumed to be developed as a result of Clean Energy BC's long-run demand forecast. These categories are outlined below:

Calls for power

At present, the Bioenergy Phase 2 Call and Standing Offer program are the remaining calls with capacity available for additional electricity purchase contracts.

Since November 2009, BC Hydro has selected 27 projects for the award of 25 electricity purchase agreements representing 3,266 GWh of annual firm energy and 1,168 MW of capacity from the 2008 Clean Power Call.

Bioenergy Phase 2 Call

Although results of the Bioenergy Phase 2 Call have not yet been released, BC Hydro states that it expects to award electricity purchase agreements for 1,000 GWh per year from the Phase 2 Call. As of October 2010, BC Hydro had received proposals for 13 projects from 10 proponents representing 400 MW of capacity and 3,300 GWh per year of firm energy.[6]

Standing Offer Program

This program is targeted at small clean energy projects, with maximum capacity of 15 MW. In January 2011, BC Hydro released the results of a program review that recommended changes to key program areas including: eligibility, pricing, interconnections, EPA terms, and the overall standing offer program process. In the report, BC Hydro indicates they expect the new pricing will result in approximately 1,000 GWh per year of energy over the next two years of the program.[7] As of October 2010, six projects with approximately 150 GWh and 37.5 MW of capacity have been offered EPAs.[8]

BC Hydro anticipates attrition - that is projects receiving EPAs that do not pursue development due to permitting issues, financing problems, transmission and interconnection issues or other reasons – of about 30%.[9] Therefore, energy supply, net of attrition, from the 2008 Clean Power Call is anticipated to equal roughly 2,286 GWh per year. As results for the Bioenergy Phase 2 Call are not yet available and further offers resulting from the Standing Offer Program have been delayed, no attrition has been attributed for either program.

3.2 Clean Energy BC - Revised 2020 Demand Forecast

Clean Energy BC has revised its prior year's forecast of the province's 2020 electricity demand to reflect that by 2020, electricity demand could expand by a further 11,887 GWh through increased domestic demand as shown in table 3.2. The additional demand for power exports is assumed to remain at 12,000 GWh. Clean Energy BC's assumptions underlying this forecast are outlined below.

Clean Energy BC 2020 domestic demand and supply forecasts

Clean Energy BC revised its 2020 domestic demand and supply forecasts based on BC Hydro actual domestic load as provided by in the F2011 Revenue Requirement Application submitted to the BCUC July 9, 2010.[10] Clean Energy BC has used BC Hydro actual domestic load (including line losses and system use) as the base to revise their estimates of future electricity demand and supply taking into account a number of adjustments. The forecast provided in table 3.2 updates the prior year's forecast and is based on the assumptions below.

[6] BC Hydro, Bioenergy Phase 2 Call RFP, www.bchydro.com/planning_regulatory/acquiring_power/
[7] BC Hydro, Standing Offer Program, Report on the SOP 2-Year Review, January 2011
[8] BC Hydro, Current Applications & Offered EPAs, www.bchydro.com
[9] BC Hydro, 2008 Long Term Acquisition Plan (LTAP), page 6-29.
[10] BC Hydro F2011 Revenue Requirement Application Exhibit B-8 Appendix 1 Schedule 4.0, July 25, 2010.

Table 3.2: Comparison of the Clean Energy BC 2020 Forecast from the 2009 Report to the 2010 Report

Clean Energy Association of British Columbia Comparison of 2009 and 2010 Electricity Forecast	CEBC Forecast 2009 - F2020	(GWh's per year) Difference	CEBC Forecast 2010 - F2020
Expected Load Growth to 2020 Based on BC Hydro Data[1, 2]	**61,600**	**(483)**	**61,117**
CEBC adjustments to BC Hydro demand forecasts			
Allowance for residential heat & hot water	2,600	**(2,600)**	0
Allowance for electrification of North East oil and gas facilities	3,000	**9,500**	12,500
Allowance for new industrial load from development in the NW	0	**3,000**	3,000
Allowance for electric vehicles	1,400	**2,000**	3,400
Insurance required by 2020	3,000	**0**	3,000
Total adjustments to future demand	**10,000**	**11,900**	**21,900**
Future demand after adjustments	71,600	11,417	83,017
CEBC forecast supply from existing sources			
Heritage hydro at critical water	42,600	**0**	42,600
Reduce Burrrard to minimum energy[3]	400	**0**	400
Resource Smart	500	**0**	500
Revelstoke 5	100	**0**	100
Existing contracts [4]	6,100	**1,300**	7,400
F2006 Call EPAs [5]	1,900	**(1,156)**	744
Clean Power Call	3,500	**(1,214)**	2,286
New BC Hydro supply from Waneta	900	**0**	900
New BC Hydro supply from Site C	4600	**0**	4600
Total forecast supply from existing sources	**60,600**	**(1,070)**	**59,530**
Future supply before new supply adjustments	**11,000**		**23,487**
Current calls for IPP electricity:			
New supply from Standing Offer Program	400	**600**	1,000
New supply from Bioenergy Calls	1,000	**0**	1,000
Total adjustment to future supply	**1,400**	**600**	**2,000**
Future supply after adjustments	62,000	**(470)**	61,530
Forecast supply deficit	**(9,600)**	**11,887**	**(21,487)**

1. F2009 forecast based on BC Hydro 2008 Mid Load Forecast and includes an adjustment of 3,000 GWh for DSM
2. F2010 forecast based on BC Hydro actual domestic load adjusted for residential, commercial, and DSM
3. Burrard Thermal no longer available to supply firm energy and can only b erelied upon for no more than 900 MW of capacity
4. Existing contracts as per BC Hydro 2008 Long-Term Acquisition Plan Application, Table 2-10 and adjusted to reflect F2010 Actual (8,893 GWh less 1,500 GWh reduction as forecast in LTAP)
5. F2006 Call, non-operating EPAs as per BC Hydro 2008 Long-Term Acquisition Plan Application, Table 2-10

Source: BC Hydro, Clean Energy Association of BC

Demand Forecast

- **Demand Side Management (DSM)** - BC Hydro's total source of supply in 2010 is reported as 55,208 annual GWh.[11]

  Clean Energy BC has assumed that the expected load growth to 2020, after DSM, could increase to 61,117 GWh. This assumes an annual compound growth rate of approximately 1.5% on residential and commercial loads after the impact of DSM efficiency savings. Growth is based on the historical experience of residential and commercial customer loads which have been growing at 1.5% and 2.0% respectively after DSM for the past eight years and is expected to continue at a consistent rate. Although the industrial load was depressed in 2010, it is assumed in the forecast that even with the economic recovery, DSM will keep load flat except for the addition of the development opportunities provided below.

