Opportunities and Challenges for Renewable Energy Development in British Columbia:

Policy Instruments to Reduce Greenhouse Gas Emissions in the Provincial Electricity Sector

Honours Thesis: Final Report
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1.0 Introduction:

Climate change is one of the most challenging and complex issues facing the world this century. Over the last decade, there has been significant international discussion and debate over the need to slow the rate of climate change by reducing greenhouse gas emissions. Provincial energy policy makers will have to meet the challenges of this new period through new planning strategies that are substantially different from the energy decisions of the last century.

British Columbia is at a crossroads in its provincial energy development process and its contribution to a national climate change strategy. The provincial government faces economic challenges from its traditional resource sector due to the collapse of the west coast salmon fishery, the ongoing softwood lumber dispute, and aboriginal and environmental uncertainty in the mining sector. Currently, the government is looking to expand development in other resource sectors such as its coal, oil and natural gas reserves to create new economic opportunities in the provincial energy sector. Meanwhile, the federal government is also moving towards ratifying the Kyoto Protocol by the end of 2002.

In August 2001, Premier Gordon Campbell established a Task Force to develop an energy policy framework for British Columbia. This framework was designed to assess the potential for the development of provincial energy resources to meet the economic needs of British Columbia. Upon the release of its interim report in November 2001, the task force primarily recommended the further development of resources such as coal, natural gas and oil to meet provincial energy needs. This created a strong public debate over which direction the provincial government should follow to create economic opportunity and strive to reduce greenhouse gas emissions.

After the task force consulted with stakeholders and the public, the final report was submitted to the Minister of Energy and Mines on March 15, 2002. It contained 46 recommendations in the areas of conservation and energy efficiency, alternative energy, electricity, oil and natural gas, coal and regulation. The recommendations support a series of policy directions that include developing new energy supplies, making markets more competitive, reforming the electricity sector, ensuring sound environmental decisions and harmonizing regulations. The provincial government released its comprehensive energy policy in a document entitled: “Energy for Our Future: A Plan for BC” on November 25, 2002 (Government of British Columbia, 2002). The provincial government reports that its energy policy will be fully implemented by 2004. A full analysis of the final energy policy and new strategies remains beyond the scope of this report because they are subject to continuous change over the next two years.

Throughout the consultation process, environmental groups such as the David Suzuki Foundation, Pembina Institute and the Canadian Center for Policy Alternatives, outlined several ways to reduce emissions and to explore alternative energy strategies to create economic opportunities amidst international pressures to mitigate climate change. These groups have been advocating for the energy policy to include renewable energy sources such as small hydro, wind, wave and biomass. Opponents to the increased development of fossil fuels maintain it will lead to new power plants, pipelines and gas processing facilities resulting in greater air pollution, greenhouse gas emissions and volatile energy prices. They contend that working to reduce greenhouse gas emissions in British Columbia will not only help prevent climate change but will also provide environmental, social and economic benefits.

The purpose of this report is to identify and discuss some potential policy instruments for increasing the generation of electricity from small and medium scale renewable energy sources. It will focus upon the potential tools and challenges to mitigate climate change and reduce greenhouse gas emissions. It will also evaluate some of the key recommendations from environmental groups through a literature review and interviews with representatives from the provincial and federal governments and BC Hydro. As a result, this report will discuss the following key topics to encourage the development of provincial green energy projects:

- Policy tools to reform the price of electricity that will allow all forms of generation to compete in an equal operating environment.
- Implementing a voluntary or legislated renewable portfolio standard that would require electricity providers to include a growing percentage of renewable generation in the provincial supply.
- Net metering as a possible mechanism to support the deployment of small-scale, distributed renewable technologies in British Columbia.

The use of renewable energy should be an important component in a larger provincial reduction strategy that also considers other reduction options (Berry, 2001). It should be noted that the policies discussed in this paper represent only a small portion of the total options available for reducing emissions in the provincial electricity sector. However, before these policy instruments will be discussed, it is important to understand the international climate change debate, possible national and provincial implications, and the challenges associated with the existing electricity generation systems in British Columbia.

2.0 Climate Change

There is a strong consensus in the international scientific community that climate change is occurring and the impacts are already being felt in some regions. In its Third Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) projects an increase in globally averaged air temperatures from between 1.4 to 5.8 degrees Celsius in the next century (IPCC, 1996). Environmental groups in British Columbia argue that the drive towards greater fossil fuel production and consumption is rapidly increasing provincial greenhouse gas emissions and our economic dependence on fossil fuels. They report that an effective response involves the reduction of greenhouse gas emissions through new strategies in every economic sector of activity. Similar reduction efforts can be made in other sectors such as transportation or industrial sectors; however, this analysis will only focus on the energy sector in British Columbia. Before discussing the proposals to reform the British Columbia electricity sector, it is important to analyze the aspects of climate change to understand the nature of the provincial debate.

Human activities, particularly the use of fossil fuels like coal, oil and natural gas to supply the world energy demands, are largely responsible for climate change. Gases such as carbon dioxide, methane, and nitrous oxide trap heat in the atmosphere to produce a natural greenhouse effect to sustain life on earth. The combustion of fossil fuels, however, is dramatically increasing the atmospheric concentration of these gases. This is magnifying the greenhouse effect and the result is climate change (Hornung, 1998).

One of the key elements of climate change is global warming. The Pembina Institute reports that even though global warming temperatures have "always fluctuated according to natural activities, temperature records show a historically unprecedented upward trend in average global temperatures from 1860 to 1998" (Hornung, 1998). Based on direct measurements, the world's average temperature has risen by almost one degree during the past 135 years. The Canadian Center for Policy Alternatives reports that the year 2001 was the twenty-third consecutive year that global temperatures were above average. The odds of this occurring naturally are over 8 million-to-one (Marshall, 2002).

2.1 Climate Change and Canada

Over the last decade, there has been significant international discussion on the most appropriate methods to slow down the rate of climate change by reducing greenhouse gas emissions. At the 1997 Kyoto Conference, Canada agreed to reduce greenhouse gas emissions by six per cent below 1990 levels by 2012. The Kyoto Protocol commits its signatory parties to the development of national action programs that include measures to mitigate climate change and to facilitate adaptation to climate change. The greenhouse gases that have been added to the atmosphere will likely continue to drive global climate change for centuries to come and require British Columbia and other jurisdictions to adapt. As a result, the federal, provincial, and territorial governments will have to develop a national impact and adaptation framework to meet reduction targets (Fraser, 2002).

On a per capita basis, Canada is one of the largest producers of greenhouse gas emissions in the world. In 1990, Canada's per capita emissions of all greenhouse gas emissions were equivalent to 21.5 tonnes of carbon dioxide per person, but in 1997, this increased to 22.7 tonnes. In 1996, British Columbia's per capita emissions were about 16 tonnes per person. This is a sharp contrast to the global average of 3.8 tonnes per person. The David Suzuki Foundation maintains that the primary responsibility for reduction efforts lie with the developed nations with high levels of energy consumption (Foley, 1998).

2.2 Climate Change in British Columbia

Climate change has already been detected in British Columbia. According to the David Suzuki Foundation, coastal temperatures have increased by about 0.6 degrees Celsius over the past century. In addition, the interior has warmed by over 1 degree, which is twice the rate of the global average. Due to the mid-latitude location of the province, it can be expected that British Columbia will continue to follow this trend in relation to global average temperature. In the short term, the Lower Fraser Valley may experience some of the largest climate change impacts in southern British Columbia. Climate model predictions suggest that warmer, drier weather in the summer will produce periods of hot, stagnant weather, resulting in more severe smog episodes (Foley, 1998).

In addition to increased air pollution, climate change may also affect the way air pollution disperses through the atmosphere because of its impact on air currents and heating patterns (Foley, 1998). Climate change will also change water levels, temperatures and peak flow timing for rivers and streams, leading to further pressures on already critically threatened species, such as salmon, and the communities that depend on them. For example, the Fraser River, one of Canada's biggest salmon producers, often reaches temperatures of 21-22 degrees while the salmon are returning to spawn. For sockeye salmon, warm years are associated with "increased juvenile mortality, increased competition and reduced spawning success" (Fraser, 2002, p. 35). This is just one of many examples that prove the provincial impacts of climate change are interconnected with social, economic and environmental consequences.

2.3 Provincial Greenhouse Gas Emissions

British Columbia, which comprises 13 per cent of Canada's population, is responsible for approximately nine per cent of Canada's emissions. The largest components of energy and process related emissions in 1997 were: commercial and industrial operations which produced 24 per cent; oil and gas production and distribution with 17 per cent; and a further three per cent for electricity, which was produced to power these sectors; freight transportation which produced 12 per cent; personal motor vehicles accounted for 16 per cent and residential buildings with 8 per cent (Foley, 1998).

In 1995, British Columbia committed to stabilize greenhouse gas emissions at 1990 levels by the year 2000. However, the province missed this target significantly when emissions grew from 51.2 million tonnes in 1990 to 61.9 million tonnes by 1997. Energy related emissions and emissions from industrial processes accounted for 54 million tonnes of that total. BC Hydro accounts for one per cent of the total emissions from Canada's electricity sector, which equates to 0.2 per cent of the national greenhouse gas emissions total (BC Hydro Greenhouse Gas Report, 2001). As a result of increases in residential, industrial and commercial consumption, BC Hydro is projecting that overall electricity use in British Columbia will grow by 30 per cent between 1998 and 2015 (Foley, 1998).