- **Allowance for heat and hot water** - The prior forecast assumed increased demand attributable to residential conversion to electric water and space heating however, at present, the demand for fuel switching has declined. Therefore, the revised forecast does not consider residential heating requirements as a primary source of future electrical demand.

- **Northeast Oil and Gas Development** – The demand forecast has been adjusted to take into account the potentially higher demand from the electrification of oil and gas projects in the North East particularly the development of shale gas. A robust estimate of 12,500 GWh has been forecast as demand for oil and gas development increases.

- **Northwest Development** – The Northwest Transmission Line (NTL) is expected to open up the northwest section of the Province to further development especially in the mining sector. Future mining development is expected to add up to 450 MW or 3,000 GWh's of new demand by 2020.

- **Electric Vehicles** - Clean Energy BC has made an allowance for the potential increased use of electric vehicles by 2020. Based on research undertaken by the Pembina Institute, Clean Energy BC estimates that one million electric vehicles will be operating in BC by 2020 that could lift electricity demand by 3,400 GWh.[12]

- **Insurance** – Clean Energy BC has also accounted for the 3,000 GWh required insurance buffer as outlined in the BC Energy Plan.[13]

Clean Energy BC forecasts that electricity demand in 2020 could reach 83,017 GWh by 2020 after taking into account the above adjustments, an increase from the prior year forecast of 11,417 GWh.

Existing, Committed and New Supply

Consistent with the prior year's forecast, on the supply side, Clean Energy BC has assumed that BC Hydro heritage facilities will supply 42,600 GWh's as prescribed for "critical" water as the base supply capacity. Clean Energy BC has included the assumption that until 2015, up to 400 GWh's will be available from the heritage Burrard thermal power plant for emergency back-up capacity and reliability purposes. This follows the direction of the BC Energy Plan and the Throne speech delivered in August 2009. [14, 15]

Additional sources of supply include 500 GWh from BC Hydro's resource smart program resulting from BC Hydro's efforts to identify and implement efficiency gains at existing BC Hydro facilities by modifying,

[11] F2011 RRA Evidentiary Update Exhibit B-8, Appendix 1, July 9, 2010
[12] 2008 Long-term acquisition plan, Evidentiary Update, December 2008, pg 11-12
[13] The BC Energy Plan point 10.
[14] BCUC Order No. G-150-09 for emergency back-up capacity and reliability purposes
[15] The BC Energy Plan point 22.

updating and retrofitting existing generation facilities. Revelstoke 5 is expected to generate 100 GWh of annual firm power.

As provided in BC Hydro's 2008 LTAP application, existing clean energy projects with EPAs and available to supply electricity are forecast to generate approximately 7,400 GWhs, projects from the F2006 Call will be available to generate 744 GWh of electricity, and projects awarded EPAs under the Clean Power Call will be available to generate 2,286 GWh of electricity.

An adjustment for the new supply of power from Waneta at 900 GWh (estimated at one-third of the project output) have also been factored into future supply figures as well as an allowance for new BC Hydro supply resulting from the construction of Site C estimated at 4,600 GWh.

Lastly, Clean Energy BC has adjusted supply for potential electricity to be acquired from the Standing Offer Program and Bioenergy Phase 2 Call estimated by BC Hydro at 1,000 GWh respectively.

Clean Energy BC forecasts that electricity supply in 2020 could reach 61,530 GWh by 2020 after taking into account the above adjustments.

Overall, Clean Energy BC forecasts a supply deficit of 21,487 GWh by 2020, an increase from the prior year forecast of 11,887 GWh, which could be filled by future clean energy projects.

Export Demand Assumptions

Clean Energy BC is continuing to forecast that, as a result of demand arising from accessible export regions in the Western Interconnection, clean energy projects in BC will be able to export 12,000 GWh of electricity to the United States.[16]

This forecast is predicated on the following Clean Energy BC assumptions:

- BC clean energy projects will capture 10% of the 120,000 GWh total legislated renewable portfolio standards requirement across the Western Electricity Coordinating Council (WECC) area[17]
- Construction of transmission capacity will occur to enable greater flow of renewable energy between BC/Alberta, the Pacific Northwest and California
- Canada will establish comparable fiscal incentives for renewable energy sources comparable to U.S. levels
- BC renewable energy sources will be able to shape and firm their typically intermittent and seasonal energy to meet export buyers needs
- The cost of transmission to deliver electricity to export buyers will not be so high as to make BC renewable energy sources uncompetitive

3.3 Summary

Based on the methodology developed in the 2009 report, clean energy projects are grouped into two broad categories: existing clean energy projects, and potential clean energy projects. These categories are defined below.

[16] Participants of the Western Interconnection include 14 western states, Alberta, British Columbia and northern Baja California, Mexico.
[17] Base Case RPS Targets by Region, Terms of Reference, Overview of Export Study, Energy and Environmental Economics Inc., Long-Term Electricity Transmission Inquiry, page 39, August 5, 2009.

Existing Clean Energy Projects

Existing clean energy projects are defined as run-of-river, wind and thermal projects that are currently operating and generating power in BC, including self-generation projects. Similar to the prior year's report, non-BC Hydro large-scale hydro projects are excluded from this analysis. Existing clean energy projects generate roughly 8,210 annual GWh of electricity in British Columbia.

Potential Clean Energy Projects

Potential clean energy projects are defined as run-of-river, wind, and thermal projects that may arise from electricity purchase agreements (EPAs) awarded through previous BC Hydro power calls, projected future EPAs from current BC Hydro power calls and projects assumed to be developed as result of Clean Energy BC's long-run demand forecast. These categories are outlined below:

1. **Projects arising from previous BC Hydro Power Calls**: this category includes clean energy projects that have been granted EPAs through BC Hydro power calls occurring prior to or through the 2008 call but are not yet operational and is approximately 3,796 GWh of electricity.

2. **Projects arising from current BC Hydro Power Calls**: this category includes clean projects that may become operational as a result of the Bioenergy Phase 2 Call, and BC Hydro's Standing Offer Program. These power calls are projected to lead to EPAs for approximately 2,000 annual GWh of electricity.

3. **Additional clean energy projects arising from Clean Energy BC's forecast of future electricity demand**: In addition to clean energy projects defined in categories (1) and (2) above, our understanding is that Clean Energy BC has projected demand for future power generation equalling 33,487 annual GWh by 2020. This consists of an additional 21,487 GWh from future BC Hydro calls and 12,000 GWh through exports of power to the United States.

Table 3.3 summarizes the output (GWh) and capacity (MW) of existing clean energy projects and potential clean energy projects and provides the basis for the economic impacts presented in Section 4.

Table 3.3 Summary of Output and Capacity from Existing and Potential Clean energy projects

Existing and Potential Clean Energy Projects	Category	GWh	MW
Projects from previous BC Hydro Power Calls	2006 and Prior Calls	1,510	517
	2008 Clean Power Call	2,286	818
Projects from current BC Hydro Power Calls	2008 Bioenergy Call 2	1,000	135
	Standing Offer Program	1,000	135
Total demand from current BC Hydro Power Calls		**5,796**	**1,605**
CEBC forecast of future electricity demand	2020 Domestic Demand	21,487	6,018
	2020 Export Demand	12,000	3,361
Total future demand		**33,487**	**9,379**
Total potential projects		**39,283**	**10,984**
Total existing clean energy projects		**8,210**	**1,599**
Total existing and potential projects		**47,493**	**12,583**

4 Economic Impact Analysis

In our study economic impacts were estimated using economic multipliers for BC published by BC Stats. These multipliers represent the effects of a one-time shock to the economy. Impacts arise from direct spending by an industry, as well as through indirect spending via backward linkages (e.g. supply-chains) throughout the BC economy.

This analysis attempts to capture the economic impacts derived from investment in existing and potential BC based clean energy projects. While clean energy projects may produce many qualitative benefits for an economy, the measurement of economic impacts is generally viewed as being restricted to quantitative, well-established measures of economic activity. The most commonly used of these measures are value added (or gross domestic product (GDP)), government tax revenues and employment:

- Value added (GDP) – the "value added" to the economy is the unduplicated total value of goods and services. It includes only final goods to avoid double counting of products sold.
- Government tax revenue – the total amount of tax revenues generated for different levels of government.
- Wages and salaries – the total value of wages and salaries associated with employment impacts.
- Employment – the number of additional jobs created. It represents the number of full-time jobs and is expressed in equivalent person years.

By convention, economic impacts are reported at the direct, indirect, and induced levels. These levels are defined below:

- **Direct impacts** are changes that occur in "front-end" businesses that would initially receive expenditures and operating revenue as a direct consequence of the operations and activities of a project (e.g., the purchase of construction materials or equipment from a local supplier).
- **Indirect impacts** arise from changes in activity by suppliers of the "front-end" businesses (e.g., purchase of merchandise from factory by local business supplying the project).
- **Induced impacts** arise from shifts in spending on goods and services as a consequence of changes to the wages and salaries of the directly and indirectly affected businesses.

The total impact of any given initial expenditure by a project is calculated by adding the direct, indirect and induced impacts.

4.1.1 Regional Impacts

An element of the clean energy industry is that it impacts a diversity of geographic areas. In many cases, clean energy projects are constructed in economically disadvantaged areas of the province, or in areas that have been hit hard by the downturn in the forestry industry. We have estimated economic impacts from clean energy projects within the following BC transmission regions.

- Vancouver Island
- Lower Mainland (includes: Sunshine Coast, Squamish to Pemberton Corridor, Harrison and Lillouet Lake area)
- Kelly/Nicola
- South Interior
- East Kootenay
- Central Interior
- Peace River
- North Coast

Although a clean energy project may be located within a specific region, not all economic impacts arising from the project occur within that region. Some project spending will occur outside of the region in which the clean energy project is located and some spending, particularly on specialized equipment such as wind turbines, will occur outside of the province. We have assumed that BC-based project spending will occur in regions that have an optimal combination of economies of scale (measured by industry share of labour) and transportation cost. For example, spending for professional or technical services is more likely to occur in the Lower Mainland where such services are concentrated. Spending that occurs outside of the province has been excluded from the economic impact calculations.

4.1.2 Data Sources

Data regarding the characteristics of clean energy projects in BC were sourced from BC Hydro and Clean Energy BC. Estimates of future clean energy investments were made by combining information obtained from Clean Energy BC and documents available from BC Hydro.

Economic impacts were estimated using BC Stats input-output multipliers. The composition of capital and operating expenditures used to generate these impacts were based on information for typical projects for each energy type. This information was supplied by Clean Energy BC which was obtained from clean energy company sources.

The methodology and assumptions used in this report follows what was used in the previous PwC report.

4.2 Capital Spending on Clean Energy Projects

The economic impacts in this study are estimated in 2009 dollars. For current clean energy projects, this means that economic impacts reflect the impact of the project at 2009 replacement cost. As this report is meant to update the previous report, 2009 dollars have been used so that comparisons can be made with that report. Key assumptions regarding capital costs used to estimate economic impacts were scaled by installed capacity (Megawatts, MW) for each clean energy type. These assumptions are presented in Table 4.1 and have been reviewed and agreed to by clean energy industry experts.[18]

[18] D.E. Park & Associates, April 2009

Table 4.1 Capital Spending and Installed Capacity by Energy Type

	Small Hydro/Run-of-River	Wind	Thermal	
			Biomass/Energy Recovery	Gas/BioGas
Capital expenditures/MW during construction phase ($2009 million)	$3.5	$3.0	$4.0	$1.5
Existing operations (MW)	798	102	176	523
Estimated capital expenditures at 2009 replacement Cost (millions)	**$2,793**	**$240**[1]	**$704**	**$785**
Total anticipated supply from potential clean energy projects (MW) – net of attrition. [2]	817	521	266	-
Future calls & export demand (MW)[4]	3,571	4,997	811	-
Total potential (MW)	4,388	5,518	1,077	-
Estimated capital expenditures during construction phase ($2009 million)	**$15,358**	**$16,554**	**$4,308**	-

Notes:

1. Estimated Capital Cost of Bear Mountain wind project.
2. Includes projects net of attrition from the F2006 Call, 2008 Clean Power Call, and the Bioenergy Phase 2 Call, and assumptions for the Standing Offer Program based on the composition of applications.
3. Capacity (MW) from future calls is based on Clean Energy BC's long-term forecast assumptions and project inventory. The energy composition of these future calls is based on a Pacific Gas and Electric Company 2008 feasibility study for potential renewable energy generation in BC. (See: *PG&E's Renewable Energy Feasibility Study – Phase One Results, PG&E Media Backgrounder, June 20, 2008.*

Source: D.E. Park & Associates; Clean Energy Association of BC

From the above table, the estimated value of capital investment in existing clean energy projects across BC, at 2009 replacement cost, is estimated to equal $4.5 billion. Capital investment in potential clean energy projects is estimated to equal $36.2 billion in 2009 constant dollars. It should be noted that capital investments are projected to occur over at least a 10-year time period. Also, much of the projected capital expenditure is expected to flow outside of the province due to the specialized nature of capital equipment needed for these projects.