3.0 BC Hydro Utility Operations

Over the years, the electricity industry has developed primarily within provincial boundaries; most of the regulation of the industry is under provincial control. Traditionally, the market structures of the electricity sector are usually controlled by a vertically integrated monopoly through public ownership or regulated private ownership. In British Columbia, electricity is produced mostly from hydroelectric facilities. BC Hydro, a provincial crown corporation, is the largest electricity provider in the province, accounting for more than 90 percent of production. It also owns and operates most of the transmission and distribution systems in the province. West Kootenay Power is a smaller utility that operates generation, transmission and distribution in the vicinity of Trail, Nelson and the Okanagan Valley. The operations of BC Hydro and West Kootenay Power are both regulated by the B.C. Utilities Commission (National Energy Board, 2001). However, due to the complexity of the topic, this paper will only focus on BC Hydro operations to discuss renewable energy development.

BC Hydro is the third largest electrical utility in Canada and one of the leading producers of hydroelectricity in North America. The crown corporation's primary business activities are the generation, transmission, and distribution of electricity. At present, the company serves more than 1.6 million residential, commercial and industrial customers in an operating area that contains 94 per cent of British Columbia's population. It operates 30 hydroelectric facilities and 36 reservoirs in seven major river basins and 17 small river basins with most hydroelectric generating capability originating in the Peace and Columbia river systems (BC Hydro Triple Bottom Line Report, 2002). The company also operates two thermal generating plants to augment hydroelectric production and a small number of diesel-generating stations to provide local power to remote areas in the province.

3.1 BC Hydro Natural Gas Strategy

While electricity has been historically produced with hydropower, BC Hydro is now developing natural gas pipelines and gas-fired turbines to generate more electricity. Due to the limited prospects for developing new large-scale hydro projects, natural gas provides the next available option to meet incremental growth in generation capacity. For example, the population on Vancouver Island has grown by 20 percent since 1991, which has created more demand for electricity. Most of the electricity is supplied from generation on the mainland via submarine cables, some of which are now 45 years old. These cables are due for retirement and BC Hydro has determined that new electricity supply to replace them will be needed by 2004. As a result, new generation facilities will be needed to meet regional and eventually provincial supply (Government of British Columbia, 2002).

According to the David Suzuki Foundation, combined-cycle gas turbines are a relatively new development in power generation. The technology consists of one or more large gas turbines fuelled by natural gas or oil distillates, in combination with a secondary steam unit that captures much of the excess exhaust heat. The secondary steam is used to power a turbine, and both the gas and steam turbines drive an electrical generator on a common shaft. Combined-cycle technology offers many competitive advantages over other conventional power plants through higher thermal efficiencies, lower fuel costs and efficient construction. Rather than being designed and assembled on site for each power plant, the various components are pre-assembled in modules at the factory and transported for easy installation. In addition, more units can be added as demand increases. The modularity and pre-assembly features of the components allow utilities to select a manufacturer, model and capacity suitable to their projected energy market opportunities, without waiting for engineers to design each new plant (Foley, Hertzog, Scott, 2001).

The David Suzuki Foundation reports that, over the last decade, electric utilities have moved towards a natural gas strategy to plan for additional electricity supply. In anticipation of entering competitive electricity markets, utilities have minimized long-term capital investment costs through new additions to natural gas combustion turbines, which have low capital costs. In addition, utilities have been able to plan natural gas purchases through short and long-term contracts to mitigate price fluctuations. On the western electrical system, there is approximately 24,000 megawatts of new natural gas generating capacity under construction or recently completed (Foley, Hertzog, Scott, 2001).

As previously discussed, BC Hydro generates most of its 11,688 megawatts of electricity from hydroelectric facilities, which are backed by a series of large dams and storage reservoirs. The natural gas-fired Burrard generating station serves as BC Hydro's main thermal facility, which is capable of supplying 12 per cent of the total supply (BC Hydro, Integrated Electricity Plan Update, 2000).

In recent years, BC Hydro has developed a policy to meet 90 percent of new demand by burning natural gas in combined-cycle generating plants. In order to develop this strategy, BC Hydro has partnered with independent power producers to build two new 240 megawatt gas-fired plants on Vancouver Island. One example is the Island Cogeneration Project near Campbell River, which is a combined-cycle plant expected to commence commercial operation later this year. Another generation facility near Port Alberni is planned for completion in 2003. (National Energy Board, 2001). A third plant, which could be as large as 600 megawatts, has also been proposed for Vancouver Island. Although the location has not been specified, BC Hydro has stated that a location near Duncan would be sufficient (Foley, Hertzog, Scott, 2001).

BC Hydro is also partnering with Williams Pipelines to build the GSX natural gas pipeline across the Strait of Georgia. This pipelines measures 41 centimeters in diameter and will run 137 kilometers from Cherry Point in Washington State to connect with the existing Centra Gas line at Cobble Hill on Vancouver Island. The GSX Pipeline will provide natural gas to supply the new facilities (Foley, Hertzog, Scott, 2001).

Environmental groups argue that this strategy will increase greenhouse gas emissions, contribute to local air pollution and put pressure on the cost of electricity and natural gas. They also believe that additional natural gas fired plants would "restrict the provincial government's ability to benefit fiscally from the emerging post-Kyoto energy market and adversely affect provincial business, industrial and consumer energy costs" (Foley, Hertzog, Scott, 2001, p. 11).

A study conducted in 1998 by the David Suzuki Foundation estimated that the development of new gas plants would increase greenhouse gas emissions from about 600,000 tonnes per year in 1990 to nearly 6 million tones by 2015 (Foley, 1998). However, these numbers have increased significantly over the last four years. BC Hydro's greenhouse gas emissions totaled 2.3 million tones in 2000, which represents a 63 per cent increase from 1999 (BC Hydro Greenhouse Gas Report, 2001). By 2001, the total emissions had tripled to 6.7 million tonnes. This was largely because of low water levels in the major reservoirs, which required the company to increase operation from existing provincial facilities and import more power from non-hydro sources (BC Hydro Triple Bottom Line Report, 2002). The final total includes emissions from its generation facilities, independent power producers who sell to BC Hydro, other jurisdictions, motor vehicle use, space heating at office buildings, and losses from transmission equipment.

In addition to BC Hydro's natural gas strategy, the province is also considering coal as a viable option to provide employment and generate power. Historically, coal-fired generation has not been used to generate power in British Columbia because of the primary reliance on hydroelectric and natural gas sources. However, for some large industrial consumers, coal became an economically attractive alternative when natural gas prices increased significantly in 2000 and 2001. Further volatility in natural gas prices has increased pressure to consider it as an energy alternative (Government of British Columbia, 2002).

The coal industry has requested that air emission standards for coal-fired boilers be consistent with those adopted in Alberta. The energy policy concludes that this will provide more certainty for electricity development. On January 1, 2003, the BC Ministry of Water, Land and Air Protection will adopt emission guidelines for coal-fired power plants to allow the province to compete for investment with other jurisdictions. Currently, BC Hydro only purchases coal-fired electricity from Alberta at off-peak rates for later resale. With this policy, BC Hydro intends to buy coal-fired power from private producers while the provincial government presides over pollution control regulations (Government of British Columbia, 2002).

3.2 Hydroelectric Limitations

Natural Resources Canada has reported that climate change will have a range of impacts on both the hydrological cycle and water use in Canada. One example can be found in the melting snow and glacial runoff from mountainous areas that serve as the primary sources of water for downstream regions in Western Canada. With warmer conditions, the seasonal and long-term storage capacity of mountainous regions may decrease due to thinner snow-packs, more rapid spring runoff and decreased snow and ice coverage. It is anticipated that there will be lower summer river flows and greater water shortages during periods of peak demand (Natural Resources Canada, 2002).

In British Columbia, one of the major demands for water resources is for hydroelectric power generation, which supplies most of the electricity requirements in the province. Natural Resources Canada concludes that the potential for hydroelectric generation will likely decrease in southern areas due to a decrease in the annual volume of melting snow. Another important conclusion is that "changes in precipitation and reduced glacier cover in the mountains will affect downstream summer flows and associated hydroelectric functions" (Natural Resources Canada, 2002, p. 8). During the summer months, lower flow levels are projected to reduce hydroelectric generation potential, while demands for electricity are expected to increase.

In October 2002, BC Hydro reported that a number of its Lower Mainland and Vancouver Island reservoirs were experiencing "exceptionally low water levels" because of low rainfall throughout most of the year. BC Hydro started to experience progressively lower reservoir inflows in these regions as early as May 2002, when it was recognized that these low inflows could be problematic for fish and other water users. For example, the Vancouver coastal region experienced five consecutive months of low precipitation and the central Vancouver Island region experienced below average precipitation for every month since December 2001. As a result, BC Hydro employed special measures to use the available water at a reduced rate throughout the low inflow period. However, without rainfall, the crown corporation projected that reservoir elevations could "eventually be reduced to levels that cannot sustain minimum fish flows at a number of locations before the rains come" (BC Hydro News Release, October 24, 2002).

When low reservoir levels serve to compromise domestic water use and fish habitat, BC Hydro augments its hydroelectric facilities with thermal generation sources, thereby increasing greenhouse gas emissions. Therefore, it is not only time to develop a transition strategy from conventional energy resources, but to also explore opportunities to create a diverse energy portfolio that is less dependent on large hydroelectric facilities. Currently, BC Hydro is using green resources to expand its generation capacity to meet ten percent of demand by 2010, but first it is important to define the characteristics of green energy and why it represents an environmentally safer alternative to generate power.

4.0 Renewable Energy

The term renewable or "green" energy usually refers to the generation of electricity or heat from renewable sources such as sunlight, wind, geothermal heat, wave or tidal energy, running water and organic matter. In some examples, these sources act as fuels for a specific technology such as photovoltaic cells or wind turbines; however, other technologies can be powered by renewable and non-renewable sources. As a result, it is the fuel that should be considered the main characteristic of renewable energy sources (Berry and Jaccard, 2000, p. 263).

The Pembina Institute reports that green energy usually has two common characteristics. The first component is to ensure that the generation of power from renewable sources does not affect the ability of future generations to access efficient and affordable electricity. The second characteristic is to ensure the protection of human health and environmental quality. Overall, green power mitigates climate change by producing limited greenhouse gas emissions. It is further defined as having minimal effect on regional air quality, water quality, fisheries, flora and fauna, geophysical features and any additional increase of hazardous or toxic waste (Raynolds and Pape-Salmon, 2000, p. 4).

Renewable electricity supplies also enhance the diversity of energy portfolios by "increasing supply diversity and increasing the use of indigenous fuels or technologies, making energy systems less vulnerable to volatile fuel prices or disruptions in individual fuel supplies" (Berry and Jaccard, 2000, p. 264). In addition, renewable energy is also known to create more jobs per dollar invested than conventional energy projects. The Pembina Institute conducted a review of thirty studies related to employment in the energy sectors in North America. This review concluded that each one million dollar investment could create twelve jobs in renewable energy supply versus seven jobs in conventional energy, depending on the type of project. For example, small hydro projects have lower employment than biomass projects per dollar spent on the project. The number of jobs also depends on how many stages of production are carried out in the region because more employment may be created when the materials and technologies are manufactured locally (Campbell and Pape, 1999).

Berry and Jaccard identify some important characteristics when comparing the benefits of renewable and conventional energy sources. For example, renewable energy usually has "significantly lower social and environmental impacts and risks when compared with electricity from conventional sources such as non-renewable fossil fuels" (Berry and Jaccard, 2000, p. 264). Non-renewable energy supplies such as oil, natural gas, coal and other fossil fuels are viewed as finite and contribute to climate change, urban air pollution and acid deposition in the production of electricity (Campbell and Pape, 2001, p. 1).

Although there is a general consensus that renewable energy should protect the environment, it should be noted that every energy system has an associated impact on the environment. Certain conventional energy systems have substantial environmental benefits over other conventional sources, such as natural gas cogeneration replacing coal-fired power, yet they are not considered as green power. There is also a consensus that legitimate green power "cannot address one environmental issue by creating other problems through environmental burden shifting" (Raynolds and Pape, 2000). For example, environmental groups often exclude large hydroelectric facilities as a form of renewable energy because of the negative environmental and social impacts that extend beyond air emissions. These negative impacts result from the flooding of lands or watersheds required by large reservoirs, which can cause methane emissions from decomposing tress and soil, loss of animal habitat and altered watershed hydrology (Pape, 1999, p.2).

BC Hydro defines green energy as electricity or heat that is generated from renewable resources through "licensable and environmentally and socially responsible developments" (Green and Alternative Energy Division, 2002, p. 10). The energy source must be renewable "by natural processes within a reasonable length of time, at the longest, within about one average human life span" (BC Hydro Green Energy Fact Sheet, March 2002). In addition, green energy projects must meet all relevant regulations and standards, generate electricity that does not conflict with social values and has a minimal effect on the environment. It would seem that environmental groups and BC Hydro hold similar views on green energy, with the main difference occurring in the economics associated with the implementation of these resources in the generation mix, which will be discussed further in the paper.

4.1 Key Renewable Energy Sources in British Columbia

In this discussion paper, the term renewable energy will refer to the resources and technologies that demonstrate both infinite resource availability and green characteristics (Campbell and Pape, 1999). Over the last two years, BC Hydro has completed two green energy resource assessments for the province and these studies will serve as the primary sources for discussion in this section. The first phase of the study focused on Vancouver Island and identified a potential installed capacity of over 1,600 MW and an annual energy estimated at over 3,500 gigawatt hours from green energy resources (BC Hydro Green and Alternative Energy Division, 2001). From this study, BC Hydro determined that wind, wave and biomass energy projects will be developed for the 20 megawatt Vancouver Island Demonstration Project. This represents another contribution to developing energy projects to meet increasing demand on the island.

The second phase of the study identified a potential green electricity capacity of over 5,000 MW and an annual energy production of about 18,000 gigawatt hours (BC Hydro Green and Alternative Energy Division, 2002a). The technologies examined the energy potential from wind, small hydro, geothermal, solar, landfill gas, municipal solid waste, wood waste, wave, and tidal current. A full discussion of these technologies and resources remains beyond the scope of this report; however, the results of the most economical green energy resources will be briefly summarized below.

4.2 Biomass Energy

Biomass is defined as organic material from plants produced through photosynthesis, which is the process to convert the sunlight into chemical energy. This chemical energy can then be extracted from the biomass through combustion, to produce energy that can be used as heat or power. Wood residue or material left over from forestry operations is the most common form of biomass to create power in British Columbia. Opportunities also exist to generate power from other biomass resources such as municipal solid waste, demolition and land clearing waste, landfill gas and agricultural waste (BC Hydro Green and Alternative Energy Division, 2002a).

Green biomass technologies involve the controlled combustion of a renewable source of biomass. Pollution control equipment is used to capture the particulates, sulfur oxides and nitrous oxides that result from combustion. The carbon dioxide generated during combustion is consumed as new plants grow. BC Hydro maintains that as long as there is a sustainable source of biomass created through replanting, the net contribution of carbon dioxide to the atmosphere is balanced (BC Hydro Green and Alternative Energy Division, 2002a).

In some cases, the development of biomass energy projects can help improve the local or regional air quality because they divert wood waste products from more polluting disposal methods (Pape, 1999). Some places across the province incinerate excess biomass, such as wood residue, in beehive burners. Using wood residue in energy projects can reduce the amount that is currently incinerated, which would significantly reduce the amount of greenhouse gas emissions (BC Hydro Green and Alternative Energy Division, 2002a).

4.3 Small Hydro Energy

Run-of-river hydropower generates power by using a penstock to divert a portion of the natural stream flow to a powerhouse. A turbine converts the water pressure into mechanical energy in the form of a routing shaft, which in turn is converted into electrical energy through the generator. The water output from the powerhouse is discharged back into the watercourse through the tailrace, while the electrical output travels to the substation and power lines (BC Hydro Green and Alternative Energy Division, 2002b). The stream flow passing through the powerhouse is almost the same flow that naturally occurs in the stream. This means that there is very minimal or no storage reservoir to threaten fish habitat (BC Hydro Green and Alternative Energy Division, 2002a).

British Columbia has many opportunities for the development of small hydro projects, which are located throughout most geographical regions of the province and range in size from 500 kilowatts to 47 megawatts. The green study identified a total capacity of 2,454 megawatts with the energy production of 10,712 gigawatt hours for 756 sites (BC Hydro Green and Alternative Energy Division, 2002a).

4.4 Wind Energy

Like small hydro projects, wind energy potential is very site specific, however, turbines can generate a sufficient amount of electricity from the velocity of wind in a prime location. The first step is to establish a wind-monitoring station to determine the size of the wind resource at a given location, the seasonal variability, and the consistency of the wind. Most optimal wind energy sites can be found by examining the growth pattern of trees angling away from the prevalent winds. Wind turbines operate most efficiently at wind speeds around 12 meters per second, but can also operate at wind speeds as low as 2 meters/second (Campbell and Pape, 1999). The technology for wind energy generation has advanced significantly over the last twenty years, making it very competitive with conventional sources.

BC Hydro identified the potential wind farm locations, starting with spatial modeling with geographic information systems, investigation on small-scale maps, site inspections, and eventual wind monitoring stations. The three areas of that province have been identified for wind development includes the Northwest Coast, the Northeast and South Central Interior. A detailed conceptual evaluation of the top 10 wind sites indicated a total installed capacity of 730 megawatts and a potential total energy production of 1,600 gigawatt hours (BC Hydro Green and Alternative Energy Division, 2002a).

BC Hydro reports that British Columbia has many windy locations; however, many of these locations are in remote mountainous areas that are far from the transmission grid and difficult to access. Other common problems include visual impacts from development, potential impacts on birds, vegetation growth and its intermittent nature. BC Hydro concluded that these problems could be mitigated with the positioning and design of the turbines (BC Hydro Green and Alternative Energy Division, 2002a).

4.5 Ocean Wave Energy

Ocean Wave Technology represents a relatively new form of energy generation in North America. Different forms of ocean generation technologies are currently being developed or utilized in a number of countries including Scotland, Portugal, Norway, China, Japan, Australia and India. The technology that BC Hydro selected is the oscillating water column, which was created by an Australian company called Energetech. The oscillating water column represents one example of this technology, which uses a system design that allows water to flow into a column. The water pressure forces air up the column and past a specially designed turbine. As the wave retreats, the air in the column is decompressed and drawn down past the turbine for a second time. A generator is connected to the turbine to generate electricity. The technology will be used for a two-megawatt demonstration site located at Ucluelet for the Vancouver Island Green Energy Demonstration project (BC Hydro Website, 2002).

Much like biomass, wind and small hydro, ocean wave energy generation has many environmental advantages over conventional sources. These include a small environmental footprint, zero greenhouse gas emissions and economic development opportunities, yet some large-scale wave power technologies can also threaten estuary habitat and have an impact on aquatic life (Pape, 1999). Although British Columbia has significant resource potential along its coastlines, wave energy has not been developed at the same rate as biomass, wind or small hydro (BC Hydro Website, 2002).