4.3 Construction Phase GDP Impacts

Clean energy projects contribute to provincial GDP during both the construction phase of a project and through ongoing operations.

The construction phase impacts for existing clean energy project operations at 2009 replacement cost are presented at the provincial level, by energy type, in Table 4.2.

Table 4.2. Estimated GDP Impact of Existing Clean Energy Projects – Construction Phase (at $2009 Replacement Cost)

	Small Hydro/Run-of-River	Wind	Thermal	Total
GDP Impact	$938	$75	$883	$1896
Direct	$528	$41	$492	$1061
Indirect and Induced	$410	$34	$391	$835
GDP Impact per MW	$1.2	$0.7	$1.3	$1.2

The estimated GDP impact from the construction of existing clean energy operations is estimated to have been $1.9 billion or $1.2 million per MW at 2009 replacement cost. Most of the impact is estimated to have been generated by run-of-river and thermal projects.

Table 4.3 presents the projected clean energy impacts from potential clean energy projects It is important to note that these impacts are projections of the future and therefore contain an inherent degree of uncertainty. It should also be noted that these impacts are expected to occur over at least a 10 year period.

Table 4.3 Projected GDP Impact of Potential Clean Energy Projects - Construction Phase ($2009 million)

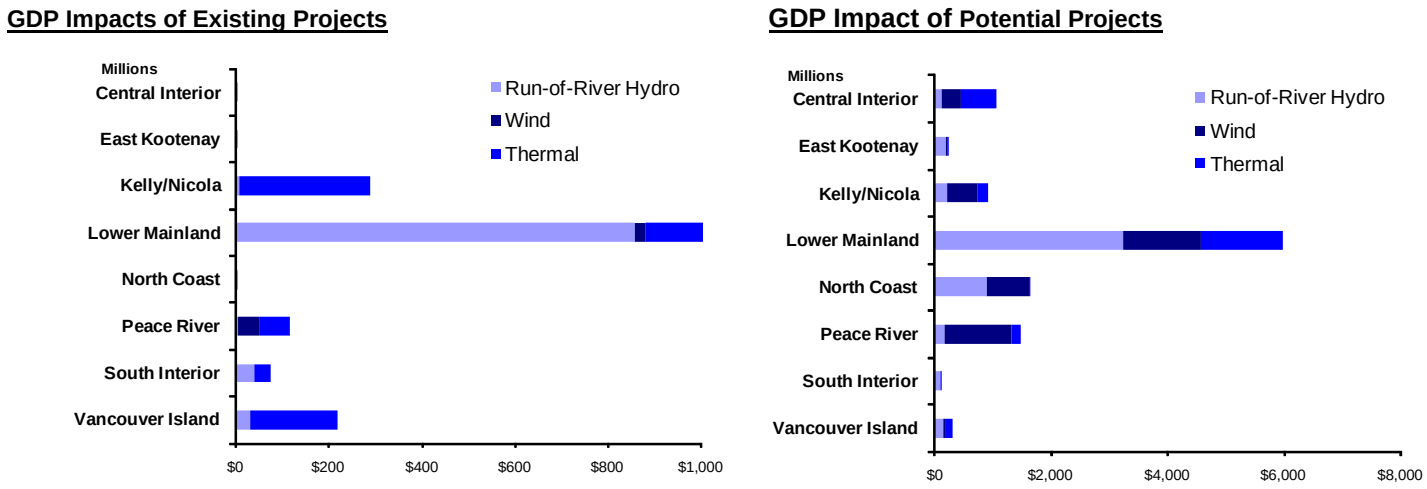
	Small Hydro/Run-of-River	Wind	Thermal	Total
GDP Impact	$5,057	$4,113	$2,549	$11,719
Direct	$2,850	$2,212	$1,419	$6,481
Indirect and Induced	$2,207	$1,901	$1,130	$5,238
GDP Impact per MW	$1.2	$0.7	$2.4	$1.1

The projected GDP impact from the construction of potential clean energy projects is equal to $11.7 billion or $1.1 million per MW. The impacts are projected to be largely generated by run-of-river and wind projects, reflecting the composition of recent BC Hydro clean power calls and BC's renewable energy resource potential. Material impacts arising from investments in biomass and other thermal energy are also reflected in the projections. The estimated GDP per MW for thermal energy is particularly high compared with other energy types because of the higher proportion of in-province capital spending for biomass projects.

4.3.1 Regional GDP Impacts – Construction Phase

Because clean energy projects occur in a diverse array of BC communities, the development of these projects presents a significant opportunity for many regions of the province to magnify and diversify their economic base. Figure 4.1 illustrates how the estimated GDP impacts are distributed across BC.

Figure 4.1 GDP Impact of Clean Energy Projects by Construction Phase by Region



As Figure 4.1 illustrates, the geographic diversity of clean energy projects translates to significant contributions to regional economies across the province. A large portion of the GDP impact is estimated to occur in the Lower Mainland (Sunshine Coast, Squamish to Pemberton Corridor, Harrison and Lillouet Lake area) because of the large number of run-of-river projects proposed for that region, and because a significant amount of overall clean energy project spending on required goods and services occurs within that region.

4.4 Operating Phase GDP Impacts

Upon completion of the construction phase, clean energy projects continue to contribute to the local economy through ongoing operations. The annual GDP impacts of existing and potential clean energy projects are presented in Table 4.4.

Table 4.4 Total Annual GDP Impact from Spending by Clean Energy Projects – Operations Phase ($2009 million)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Existing Operations	$14.7	$1.2	$113.5	$129.4
Potential Operations	$80.1	$63.1	$488.2	$631.4

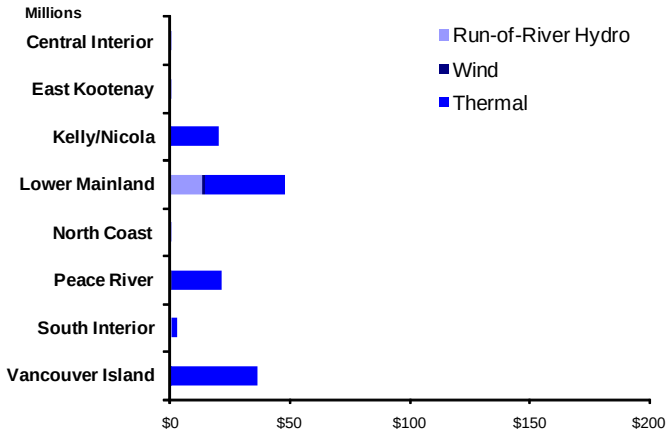
The impacts in Table 4.4 present the total direct, indirect and induced annual GDP impacts created by the operations expenditures of clean energy projects. Thermal projects are estimated to have the largest annual impact during the operating phase due to a high magnitude of spending within BC, particularly for biomass fuel from the BC forestry sector.

4.4.1 Regional GDP Impacts – Operating Phase

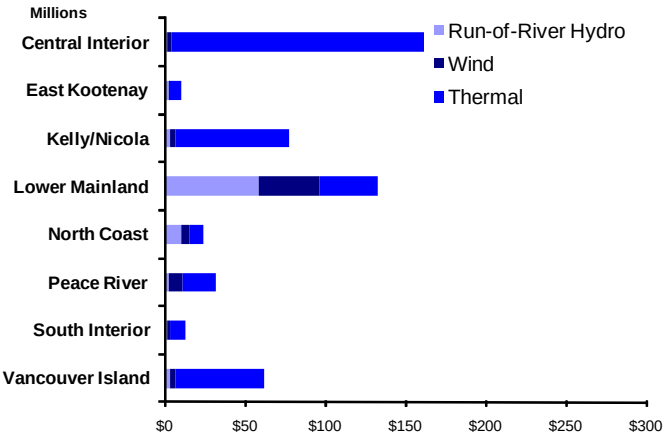
Annual GDP impacts from spending by clean energy operations are illustrated by region in Figure 4.2. Much of the spending on operations is assumed to occur locally, creating a more balanced dispersion of GDP impacts compared with the construction phase.

Figure 4.2 Annual GDP Impact of Clean Energy Project Spending During Operations Phase by Region

Annual GDP Impacts of Existing Operators



Annual GDP Impact of Potential Projects



4.5 Employment Impacts

The majority of employment created by clean energy projects occurs during the construction phase of a project. However, clean energy projects also create ongoing employment from operations. The direct employment impacts, per MW, are presented in Table 4.5, and are estimated using a conservative employment factor that is based on industry averages.[19] All indirect and induced impacts were estimated using BC Stats input-output model multipliers.

Table 4.5 Direct Employment Impacts by Energy Type, per MW

	Small Hydro/Run-of-River	Wind	Thermal	
			Biomass	Gas
Jobs/MW (person years) During Construction Phase	4.0	2.5	4.2	1.7
Jobs/MW (FTEs) During Operating Phase	0.06	0.26	0.5	0.2

Table 4.6 presents estimates of employment generated during the construction phase of existing clean energy projects and represents estimates of the person years of employment generated.

[19] D.E. Park & Associates Report, April 2009. The employment factor used is conservative in that it produces lower impacts than do BC Stats input-output multipliers.

Table 4.6 Estimated Employment Impact of Existing Clean energy projects – Construction Phse

	Small Hydro/Run-of-River	Wind	Thermal	Total
Employment (person years)	9,600	843	7,523	17,966
Direct (person years)	3,190	276	1,628	5,094
Indirect and Induced (person years)	6,410	567	5,895	12,872
Employment per MW	12	8	11	11.2

The total employment impact from the construction phase of existing clean energy projects is estimated to have been almost 18,000 person years of employment. Each of the three energy types involves labour intensive construction phases for each project and therefore are estimated to generate significant direct employment.

Table 4.7 presents the projected employment from potential clean energy projects arising from BC Hydro energy calls and Clean Energy BC forecasts of future long-run electricity demand.

Table 4.7 Projected Employment Impact of Potential Clean Energy Projects – Construction Phase

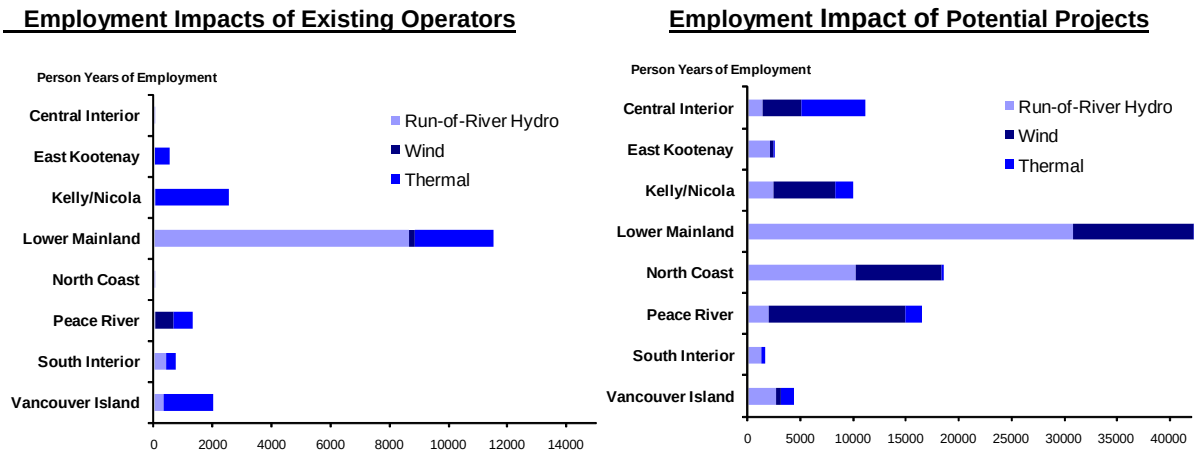
	Small Hydro/Run-of-River	Wind	Thermal	Total
Employment Impact (person years)	52,821	42,725	21,594	117,140
Direct (person years)	17,551	12,440	4,527	34,518
Indirect and Induced (person years)	35,270	30,285	17,067	82,622
Employment per MW	12	8	20	11

Total employment impacts from potential clean energy developments are projected to be approximately 117,000 person years of employment or about 11 person years of employment per MW. The majority of employment is projected to be generated by run-of-river hydro projects and wind projects. However, based on information we have collected, thermal projects (particularly biomass) have a higher portion of BC content in capital expenditures and therefore are estimated to have higher indirect and induced employment impacts.

4.5.1 Regional Employent Impacts – Construction Phase

In assessing employment impacts across regions, we have made the key assumption that construction employment is largely drawn from the local region. It may be the case that workers live outside of the region most of the year, however, we have assumed that these individuals stay within the region for the duration of their employment on the project and spend a portion of their wages locally. Therefore they are treated as temporary residents of the region. Regional employment impacts are illustrated in Figure 4.3.

Figure 4.3 Regional Employment Impacts of Clean Energy Projects During Construction Phase, Person Years of Employment



4.5.2 Operating Phase Impacts

In addition to the construction phase impacts presented in Tables 4.6 and 4.7, clean energy operations are estimated to generate ongoing employment impacts. The employment impacts of ongoing operations are considered to be permanent full-time jobs. In addition to jobs that relate directly to operating the facility, other employment arises from direct spending by clean energy projects for things such as road maintenance and vegetation maintenance on transmission lines.