5.0 Energy Pricing

Although renewable energy has many societal benefits, the implementation of green projects can be more expensive than conventional energy sources when compared on a financial cost basis. According to Berry and Jaccard, both monopoly and competitive electricity producers focus their investments on conventional energy sources, which leave renewable technologies to account for a small percentage of the total generation portfolio. There are three main differences in the costs associated with conventional and renewable forms of energy production. One reason is that some jurisdictions provide financial incentives to conventional sources. Another consideration is that the full costs of pollution are not included in the final cost of conventional energy sources. Finally, renewable technologies are often associated with new and expensive technologies, whose relative costs only decrease with mass commercialization through economies of scale (Berry and Jaccard, 2001).

Environmental groups report that the price of oil and natural gas is kept artificially low through financial support from the federal government. Between 1970 and 1999, the federal government provided the Canadian oil and gas industry over $40 billion in direct subsidies and billions in loan write-offs. The Canadian Center for Policy Alternatives reports that this government policy was "understandable in the 1970s, when Canada appeared to be blessed with limitless energy resources, climate change was not an issue, and few alternatives existed" (Marshall, 2002, p. 33). In comparison, the renewable energy industry has only received $12 million in subsidies in 2000, mostly in the form of research and development programs and tax incentives.

The David Suzuki Foundation maintains that energy markets need to be restructured to ensure that all forms of electricity generation would be able to compete on an even playing field. This would ensure that all costs of generation and the necessary information would be made available to "all actors involved in the supply and purchase of electricity, including generators, bulk purchasers and end consumers" (Elwell and Rotenberg, 2002, p. 6). In theoretical terms, this market would include the value of all costs, which includes the cost of treating health problems such as asthma and other respiratory illnesses created by using conventional sources. In fact, these groups maintain that consumers are presently paying the higher price of externalities through hidden taxes, healthcare costs, environmental degradation, and other impacts. The Canadian Center for Policy Alternatives reports that "if these costs were included in the price of using fossil fuels, technologies that do not create air pollution would become more viable and much more prominent in Canada's energy mix" (Marshall, 2002, p. 33).

The theory behind restructuring the electricity market is that market producers and consumers would only provide and purchase as much electricity as needed. Producers would decide the best method of generating electricity through sources that have the lowest cost of production and consumers would purchase the product with the retail cost. As a result, the process of generating electricity would be "socially optimal and no resources (including labour and capital) would be wasted (Elwell and Rotenberg, 2002, p. 6)." In order for the optimal price decision to be reached, all actors need to have access to all of the information available about the costs and these need to be incorporated into the final price paid for electricity. Environmental groups report that through the incorporation of the associated costs, the real price for each type of electrical power can be determined. This price would not be the "same as (determined) by a free market in the real world owing to externalities, information barriers and transaction costs" (Elwell and Rotenberg, 2002, p. 6). Determining the price difference would allow consumers to compare the real cost of electricity with the related health and environmental problems that are not calculated in the present total. If the subsidies were removed and externality costs included in the final total, then the costs of conventional energy sources could rise substantially (Berry and Jaccard, 2001).

Environmental groups suggest that the cost of wind, water and some forms of biomass for electricity generation are comparable or lower than the real cost of natural gas or coal energy. However, these technologies face multiple barriers to market entry such as "payback periods of four years or more, poor information, a need to achieve economies of scale, taxation and regulatory issues that all pose problems for renewable technologies" (Elwell and Rotenberg, 2002, p. 7). These factors continually prevent the development of renewable technologies, given the market tendency to focus on the financial dimension of energy projects.

5.1 Green Pricing

Green pricing is one method that utilities can use to make renewable energy more cost competitive with conventional sources. Under green pricing, electric utilities can offer consumers the option of purchasing a portion of their electricity from renewable energy sources. This practice has emerged in many competitive electricity markets as a form of supplier or product differentiation. Through green pricing, participating consumers pay a premium on their electric bill to cover the extra cost of the renewable energy. Under these programs, utilities are responsible for acquiring supplies, however, the amount of the energy is based on the response of the consumer (Berry, 2001).

Research has shown that the relative premium for green power is more important than the absolute premium. Jurisdictions with higher electricity rates will experience a larger demand for green energy because the premium typically represents a small percentage of the total electricity bill. In comparison, British Columbia has low electricity rates because the hydroelectric facilities throughout the province provide low cost and efficient power. Although some customers are willing to pay more to support green energy, "voluntary customer purchases even in jurisdictions with more favourable conditions, are generally not sufficient to achieve a socially optimal level of investment in green energy" (Berry, 2001, p. 16). In this case, the socially optimal level would only result when marginal costs equal marginal benefits, including both private and public costs and benefits.

BC Hydro recently announced a new program to market renewable energy through green power certificates. This is a pilot program where domestic and trade business customers purchase a specific volume of certificates each year. Each certificate costs twenty dollars and represents one megawatt of power from green generation sources. As a result, BC Hydro makes a commitment that one megawatt of power will enter the grid from one of the interconnected and operational projects from independent power producers. As of September 2002, BC Hydro reported that twenty organizations were participating in the program to "meet their environmental goals and gain a competitive edge" (BC Hydro news release, September 26, 2002).

Although there may be a low demand for green energy rates because of the higher effective premium, the growing trend to practice corporate social responsibility (CSR) may also contribute to the success of a green energy program in British Columbia. CSR refers to the practice of a "commitment to operate in an economically and environmentally sustainable manner, while acknowledging the interests of a variety of stakeholders" (Canadian Business for Social Responsibility, 2001, p. 6). This involves a transition from a financial business model to one that recognizes social and environmental values and incorporates them into current business practices. For example, small businesses are increasingly receiving community recognition and support for recycling or volunteer programs. As with medium companies, larger companies practice CSR because it serves to create a positive reputation and market differentiation for its products or services. Green energy purchases represent another area to practice CSR to key stakeholders and customers.

This business model may create some human resource and financial challenges for small-and-medium sized businesses in British Columbia. In addition, larger companies often have to receive the consent of stakeholders, such as investors and managers to build the case for this type of business model. Despite these challenges, it can be concluded that there is a emerging trend for small, medium and large companies to "build on the CSR practices and initiatives they already have in place, and to look to other companies and industries to better identify best practices and opportunities for innovation" (Canadian Business for Social Responsibility, 2001, p. 16).

5.2 Emissions Pricing

The carbon tax or emissions pricing represents another strategy to foster the development and utilization of renewable energy sources in British Columbia. The David Suzuki Foundation maintains "in order to achieve the Kyoto climate treaty target in a cost-effective manner, the federal government should quickly implement an economy-wide economic instrument such as a carbon tax" (Folley, Hertzog and Scott, 2001, p. 30). The Foundation believes that this would assist in the integration of the external costs that result from greenhouse gas emissions and local air pollution. In addition, they feel that the provincial government should participate in the development of a federal carbon tax.

One method for emissions pricing is the revenue-neutral model where carbon dioxide emissions are taxed, but governments reduce other corporate taxes to ensure that carbon-dependent industries do not actually suffer any consequences. This form of taxation would serve to advance renewable energy by increasing the relative cost of traditional energy supplies with higher emissions. In many cases, pricing is established across a limited range of sectors and activities. Most programs include transition mechanisms and revenue recycling to reduce the impacts of taxation. The carbon tax can be achieved through an emissions cap and trading system, or emissions charges above a certain limit. Without a provincial or national auction available, emission trading would not generate any direct revenues for government. Many studies conclude that emission pricing can achieve optimal reductions in greenhouse gases at the lowest cost while providing incentives for innovation and cost reductions (Berry, 2001).

The Pembina Institute reports that some European countries have improved environmental performance through ecological tax policies like emissions pricing. Sweden, Denmark, the Netherlands, Great Britain, Finland, Germany and Italy represent examples of some European countries that have implemented tax reform policies to address environmental performance and economic competitiveness. In the European scenario, these policies introduce environmental taxes while reducing existing corporate taxes. European governments view carbon taxes as a measure to reduce payroll taxes to create employment opportunities or increase research and development. Although the carbon tax program remains in the early stages of implementation, the Organization for Economic Cooperation and Development concludes, "positive effects on GDP could be expected from an ecological tax reform policy if revenues are used to cut capital taxes" (Boustie, Raynolds and Bramley, 2002, p. 23).

The implementation of a carbon tax by the federal government would require a significant adjustment from different industries, which are integrated with the markets of North America. In markets where Canadian employers must compete with foreign suppliers, the imposition of carbon taxes here, but not in other trading regions, would place domestic companies at a significant competitive disadvantage and contribute to provincial unemployment (Ontario Trucking Association, 1998). The carbon tax should be "revenue neutral" to ensure that it would not penalize the provincial electricity sector. This means that other taxes on the sector would be reduced so that total tax calculation would remain the same. The funds collected should not contribute to government revenue; instead the carbon tax should be invested in industrial research and technology to improve environmental performance. Another consideration for this policy instrument is that this tax may also increase the costs of compliance and administration for government (Stephen Owen Interview, November 29, 2002).

Some concerns associated with emissions pricing stems from the potential impacts on general income distribution, price levels, competitiveness (export industries), economic development and other potential market distortions (Berry, 2001). The federal government has decided that it will not introduce a carbon tax to reduce greenhouse gas emissions. The National Post quoted Industry Minister Allan Rock as saying, "I want to make sure that we don't just focus on industry, let's focus on the consumers as those whose behaviour must be changed if we want to change the number of greenhouse gas emissions" (National Post, September 18, 2002). Minister Rock emphasized that a reduction strategy should involve both industry and consumers to make a combined difference through technological advances, industrial efficiencies, and transportation alternatives.