Table 4.8 Annual Employment Impacts from Clean Energy Projects– Operations Phase

	Small Hydro/ Run-of-River	Wind	Thermal	Total
Existing Operations (FTE)	**248**	**52***	**1,511**	**1,811**
Direct Employment	48	31	193	272
Employment Supported by Operating Expenditures	200	21	1,318	1,539
Potential Operations (FTE)	**1,563**	**2,406**	**7,720**	**11,689**
Direct Employment	263	569	3,965	4,797
Employment Supported by Operating Expenditures	1,300	1,837	3,755	6,892

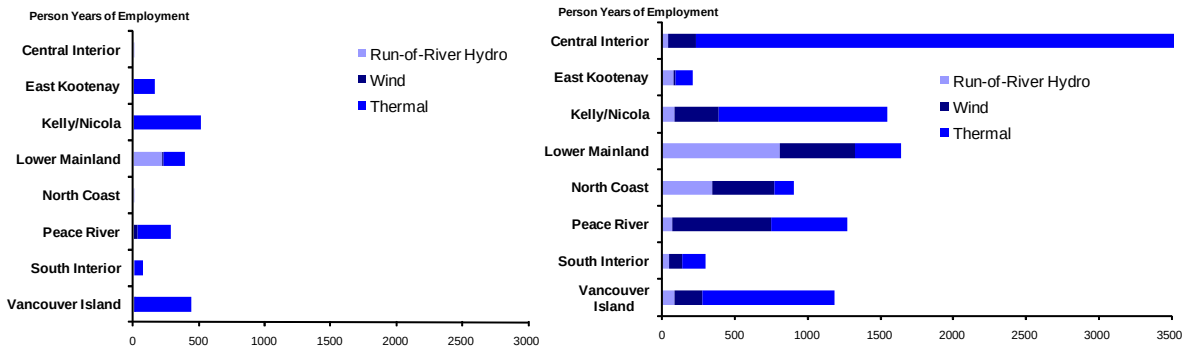
Note: Direct impacts for wind projects during operations phase are estimated to be higher than indirect impacts due to assumed out-of-province spending for operations, maintenance and financing costs.

As shown in Table 4.8, the operations of existing clean energy projects support a significant amount of employment in the province while potential clean energy projects would generate even larger employment impacts.

4.5.3 Regional Employent Impacts - Operating Phase

Regional employment impacts generated or supported by the operating expenditures of clean energy projects are shown in Figure 4.4.

Figure 4.4 Regional Employment Impacts of Clean Energy Projects During Operating Phase, Full Time Equivalents (FTEs)



We have assumed that much of the employment during the operating phase of a clean energy project will be sourced locally. Therefore, employment impacts generated by clean energy projects are assumed to be spread throughout BC. The regional diversity of the demand for labour from potential clean energy projects could translate to enhanced employment and training opportunities for individuals living in remote communities and for First Nation communities.

4.6 Government Taxation Revenue Impacts

Clean energy projects generate tax revenues for all levels of government both during the construction phase and through ongoing operations. These tax revenues include corporate income taxes, personal income taxes, property taxes and special taxes such as water rentals paid by run-of-river operations.

Table 4.9 presents estimated government tax revenues generated during the construction phase of existing clean energy projects.

Table 4.9 Estimated Government Tax Revenues from Existing Clean Energy Projects – Construction Phase ($2009 million)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Government Tax Revenues	$172	$15	$191	$378
Federal	$76	$6	$98	$180
Provincial	$77	$7	$79	$163
Municipal	$19	$2	$14	$35

Government tax revenues, accruing to all levels of government, attributable to expenditures during the construction phase of existing clean energy projects are estimated have been $378 million. Payments to

the federal government are estimated to have been $180 million, $163 million is estimated to have gone to the Province, and $35 million is estimated to have accrued to municipal governments across BC.

Table 4.10 outlines government taxation revenue projected to result from investment in potential clean energy projects.

Table 4.10 Projected Government Taxation Revenues from Potential Clean Energy Projects – Construction Phase ($2009 million)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Government Tax Revenues	$927	$848	$551	$2,326
Federal	$408	$346	$283	$1,037
Provincial	$418	$418	$228	$1,064
Municipal	$101	$84	$40	$225

Tax revenues generated from the construction of potential clean energy projects are projected at $2.3 billion. Approximately $1.0 billion in government revenues are projected to accrue to the federal government, $1.1 billion is projected to flow to the Province, and $225 million is projected to be paid to municipal governments across BC.

4.6.1 Operating Phase Impacts

Clean energy projects generate taxes paid directly to all levels of government and include corporate income taxes, personal income taxes paid by employees, property taxes and energy specific taxes such as water rentals.

Estimates of direct tax payments to all levels of governments are presented in Table 4.11. It should be noted that these are estimates based on simplifying assumptions and may differ from actual results.

Estimating the corporate and personal income taxes for clean energy firms is challenging since some of the technology applications are relatively new in British Columbia and therefore there is little historical data from which to calculate reliable measures of income taxes generated by the industry.

To estimate direct annual corporate and personal income tax payments from clean energy projects, some necessary and simplifying assumptions were made. For example, to estimate personal income taxes paid by direct employees of clean energy projects, we have assumed that the average wage in the clean energy industry will be competitive with average wages for the utility industry in BC. Furthermore, estimates of corporate income taxes assume that the clean energy operations are profitable, though in practice these operations may take several years to generate positive earnings. Other taxes such as property taxes and water rentals have been estimated based on data collected from individual clean energy projects.