Ardath Paxton Mann, the Assistant Deputy Minister of Western Economic Diversification Canada, explained that the "federal government tends to focus on positive incentives for renewable energy development and greenhouse gas reductions rather than penalties like emissions pricing. This remains a public policy issue for Western Canada to show some real leadership" (Ardath Paxton Mann Interview, November 08, 2002).

5.3 Financial Incentives and Subsidies

Trent Berry reports that financial incentives or subsides can reduce the relative costs of renewable energy when compared with traditional sources. There are many types of incentives and subsidies, which can be applied to upfront investments or actual production. Some involve direct payments to energy projects and indirect tax credits. Other incentives can target producers for on-site generation facilities while others can be aimed at consumers for making green power purchases. Some common examples for renewable energy production include: production tax credits, accelerated depreciation allowances, property tax or resource rent reductions and investment grants and financing programs (Berry, 2001).

Financial incentives or subsidies can serve as useful tools for overcoming the obstacles associated with the high capital costs required for most renewable energy projects. However, incentives may not produce the desired outcome when considering other barriers to development. For example, production incentives may not stimulate resource development in the face of technical interconnection barriers or electricity sectors dominated by vertically integrated monopolies that may limit independent power projects. In many cases, incentives may simply redistribute the costs and benefits of other policies without stimulating incremental investments in renewable energy (Berry, 2001).

As discussed earlier, the Canadian Center for Policy Alternatives has called for provincial and federal governments to provide the same subsidies in the oil and gas sector towards renewable energy projects. The Government of Canada's Wind Power Production Incentive (WPPI), announced in the December 2001 budget, provides an initial incentive payment of 1.2 cents per kilowatt-hour for the production of wind power. The incentive, which declines over time, is a taxable benefit and applies to projects launched between 2002 and 2007. Federal payments will be available for the first ten years of production and the program is expected to cost around $260 million (Natural Resources Canada, 2002b).

The Pembina Institute is a member of the Clean Air Renewable Energy Coalition, which represents a group of corporations, environmental organizations and municipal governments, working to advance government incentives for renewable energy in Canada. Depending on the location and resource availability, the estimated costs for wind power range from 8 – 10 cents per kilowatt-hour, which exceeds the wholesale price of electricity in all Canadian jurisdictions by a cost premium of 1.2 – 7.8 cents per kilowatt-hour. Further, the additional marketing, administration and distribution costs and retail returns increase the retail costs of renewable energy by 2 – 4 cents per kilowatt-hour. In total, the financial gaps for wind power development and sales in Canada are between 3.2 and 11.8 cents per kilowatt-hour. The Coalition reports that the WPPI has a market after tax of 0.6 cents per kilowatt-hour. In a policy submission, they requested that the federal government should "increase the WPPI to cover the cost-price gap and to match the United States Production Tax Credit equivalent of 2.7 cents per kilowatt hour to ensure appropriate investment in wind energy" (Clean Air Renewable Energy Coalition, 2002, p. 8).

The Coalition also proposes that similar financial incentives should be introduced to encourage other renewable energy technologies. These incentives would apply to technologies like on-grid solar photovoltaic, sustainable-biomass, small hydro, geothermal, tidal and wave energy or others that serve to mitigate climate change. These incentives would be structured in the same manner as the WPPI, yet possess different incentive levels to reflect marginal development costs (Clean Air Renewable Energy Coalition, 2002, p. 8).

Ardath Paxton Mann commented, "Perhaps the government felt like wind was the most cost-effective and practical application of public funds, whereas other technologies can be developed with other programs and partnerships with industry" (Ardath Paxton Mann Interview, November 08, 2002). She expressed the need to identify the circumstances that allowed wind energy to advance further than other renewable technologies. In turn, these practices may be valuable in developing policies and incentives for other technologies.

Mike Harcourt, the former Premier of British Columbia, supported the concept of providing provincial incentives to allow renewable technologies to become competitive with conventional sources. However, he commented, "It appears the province does not have the available resources to offer financial incentives to renewable energy projects. Presently, private investors are the primary source of funding" (Mike Harcourt Interview, October 24, 2002). Based on the current economic situation in British Columbia, Mr. Harcourt concluded that the provincial government could not offer the same incentives as the federal government.

Ardath Paxton Mann suggested that the provincial government could provide support for smaller green energy projects. This would support the research and development stages for small demonstration projects that "would have smaller costs but a greater impact on the development of these projects. Eventually, the province will experience more prosperous economic conditions that will enable more funds to be available" (Ardath Paxton Mann Interview, November 08, 2002).

Moreover, she theorized that joint provincial and federal funding for renewable energy could be possible through an arrangement similar to the Western Economic Partnership Agreement (WEPA), which is administered by Western Economic Diversification and the B.C. Government. Over five years, these federal-provincial agreements focused on strategic areas of mutual interest and led to approximately $160 million in federal and provincial contributions in Western Canada. Western Economic Diversification provided $20 million in funding to each Western Province. Each province provided a matching contribution that led to a $40 million investment in each province, which created new employment opportunities, new economic infrastructure and promoted economic development (Western Economic Diversification website, 2002). She suggested, "A similar agreement to the WEPA would be applied on a 50% cost sharing arrangement with the provincial government and also leverage additional private sector funds" (Ardath Paxton Mann Interview, November 08, 2002). In addition, she expressed the need for further private sector involvement with both governments to advance renewable energy projects.

Ardath Paxton Mann also suggested that an Institute of Alternative Energy in Western Canada could be established to develop Canadian expertise. In this scenario, educational institutes and universities could partner with government and the private sector to create innovative solutions. The Institute would act a centralized resource, collecting information on renewable energy technologies and identify financial sources, which would assist technology developers, manufacturers and investors who are looking to develop the sector. It would also allow for the industry to create a market and assist the sector in overcoming barriers to economic development. The institute could be funded by a foundation, trust or research chair grants. "This could represent a position for the provincial governments as they search for Kyoto alternatives" (Ardath Paxton Mann Interview, November 08, 2002).

In order to support the development of the renewable energy sector, environmental groups are urging the provincial government to "encourage the development of low impact renewables of electricity such as wind, solar and micro-hydro through specific initiatives such as net metering and portfolio standards" (Foley, Hertzog and Scott, 2002, p. 30). These groups feel that these initiatives are needed to encourage utilities to purchase renewable energy, advance new energy projects, limit the growth in fossil fuel electricity generation and reduce greenhouse gas emissions.

While BC Hydro and environmental groups agree on the benefits of green energy, a difference exists in the development of these resources. The environmental groups argue for new programs to implement these projects, whereas BC Hydro has to examine the economics and appropriate mechanisms of development. The next two sections will examine the renewable portfolio standard and net metering as potential programs to encourage the growth of a renewable energy in the provincial electricity sector.

6.0 Renewable Portfolio Standard (RPS)

The RPS is a policy instrument to increase the generation of electricity from energy sources with higher costs of production but with more social and environmental benefits. In a provincial context, this policy would require the provincial electricity market to deliver a minimum amount of renewable electricity from specific fuels and technologies. It would be similar to other types of minimum standards established by governments to address "real or perceived market failures like minimum standards for insulation in new buildings, fuel efficiency in new buildings, or recycled content in consumer packaging" (Berry and Jaccard, 2001, p. 263). The main characteristic of the RPS is the dependence on competitive markets to reach its policy objectives. This also depends on whether the objective is to correct market failures, overcome market barriers, or to lead the electricity sector on a sustainable path (Rader and Norgaard, 1996).

Under the RPS, every retail power supplier would be responsible for the purchase renewable energy credits, which would be equivalent to the percentage of its total annual energy sales. A renewable energy credit would be created when a qualifying energy source generated one unit of electricity. These units can be measured in kilowatts, megawatts, or any reasonable output of power. Retail electricity suppliers could own renewable facilities and certify company energy credits, purchase energy credits packaged with renewable power, or purchase credits separately from a generator or power broker. In RPS programs, the retail supplier and renewable energy producers negotiate to bring the supplier into compliance with the standard over issues such as whether to own, purchase power, or buy credits, appropriate technologies to use, intermittent challenges, contractual terms and distribution conditions (Rader and Norgaard, 1996).

There are three main reasons for the growing popularity of this policy mechanism. The first reason is that the RPS maintains incentives for renewable energy producers to seek continuous cost reductions. The program can be designed to ensure that these cost reductions are passed on to consumers. This can be achieved through mechanisms that establish cost competition among renewable energy producers to maintain their share of the RPS. The second reason is that because the RPS is guaranteed a specific share of the electricity market, it can be connected to government reduction targets. The government can establish a certain RPS target and demonstrate the direct environmental benefits. The final reason is that the RPS will seek to minimize government involvement relative to other measures. For example, the government budget would not be included in the operating costs because the customers would pay for the extra financial cost of the program. In addition, the projects would be selected through the market and not by government evaluation (Berry and Jaccard, 2001, p. 264).

The RPS has been adopted in a number of jurisdictions in North America, Europe, Asia and the South Pacific. There has also been active discussion of a national RPS in the United States and some analysis of a national RPS in Canada. The Electricity Table of Canada has modeled a national RPS, however, this model is limited because the federal government has no direct jurisdiction over provincial electricity markets (Berry, 2001). BC Hydro is the only public utility to implement a voluntary RPS in Canada (BC Hydro Interview: September 3, 2002).

Experience in the implementation and evaluation of this policy instrument is limited because it is a new program. The RPS policies that have already been effectively implemented in the United States are expected to support the development of several thousand megawatts of renewable energy capacity over the next decade. Although some programs contained design flaws, the general policy studies and preliminary experience in most programs suggest that the RPS can act as a "powerful and simple tool for meeting a market-wide target for renewable energy supplies" (Berry, 2001, p. 25). Trent Berry and Mark Jaccard have researched the RPS design trends in numerous electricity jurisdictions and their findings will be used to compare the RPS of BC Hydro.

6.1 Target Size

The main challenge of the RPS is the determination of the binding target or quota for renewable energy production. One example is the selection of the target size or portion of the total portfolio capacity. This requires a careful balance between the objectives and capital costs of each energy project. These impacts will be dependent upon the local cost and availability of different renewable projects and the price of traditional energy supplies. In theory, the target should be large enough to encourage the industry to meet the environmental target and limit electricity price increases. The size of the target can also impact the level of competition among renewable fuels or technologies. When the target can be achieved with a relatively small number of large projects or exceeds the available resources, there may be less competition and pressure to innovate (Berry and Jaccard, 2001).

In a separate report with energy policy recommendations to the Alberta Government, the Pembina Institute states that a sufficient target for all electricity retail companies would need to "demonstrate that at least 5% of their electricity sales are provided by low-impact renewable energy sources in 2005 and 10% in 2010" (Pape, 2001, p. 9). This amount is substantially different from their submission to the BC Energy Policy Task Force, which recommended an expansion of the BC Hydro target from ten to thirty percent (Pape, 2002).

BC Hydro officials stated that the ten percent target is sufficient to meet its voluntary commitment and not contribute to electricity price increases. The corporation maintains that the target size encourages the development of new projects in a short period of time and remains "sufficiently large enough to promote competition among various technologies" (Goehring and Thompson, 2001, p. 7). BC Hydro concludes that its RPS will not place restrictions on technologies and will allow the market to determine the most cost-effective projects. In addition, the provincial electricity subcommittee and alternative energy subcommittee are reviewing this target to advance the development of new projects. This target may be increased in part from continuous efficiencies and the emergence of new opportunities for more energy projects.

6.2 Target Timing

Another consideration in the selection of an appropriate target is the timing of each project. The duration of targets can be important in determining the stability of the RPS over a long period of time. If the commitment is firm, then buyers and sellers will be more likely to enter into long-term supply contracts. These long-term commitments establish revenue streams and secure low-cost project financing, which is very important for projects with high-capital costs (Berry and Jaccard, 2001).

BC Hydro is working to achieve its ten percent target within the next three years. The BC Hydro Integrated Electricity Plan forecasts that provincial energy consumption will increase by 2,370 megawatts by 2007, which is more than the annual energy capacity output (BC Hydro Integrated Electricity Plan, 2000). Goehring also reports that independent power producers have "overwhelmingly responded to BC Hydro's expression of intent to acquire green energy" (Goehring and Thompson, 2001, p. 7). The crown corporation estimates that it will develop a sufficient amount of electricity purchase agreements to meet its ten percent target in the 2004-2005 fiscal year. As the company moves forward with green energy development and the market evolves, it will "likely revisit the RPS design and goals to maintain its optimal application for the utility" (Goehring and Thompson, 2001, p. 7).

6.3 One or Multiple Targets

The determination of the appropriate portfolio target is dependent upon whether there should be one target for all renewable projects or separate targets for different technologies. Under the first approach, the least-cost options would be developed to meet the overall target. This approach may minimize project costs and satisfy environmental objectives, but it may limit other objectives such as greater supply diversity or support for emerging renewable energy projects. One renewable technology could dominate the entire RPS market, even though other technologies may become competitive with more commercialization opportunities (Berry and Jaccard, 2001).

BC Hydro has a "blanket RPS" that adopts a single green energy target. The majority of this target will be achieved through wood residue and small hydro energy projects because the technologies are more advanced. However, the technologies of the Vancouver Island Green Energy Demonstration Project (comprised of wave, wind, and micro hydro targets) are being developed concurrently and included in the total green energy target (Goehring and Thompson, 2001, p. 8).

6.4 Eligible Resources

According to Berry and Jaccard, the RPS must contain a list of eligible resources for meeting the requirements. This will depend on the RPS objectives, availability of the different resources, and the associated costs and benefits. A key decision is whether the RPS should be limited to renewable sources of electricity or expanded to include other energy and technology combinations. For example, some jurisdictions will include fossil fuel cogeneration because the energy efficiency makes a contribution to the environmental objective (Berry and Jaccard, 2001).

Another eligibility consideration is whether the RPS should include all renewable resources or only new investments in renewable resources. The application to new investments will prevent huge profits to existing plants but will require a firm definition about the exact qualifications. A determination must also be made on the inclusion of grid-connected facilities and off-grid facilities. A simple approach would be to focus the policy on the energy projects that are connected to the transmission grid. Some environmental groups would argue that the policy should include all renewable projects, including off-grid systems. However, it could be difficult to determine the annual production and there could be significant administrative costs. Further considerations around size limitations and electricity imports may also compromise the target objectives (Berry and Jaccard, 2001).

The BC Hydro standard targets new resources constructed in the province and uses a "comprehensive and proactive approach when defining eligible resources, for example it accepts off-grid resources and eligibility is determined by BC Hydro's definition of green" (Goehring and Thompson, 2001, p. 9). All of these projects must be under 50 megawatts. BC Hydro has initiated two commercial green energy processes for independent power projects that meet or surpass 40GWh/year.

BC Hydro has developed its own criteria for the acquisition of green power from new projects. This definition includes the satisfaction of provincial regulatory requirements, infinite supply, low environmental impacts, and socially responsible characteristics. The green definition also extends beyond the technology and includes an evaluation of the entire project. For example, the operation of a wind farm on traditional aboriginal territory must be included as well. As a result, green projects must guarantee that they are socially and environmentally responsible (Goehring and Thompson, 2001).

6.5 RPS Administration

Implementing an RPS requires several elements such as the volume of the target, project certification, compliance monitoring and penalties for non-compliance. These can be managed through an RPS administrator or delegated to specialized agencies. Berry and Jaccard offer two governing methods that include the combination of government and delegated electricity regulators or single government administration. To administer its voluntary RPS, the electricity purchase agreements between BC Hydro and independent power producers contain financial penalties for non-compliance. Most problematic situations have been avoided through consultation with regulators, environmental groups and developers. BC Hydro is also moving towards a validation system by credible third parties and a dispute resolution process to build public understanding and confidence in the process (Goehring and Thompson, 2001, p. 11).

6.6 Provincial RPS Challenges

Understanding the benefits and limitations of renewable energy remains crucial in the development and operation of a sustainable resource portfolio. The BC Hydro Green Energy Study reported that green energy sources do not provide the necessary capacity to meet the winter peak demand without some storage, back-up, or firm supply option to support the green resources. For example, the Vancouver Island Demonstration Project can only produce energy on an average basis. The remaining balance of energy must be provided by the existing transmission links from the mainland. The intermittent or seasonal nature of green technologies does not allow for a consistent flow of electricity. For example, the output from small hydro installations may face limitations during cold winter temperatures and wind energy cannot blow on a regular basis. Green resources are supplemented with large hydro and natural gas facilities because the provincial energy demand requires an immediate source of power. Brenda Goehring concludes that BC Hydro requires "numerous green resources to make a firm contribution to the overall portfolio. Mother nature is the weather forecaster not the utility company" (Brenda Goehring Interview, September 03, 2002). As more energy projects are brought online, this seasonal variance may be reduced because of the continuous output from multiple renewable sources of electricity throughout the province.

6.7 Legislated Versus Voluntary Implementation

BC Hydro has adopted a voluntary target to acquire a minimum of ten percent of new generation sources from green energy projects. However, this is a voluntary target and does not apply to other utilities or suppliers in the province. In addition, resource acquisitions still need to be approved by the British Columbia Utilities Commission. Under a formal RPS, the overall target would be established through a legislated government policy (Berry, 2001). This section will discuss the characteristics of a provincially legislated and voluntary approach.

Environmental groups have been advocating for a legislated standard because the current voluntary approach lacks regulation to guarantee compliance. The David Suzuki Foundation maintains that all energy companies should move towards generating or purchasing all of the energy supply from green projects to mitigate greenhouse gas emissions. They report that while the voluntary RPS is a "welcome first step it must be noted that this is a voluntary program designed to mitigate greenhouse gas emissions and can be dropped at anytime by the utility, unlike the regulated portfolio standards adopted elsewhere" (Foley, Hertzog and Scott, 2002, p. 31).

The Pembina Institute maintains that government involvement is necessary in the design of an RPS to protect consumer rates. In a similar policy recommendation to the Alberta Government, the Pembina Institute concluded, "if rates do fall below the price of low-impact renewable energy, then consumers would be protected from price increases through a government-funded production incentive" (Pape-Salmon, 2001, p. 10). It would be structured to include all developers such as large electricity companies, municipalities and First Nations. The production incentive would cover the difference between the average annual market price of electricity and the cost of generation from low-impact renewable energy. The total cost to the Alberta government would be $60 million per year. This assumes that the entire portfolio standard is equivalent to 2,000 GWh of electricity production or five percent of new generating capacity (Pape-Salmon, 2001). In a British Columbia scenario, the provincial financial guarantee would be significantly higher for the voluntary ten percent standard.

Janice Larson, a Senior Policy Analyst with the B.C. Ministry of Energy and Mines, said that a legislated approach would establish a firm commitment but may impose unexpected costs on the electricity sector. She indicated that, "The private sector works better with certainty and not uncertainty" (Janice Larson Interview, October 07, 2002). She stressed that the electricity sector would be faced with additional costs to meet a regulatory target and may have issues surrounding existing capital investment.