Table 4.11 Annual Direct Tax Payments by Clean Energy Projects – Operations Phase ($2009 millions)

	Small Hydro/Run-of-River	Wind	Thermal	Total
Existing Clean Energy Operations	**$55.5**	**$5.4**	**$106.4**	**$167.3**
Federal	$25.6	$3.2	$52.9	$81.7
Provincial	$24.8*	$2.1	$34.9	$61.8
Municipal	$5.1	$0.11	$18.6	$23.8
Potential Clean Energy Operations	**$280.2**	**$291.7**	**$178.4**	**$750.3**
Federal	$128.5	$173.0	$90.4	$391.9
Provincial	$125.9	$112.8	$59.3	$298.0
Municipal	$25.8	$5.9	$28.7	$60.4

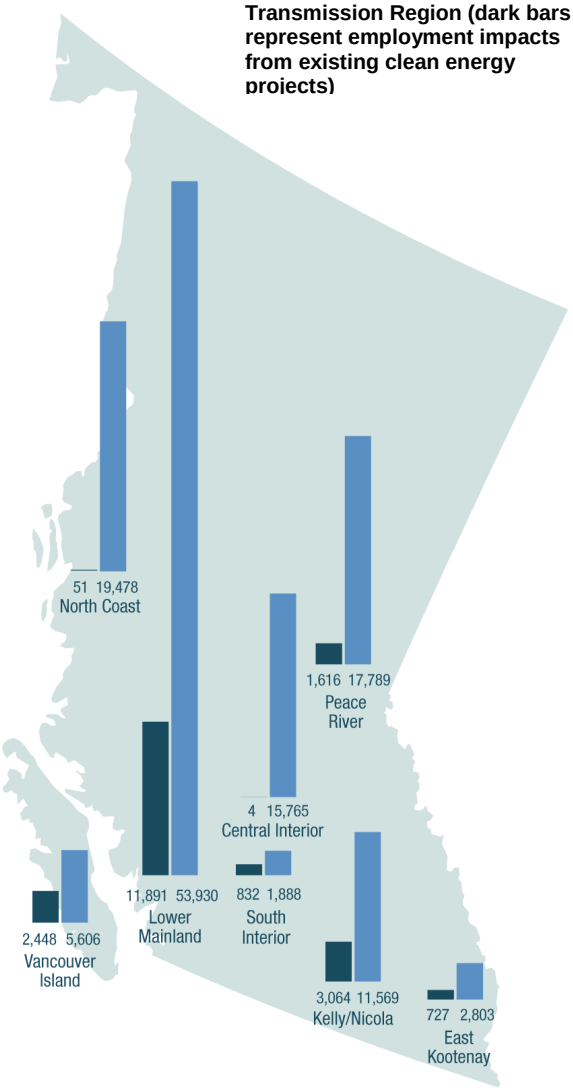
* Includes water rentals

5 Community Economic Benefits

BC Communities

In addition to economic impacts clean energy projects may generate broader economic benefits. In this section we describe some of these benefits. In Figure 5.1, estimated employment impacts are presented for the construction and operation of existing and potential projects by BC Transmission Region. Employment impacts illustrated combine person-years of employment from construction projects with Full Time Equivalent (FTE) employment related to operating conditions.

Figure 5.1 Employment Impacts by BC Transmission Region (dark bars represent employment impacts from existing clean energy projects)



5.1.1 Employment Benefits

Many clean energy projects are located in remote locations of BC that are at present economically disadvantaged. This is especially true for communities that have historically relied on the forestry industry as a significant employer. Figure 5.1 illustrates the geographic distribution of estimated clean energy projects employment impacts for existing and potential projects.

Because many of the skills required in the forestry industry are transferrable to the clean energy industry, clean energy projects may provide an employment stimulus to economically depressed regions of BC. Examples of roles and jobs that cross over from existing BC industries to work on clean energy projects include:

5.1.2 Benefits to First Nations

Clean energy projects can have a significant impact on First Nations as many clean energy projects are constructed on traditional First Nation territories. In many instances, First Nations benefit economically from clean energy projects through negotiation of Impact and Benefit Agreements with the clean energy projects. These agreements can contain a wide range of provisions including education and training, employment, contracting, revenue sharing, business development and social / cultural measures.

5.1.3 Other Benefits from clean energy Projects

Clean energy projects also contribute to provincial energy self-sufficiency, have zero or reduced greenhouse gas emissions compared to coal-fired or other fossil fuel electricity generation and use renewable energy technologies to generate electricity.

Appendix A - Data Sources

BC Hydro, *BC Hydro Annual Report 2010*

BC Hydro, *BC Hydro Service Plan 2009/10-2011/12*

BC Hydro, F2011 Revenue Requirement Application, Exhibit B-8, July 9, 2010

BC Hydro: 2010: *Clean Power Call Request for Proposals, Report on the RFP Process*, August 2010

Clean Energy Act, Province of British Columbia, 2010

D.E. Park and Associates, *Economic Impact of Independent Power Projects in British Columbia*, 2009

Ministry of Energy, Mines and Petroleum Resources: *The BC Energy Plan: A Vision for Clean Energy Leadership, 2007*

Ministry of Energy, Mines and Petroleum Resources: *Summary of Shale Gas Activity in Northeast British Columbia 2008/09*

Pacific Gas and Electricity Company: 2008, *BC Renewable Study Phase 1.*

Pembina Institute, *Electric Vehicles, Powering the Future*, Backgrounder, September 2010

PricewaterhouseCoopers, *Economic Impact Analysis of Independent Power Projects in British Columbia,* December 2009.