Janice Larson said that a voluntary approach for introducing an RPS is viewed more favorably because it does not establish a minimum target for compliance. The voluntary approach could prepare the energy sector for future regulatory requirements and would require lower administrative costs. This would allow the time to develop a transition strategy through establishing best practices, working internally to improve operations and finding ways to lower costs. “Voluntary compliance can also ensure a learning process that establishes a cooperative approach to build a legislated framework through ongoing consultations. However, if the voluntary standard can improve the corporate bottom line, it will never have to be legislated” (Janice Larson Interview, October 07, 2002).

According to Mike Harcourt, “BC Hydro has done a reasonable job with its sustainable development initiatives…over the last few years, we have witnessed a new openness at BC Hydro” (Mike Harcourt Interview, October 24, 2002). He expressed the growing need to enhance the provincial generation capacity with renewable sources because “industry is starting to recognize the finite nature of non-renewable supplies.” The real challenge is determining the appropriate strategy to encourage the development of these resources.

If the provincial government legislates an RPS, it will have to establish a specific goal to make renewable energy technologies like wind and solar more technologically advanced and competitive with traditional sources. Legislators would have to examine whether the target is technologically and economically feasible and whether a transition program that offers financial incentives would be needed. The technologies would have to be offered close to the market rate, however, the “challenge is determining who will make up the price difference” (Mike Harcourt Interview, October 24, 2002). Mike Harcourt also expressed the need to conduct consultations with key stakeholders before tabling the legislation.

The general purpose of the RPS should be sufficient enough to reach the overall objectives of the target. In the provincial context, BC Hydro may act as the catalyst, but the renewable portfolio standard creates the market share. Brenda Goehring feels that the involvement of the private sector represents a crucial component in the success of the standard and creates a stable foundation of investment. “It is more proactive when these efforts are voluntary. Some may say that it is vulnerable to shifts in provincial leadership, but this strategy creates a precedent and a commitment to the private sector” (Brenda Goehring Interview, September 03, 2002).

7.0 Net Metering

According to Andrew Pape, net metering programs have been developed in at least 24 U.S. States, two Canadian provinces, Germany and Japan. In British Columbia, the program was proposed by the Provincial Task Force on Energy Policy which recommended that the "the development of alternative energy sources requires innovative approaches…such as net metering to increase on-site electricity generation" (Task Force on Energy Policy, 2001, p.46). This section will analyze some of the characteristics of a net metering program and examine the barriers to its implementation in British Columbia.

The practice of net metering allows residential customers to generate their own electricity and sell the remaining surplus power back to the utility company over a specific billing period. Net metering utilizes a single electrical meter to measure the total difference between the consumer consumption of the utility electricity and their total domestic generation from renewable energy sources. In this generation scenario, the meter will run backwards when electricity production exceeds consumption. This practice is also known as reverse metering, net billing or power banking (Berry, 2001).

Smaller-scale technologies would produce a sufficient amount of power to meet the electricity needs of a home, office or industrial plant. Some examples of these smaller-scale technologies range from photovoltaic solar arrays that generate power from solar radiation or micro-hydroelectricity generators that produce electricity from water power (Pape, 1999). In British Columbia, net metering technologies could include small hydro, wind, solar and even some small-scale co-generation facilities. Although there may be a number of viable small hydro and small-scale wind sites in the province, many will not be appropriate for a customer site. For example, even with substantial financial support, solar power is currently very expensive in British Columbia and would not likely be attractive to consumers (Berry, 2001).

Andrew Pape uses the term customer-generator to refer to the electricity consumer with a "renewable energy technology at their premises that is grid-interconnected and capable of doing net metering" (Pape, 1999, p. 3). Without net metering, an individual has little opportunity to produce power because of the excessive costs involved with operating two parallel systems (utility grid system and distributed renewable system).

In most net metering programs, customer-generators receive the retail price of utility electricity for any excess production of electricity that is fed into the transmission grid. In a provincial context, Andrew Pape estimates that this would be the equivalent of almost 6 cents per kilowatt-hour for residential electricity consumers. In other programs, the utility usually applies a standard residential, commercial or industrial rate for each kilowatt-hour of net power consumption. The final amount of the utility bill would be nothing when the net electricity production of a billing period is equivalent or greater than the actual consumption. Some net metering programs allow the customer-generator to carry forward excess generation into the next billing period, which serves to increase the value of renewable technologies with seasonal characteristics. Other utility companies "will pay a customer-generator for any power production in excess of their total consumption within a billing period…at the utility wholesale rate, spot price of electricity or the avoided cost of power from a new power plant" (Pape, 1999, p. 11).

7.1 Benefits of Net Metering

Net metering programs can offer several benefits to customer-generators. The ability to interconnect distributed renewable technologies to the grid often reduces the capital costs of the equipment. For example, small hydro and wind technologies can use induction generators to reduce the capital costs of synchronous generators. For renewable projects that generate power from intermittent sources such as the wind and sunlight, the practice of net metering would eliminate the need for some storage, power conditioning and transforming equipment. This may include batteries, large-scale inverters, and battery charge controllers, which "can easily double or triple the price of a complete system" (Pape, 1999, p. 11). The main socio-economic benefit of net metering is that it provides a measure for electricity consumers to use renewable technologies to reduce the environmental impacts from electricity consumption.

Net metering can also provide utility companies with several benefits. For example, utilities can enhance their public support and improve customer relations by providing a customer-driven energy solution to conventional sources. Another benefit is that some customer-generators can contribute to improving transmission system load factors. However, this program would be limited to specific project sites, such as small hydro technologies in coastal areas that produce power during rainy periods, which can correlate with provincial peak demand. Finally, some utilities may receive greenhouse gas reduction credits, offer market green power to electricity consumers or determine other tradable commodities (Pape, 1999).

7.2 Barriers to Implementation

With these technologies, electricity generation would be distributed throughout the transmission grid. In comparison, the most dominant source of electricity in British Columbia is generated from centralized hydroelectric facilities, which are often located away from residential areas. These facilities are located near the source of the power (e.g. reservoir) and often involve long extensions of electrical transmission lines to connect them (Pape, 1999).

Distributed resources are becoming increasingly competitive with centralized power sources because of technological innovations, reduced capital costs and maintenance, and access to energy resources. However, the electrical systems in many jurisdictions including British Columbia "are still dominated by vertically integrated electric utilities that have a monopoly on retail sales of electricity (Pape, 1999, p. 2)." Many of these companies have existing investments and expertise in centralized power sources and remain reluctant to adopt distributed resources.

One barrier is directly related to the existing worker safety requirements for BC Hydro transmission and distribution line maintenance procedures. There is a concern that some renewable technologies would continue to feed electricity into the grid after the network goes down during power outages, which would put people at risk while working on the lines. This scenario is called "islanding" or when a customer-generator feeds an electricity load adjacent to its location when that part of the distribution system is down for maintenance. For some projects, worker safety is ensured by mechanisms such as power inverters that automatically disconnect the energy project when the utility grid is down (Pape, 1999).

There is also a lack of uniform utility interconnection standards for net metering. In some cases, utilities will develop their own standard that is different from other jurisdictions that use the same technologies. Andrew Pape recommends that governments could legislate a standard to require all utilities and net metering customers to comply with the regulations. Another approach would be to establish a collective of electric utilities and stakeholder groups to voluntarily adopt a universal standard (Pape, 1999).

Another barrier relates to the subsidies from the utility ratepayer to the customer that owns the net metering project. The issue is that net metering will create a large burden to utility ratepayers and that customer-generators will gain an unfair advantage from the subsidy. One subsidy may be related to the value of the time that the power enters the utility system. The magnitude of this subsidy depends on the costs of producing electricity during peak periods, opportunity costs of electricity during different time periods and consumption patterns of the customer. In British Columbia, BC Hydro could face large subsidy costs related to the expense of providing capacity to customers through distribution line connections or program administrative costs (Pape, 1999).

7.3 BC Hydro Position

The David Suzuki Foundation reports that net metering would allow utility customers, institutions, businesses or governments to use renewable technologies to generate up to 150 kilowatts of power for domestic consumption. The Foundation maintains that the provincial government should direct BC Hydro to develop a net metering program and offer a financial assistance program for small-scale renewable energy projects. They also want the provincial government to implement a tax incentive for consumers who invest in renewable energy projects. Another request is for the provincial government to form a partnership with commercial lending institutions to assist in providing capital financing for renewable technologies. The benefits would be to decrease urban air pollution and greenhouse gas emissions, lower demand from conventional energy supplies and to reduce electrical bills for consumers (Folley, Hertzog and Scott, 2001).

The current BC Hydro policy on distributed renewable systems is that building owners must install a switch that separates the self-generation operations from the transmission grid. The total electricity supply must only be provided by BC Hydro or from the distributed renewable and not from a combination of the two systems operating simultaneously. This policy serves to protect utility workers when they are servicing transmission and distribution lines. Andrew Pape reports that other jurisdictions have overcome this obstacle without harm to personnel. He concludes that net metering is one mechanism to address this problem, although other solutions may be possible such as a policy on the interconnection of small-scale distributed renewable systems without net metering (Pape, 1999, p. 11).

According to Brenda Goehring, there are some additional challenges facing the implementation of a net metering program in British Columbia. For example, some provincial homeowners would expect to receive a retail rate for excess production instead of the wholesale rate that BC Hydro would offer. She maintains, "BC Hydro sells power at a retail rate because it transforms and reshapes the power for distribution. Excess power from these houses would not perform the same function and would only qualify to receive a wholesale rate" (Brenda Goehring Interview, September 03, 2002).

Other challenges include the significant capital investments for panel and metering equipment that can cost $20,000 per household or more. Brenda Goehring added that most people would rather put their money into registered retirement savings plans over expending a large amount of money for these small energy projects. In addition, the existing BC Hydro electricity meters are not equipped to calculate excess electricity production. Some additional life cycle assessments will have be considered because equipment upgrades would "represent a huge expenditure from BC Hydro for every interested household wanting to participate" (Brenda Goehring Interview, September 03, 2002).

Currently, there is provincial policy on a net metering program. Brenda Goehring indicated that BC Hydro might be receptive to the development of a future strategy to promote net metering in British Columbia. She concluded the topic stating that a "net metering concept would have to be discussed at higher levels to determine the goals of the program" (Brenda Goehring Interview, September 03, 2002). As a result, the provincial government would have to legislate a net metering program.

8.0 Conclusions and Recommendations

As the electricity sector evolves over the next few years, renewable energy projects have significant potential to contribute to the long-term energy needs of the province. Traditionally, the larger hydroelectric or "mega-projects" have been seen as drivers of economic development in the province. However, with the transformation of the electricity sector to include more social and environmental accountability, smaller projects are becoming more attractive because of the reduction in environmental impacts.

Renewable energy projects stand to become economically and environmentally attractive to many resource-based communities, particularly in some parts of the province where communities have traditionally relied on mining and forestry to drive local economies. Ardath Paxton Mann concludes that renewable energy could also "break down the barriers between rural and urban communities…(and) it could represent a strategy to diversify the north" (Ardath Paxton Mann Interview, November 08, 2002). This could allow for the commercialization of research outside urban areas. As new projects emerge throughout the province, more local employment can be created to bring new economic value to waste products. This value can also be extended to other renewable energy projects because local expertise can be developed in the design, construction and maintenance stages of their operation with enormous export opportunities. For example, renewable energy projects may require plumbers, electricians, designers, architects and engineers, as well as specialists in the particular field, such as small hydro or wind power (Campbell and Pape, 1999).

The Pembina Institute concludes that investing in wind turbines, developing and managing biomass plants, and designing and installing small hydro systems, can create new business activity in rural communities. This would produce new forms of local income as these products and services are developed, which also creates revenues for businesses and governments. Therefore, as the provincial government looks to the private sector to provide new generation facilities, it will also create new opportunities for smaller communities to diversify and develop their local economies.

Competitive electricity producers prefer to invest in conventional energy sources because of government incentives and green technologies tend to be more expensive. Environmental groups maintain that the price of electricity should be restructured to account for all negative environmental and social impacts, however, the inclusion of these costs may not occur in the near future. It remains important to explore alternative methods such as green pricing, emission pricing and financial incentives and subsidies to make renewable energy more cost competitive with conventional sources.

Under green pricing, electric utilities can offer consumers the option of purchasing a portion of their electricity from renewable energy sources. One challenge is that since British Columbia has low electricity rates, most consumers would not voluntarily support price increases to encourage green energy development. BC Hydro uses green power certificates to market green energy to domestic and trade business customers. This program suggests that there may be growing demand in the business community to practice corporate social responsibility by supporting green energy projects. Although it is too early to evaluate the success of the program, it can be concluded that green pricing can allow businesses to develop a positive consumer reputation and product differentiation in the market.

Emissions pricing or carbon taxes seek to increase the relative cost of conventional energy supplies with higher emissions. If the electricity sector must comply with the form of a carbon tax, then a revenue-neutral carbon tax would be the best strategy. In this scenario, carbon dioxide emissions are taxed, but governments reduce other corporate taxes to ensure that carbon-dependent industries do not actually suffer any consequences. If the provincial electricity sector were to support this initiative, then taxes in other areas should be reduced in an amount equal to the carbon taxes collected. In this scenario, the funds collected from carbon taxes would be returned to the same industries that paid them and can be used for environmental research and technology. However, it appears that the federal government will not impose a carbon tax and has chosen instead to support reduction efforts through other financial incentives rather than penalties.

Financial incentives or subsidies can also serve to reduce the relative costs of renewable energy when compared with traditional sources. There are many types of incentives and subsidies, which can be applied to upfront investments or actual production. Proponents feel that the federal government should increase the WPPI to reflect the current cost-price gap and extend similar incentives to other renewable energy technologies. Ardath Paxton Mann concluded that the current WPPI incentive might have been the best way to expend limited public funds to support renewable energy. In addition, an analysis of the circumstances that allowed wind energy to advance further than other renewable technologies would be needed to move the latter initiative forward.

The province is currently experiencing tough economic conditions in a variety of its natural resource sectors. Mike Harcourt commented that the province does not have the available resources to offer financial incentives to renewable energy projects. However, Ardath Paxton Mann felt that the province could provide support for small demonstration projects with lower costs, which would maximize the investment of limited provincial funds. In addition, she noted that the province would eventually recover when export markets improve and the softwood lumber dispute is resolved.

The federal tools to provide incentives or subsidies to renewable energy projects could include a federal-provincial agreement similar to the Western Economic Partnership Agreement (WEPA). This federal initiative would match provincial funds with each renewable energy project and also leverage additional private and academic support. The exact amount of financial support would have to be negotiated in the development of this policy but it remains an effective strategy to mitigate climate change. However, it can be concluded that this remains a public policy issue for consideration when provincial economic conditions improve.

In the meantime, an Institute of Alternative Energy in Western Canada could be established to organize and expand Canadian expertise. The next stage for this proposal would be the development of an organizational structure to provide the necessary resources to innovative firms and foster economic development. The Institute could collect information on the renewable energy sector, summarize innovative products and private sector expertise and develop specific policies for government consideration. This initiative would act as an incubator for the development, demonstration and commercialization of these technologies. Again, this policy would need additional consultation between officials from the government, private sector and academic institutions.

The Renewable Portfolio Standard (RPS) is another policy instrument that would require BC Hydro to generate a certain percentage of its total production capacity from renewable energy projects. There are a number of important considerations in the design of an RPS that include the selection of the target, timing, eligible resources, and administrative responsibilities. Renewable energy projects also tend to be seasonal or intermittent, which places limitations on the generation of electricity. For example, the output from small hydro installations may face limitations during cold winter temperatures and wind energy cannot blow on a regular basis. Therefore, these projects must be supplemented with conventional sources.

BC Hydro has adopted a voluntary target to acquire a minimum of ten percent of new generation sources from green energy projects. Under a formal RPS, the overall target would be established through a legislated government policy. Without legislation, environmental groups feel that voluntary programs can be eliminated without notice or obligation to stakeholders. In addition, some groups also report that government involvement is necessary to protect consumers from large rate increases. However, provincial government and BC Hydro officials maintain that voluntary participation is more effective than a legislated standard. The voluntary approach could prepare the electricity sector for future regulatory requirements, require lower administrative costs, establish sufficient targets, and allow for ongoing consultations with the electricity sector. Brenda Goehring concluded that private sector involvement creates a stable foundation of investment that would not become vulnerable to shifts in provincial leadership.

This paper also explored net metering as a policy instrument to support the development of distributed renewable technologies in British Columbia. Environmental groups report that it represents a consumer-based mechanism that would allow utility customers, institutions, businesses or governments to use renewable technologies to generate up to 150 kilowatts of power for domestic consumption. Currently in British Columbia, there is neither a net metering program nor a utility-driven program to facilitate the interconnection of distributed renewable energy projects. The BC Hydro green rate only applies to large-scale energy technologies such as wind, biomass and small hydro. BC Hydro reports that issues such as line worker safety, electricity pricing and capital costs currently compromise the development of a provincial net metering program. If policy makers are interested in promoting distributed renewable technologies for grid applications, either a net metering rate or a utility program will need to be legislated. Otherwise, there will be limited actions from BC Hydro to start a net metering program in British Columbia.

The British Columbia electricity sector is undergoing a state of transition from its primary reliance on conventional energy sources to include more renewable technologies in the generation portfolio. Climate change and the need to practice sustainable development have been the primary sources of this change. Although this transformation is progressing at a steady rate, environmental groups have expressed concern that the rate of change is moving too slow. Some of these concerns revolve around energy pricing, the implementation of a renewable portfolio standard and a net metering program. This study has sought to identify the positions and progress within these three areas in an attempt to evaluate the progress and recommend some solutions for further change. Many of these policy instruments may play a unique role in providing a provincial contribution towards reducing greenhouse gas emissions. As a result, policy makers may be able to use these conclusions as a foundation upon which to create a more sustainable society and strengthen the economy, while significantly addressing climate change.

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10.0 Attachment One: Brief Project Description for Interview Participants

Thank you for agreeing to participant in my honours project. You have been asked to participant because of you have knowledge and experience associated with renewable energy development, policy development, or funding authority related to the provincial electricity sector. The views expressed during the interview will viewed as personal and you are free to withdraw at anytime.

The purpose of this report is for the identification and discussion of potential policy instruments for increasing the generation of electricity from small and medium scale renewable energy sources. It will focus upon the potential tools and challenges to mitigate climate change and reduce greenhouse gas emissions. It will also evaluate some of the key recommendations from environmental groups through a literature review and interviews with representatives from the provincial and federal governments and BC Hydro. As a result, this report will discuss the following key topics to encourage the development of provincial green energy projects:

- Policy tools to reform the price of electricity that will allow all forms of generation to compete in an equal operating environment.
- Implementing a voluntary or legislated renewable portfolio standard that would require electricity providers to include a growing percentage of renewable generation in the provincial supply.
- Net metering as a possible mechanism to support the deployment of small-scale, distributed renewable technologies in British Columbia.

The Ethics Board of Simon Fraser University has approved these questions. For more information about this project, please feel free to contact my supervisors, Robert Anderson (randerso@sfu.ca) or Adam Holbrook (aholbroo@sfu.ca).