Appendix B – Clean Energy Projects

Clean Energy Projects in BC	Company	Location	Energy Type	EPA Year	MW	GWH
Coats IPP	Crofter's Gleann Enterprises Ltd.	Gabriola Island	Non-Storage Hydro	1985 Negotiated EP/	0.5	1
NWE Williams Lake WW	NW Energy (Williams Lake) LP	Williams Lake	Biomass	1988 > 5 MW	68	545
McMahon Generating	McMahon Cogeneration Plant JV	Taylor	Gas Fired Thermal	1988 > 5 MW	105	840
Mamquam Hydro	Coastal Rivers Power LP	Squamish	Non-Storage Hydro	1988 > 5 MW	58	250
Akolkolex	Canadian Hydro Developers, Inc.	Revelstoke	Non-Storage Hydro	1989 < 5 MW	8	50
Boston Bar Hydro (Scuzzy Creek)	Boston Bar Limited Partnership	Boston Bar	Non-Storage Hydro	1989 < 5 MW	6	38
Brown Lake Hydro	CP Renewable Energy (B.C.) Limited Partne	Prince Rupert	Non-Storage Hydro	1989 < 5 MW	7	57
Doran Taylor	Doran Taylor Hydro (JV partnership)	Port Alberni	Non-Storage Hydro	1989 < 5 MW	6	23
East Twin Creek Hydro	Valemount Hydro LP	McBride	Non-Storage Hydro	1989 < 5 MW	2	6
McDonald Ranch	McDonald Ranch & Timber Co. Ltd.	Grasmere	Non-Storage Hydro	1989 < 5 MW	0.5	0.5
Morehead Creek	Morehead Valley Hydro Inc.	Williams Lake	Non-Storage Hydro	1989 < 5 MW	0.5	0.5
Robson Valley (Ptarmigan Creek - R	Robson Valley Power Corp	McBride	Non-Storage Hydro	1989 < 5 MW	4	26
Salmon Inlet (Sechelt Creek SCG)	Clean Power Operating Trust	Sechelt	Non-Storage Hydro	1989 < 5 MW	17	68
Seaton Creek Hydro (Homestead)	Homestead Hydro Systems	New Denver	Non-Storage Hydro	1989 < 5 MW	0.5	1
Soo River	Soo River Hydro	Whistler	Non-Storage Hydro	1989 < 5 MW	13	65
Walden North	Walden Power Partnership	Lillooet	Non-Storage Hydro	1989 < 5 MW	18	54
ICG - Island Cogeneration No. 2. Inc	Island Cogeneration No. 2 Inc.	Campbell River	Gas Fired Thermal	1994 RFP	275	2300
Arrow Lakes Hydro	Arrow Lakes Power Corporation	Slocan	Storage Hydro	1998 Negotiated EP/	185	767
Hartland Landfill Gas Utilization	Maxim Power Corp.	Saanich	Biogas	2000 RFP	2	15
Hystad Creek Hydro	Valemount Hydro LP	Valemount	Non-Storage Hydro	2000 RFP	6	20
Miller Creek Power	CP Renewable Energy (B.C.) Limited Partne	Pemberton	Non-Storage Hydro	2000 RFP	30	118
Vancouver Landfill Gas Utilization -	Maxim Power (BC) Inc.	Delta	Biogas	2001 < 40 GWh	6	40
Brandywine Creek Small Hydro	Rockford Energy Corp.	Whistler	Non-Storage Hydro	2001 < 40 GWh	8	34
Eagle Lake C2 Micro Hydro	Pacific Cascade Hydro Inc.	West Vancouv	Non-Storage Hydro	2001 < 40 GWh	0.5	1
Furry Creek	Furry Creek Power Ltd	Lions Bay	Non-Storage Hydro	2001 < 40 GWh	10	40
Hauer Creek (aka Tete)	Hauer Creek Power Inc.	Valemount	Non-Storage Hydro	2001 < 40 GWh	2	13
Marion 3 Creek	Marion Creek Hydro Inc.	Port Alberni	Non-Storage Hydro	2001 < 40 GWh	5	18
McNair Creek Hydro	McNair Creek Hydro Partnership	Sechelt	Non-Storage Hydro	2001 < 40 GWh	10	38
Mears Creek	Synex Energy Resources Ltd	Gold River	Non-Storage Hydro	2001 < 40 GWh	4	20
South Sutton Creek	South Sutton Creek Hydro Inc.	Port Alberni	Non-Storage Hydro	2001 < 40 GWh	5	26
Raging River 1 Small Hydro	Raging River Power & Mining Inc.	Port Alice	Storage Hydro	2001 < 40 GWh	2	13
Pingston Creek	Pingston Creek Hydro Joint Venture	Revelstoke	Non-Storage Hydro	2001 > 40 GWh	45	193
Rutherford Creek Hydro Project	Rutherford Creek Power Ltd.	Pemberton	Non-Storage Hydro	2001 > 40 GWh	50	172
Upper Mamquam Hydro	Canadian Hydro Developers, Inc.	Squamish	Non-Storage Hydro	2001 > 40 GWh	25	108
SEEGEN (Burnaby Incinerator)	Covanta Burnaby Renewable Energy, Inc.	Burnaby	Municipal Solid Was	2002 CBG	22	131
Vancouver Landfill Gas Utilization -	Maxim Power (BC) Inc.	Delta	Biogas	2003 GPG	2	15
Ashlu Creek Water Power	Ashlu Creek Investments LP	Squamish	Non-Storage Hydro	2003 GPG	50	269
China Creek Small Hydroelectric	Upnit Power Limited Partnership	Port Alberni	Non-Storage Hydro	2003 GPG	6	25
South Cranberry Creek Power Proje	Advanced Energy Systems Ltd.	Revelstoke	Non-Storage Hydro	2003 GPG	9	33
Brilliant Expansion 1 & 2	Brilliant Expansion Power Corporation	Castlegar	Storage Hydro	2003 GPG	121	428
Zeballos Lake	Zeballos Lake Hydro Limited Partnership	Zeballos	Storage Hydro	2003 GPG	22	93
Alcan Long Term Electricity Purchas	Rio Tinto Alcan	Kitimat	Storage Hydro	2007 Negotiated EP/	896	1945
Kamloops Green Energy	Domtar Pulp and Paper Products	Kamloops	Biomass	2008 Bio Energy	76	201
PGP Bio Energy Project	Canfor Pulp Ltd. Partnership	Prince George	Biomass	2008 Bio Energy	60	85
Cedar Road LFG Inc.	Cedar Road LFG Inc.	Nanaimo	Biogas	2008 SOP	1	6
Canoe Creek Hydro	Canoe Creek Hydro Company	Ucluelet	Non-Storage Hydro	2008 SOP	6	16
Cypress Creek	Synex Energy Resources Ltd	Gold River	Non-Storage Hydro	2008 SOP	3	12
Fitzsimmons Creek	Fitzsimmons Creek Hydro Limited Partnersh	Whistler	Non-Storage Hydro	2008 SOP	8	36
Armstrong Wood Waste Co-Gen (R'	Tolko Industries Ltd.	Armstrong	Biomass	2009 Negotiated EP/	20	163
Skookumchuk Power Project	Tembec, a general partnership	Skookumchuck	Biomass	2009 Negotiated EP/	51	206
Savona ERG	EnPower Green Energy Generation LP	Savona	Energy Recovery	F2006 CFT	6	41
150 Mile House ERG	EnPower Green Energy Generation LP	150 Mile House	Energy Recovery	F2006 CFT	6	34
East Toba and Montrose	Plutonic Power Corporation	Powell River	Non-Storage Hydro	F2006 CFT	196	702
Kwalsa Energy	Harrison Hydro LP	Mission	Non-Storage Hydro	F2006 CFT	90	384
Lower Clowhom	Hydromax Energy Ltd.	Sechelt	Non-Storage Hydro	F2006 CFT	10	48
Upper Clowhom	Hydromax Energy Ltd.	Sechelt	Non-Storage Hydro	F2006 CFT	10	45
Upper Stave Energy	Harrison Hydro Limited Partnership	Mission	Non-Storage Hydro	F2006 CFT	55	264
Eldorado Reservoir	District of Lake Country	Kelowna	Storage Hydro	F2006 CFT	1	4
Tyson Creek Hydro	Tyson Creek Hydro Corp.	Sechelt	Storage Hydro	F2006 CFT	9	53
Bear Mountain Wind Park	Bear Mountain Wind Limited Partnership	Dawson Creek	Wind	F2006 CFT	102	220