

**WE CAN: IMPLEMENTING A 100% RENEWABLE  
ENERGY POLICY IN BC**

by

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Bachelor of Arts, Dalhousie University, 2006

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## **ABSTRACT**

What mix of generation would provide British Columbia with the optimum electricity system? Energy analysts have critiqued the 2007 BC Energy Plan; A Vision for Clean Energy Leadership in regard to its goal of aiming for a 90% renewable energy mix. By failing to full embrace renewable energy at 100%, this goal fails to obtain the maximum range of benefits to be accrued from the province's electricity system.

Beginning with a thorough analysis of the literature, and personal interviews, this project examines outside critiques of the Energy Plan by sources from the non-for-profit sector, private energy developers, and the government itself, in order to make the argument that a move towards 100% renewable electricity generation makes economic, final, and technical sense. This cost-benefit analysis will compare non-renewable with renewable sources of electricity in terms of how they fair in terms of costs, supply security, employment opportunities, creating innovation clusters, and impacting the environment.

**Keywords: British Columbia; Energy Policy; BC Hydro; 2007 Energy Plan; Renewable Energy; Alternative Energy; Electricity Generation; Distributed Generation, Technology Clusters.**

**Subject Terms: BC Hydro; Energy policy -- British Columbia; Renewable Energy; Electricity; Power resources -- British Columbia; Electric power -- British Columbia.**

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## **GLOSSARY**

<b>BC</b>	British Columbia
<b>DSM</b>	demand-side management
<b>EIA</b>	Energy Information Administration
<b>FIT</b>	feed-in tariff
<b>GHG</b>	greenhouse gases
<b>GWh</b>	gigawatt hour: one million kilowatt hours (kWh)
<b>IPPs</b>	Independent Power Producers
<b>kW</b>	kilowatt: 1,000 watts or 1.34 horsepower
<b>kWh</b>	kilowatt hour: the amount of electrical energy used/ generated by a one-kilowatt unit for one hour
<b>MWh</b>	megawatt hour: 1,000 kilowatt hours (kWh) or one million watt hours
<b>PV</b>	solar photovoltaic
<b>RPS</b>	renewable portfolio standard
<b>R&amp;D</b>	Research and Development
<b>WECC</b>	Western Electricity Co-ordinating Council
<b>WCI</b>	Western Climate Initiative

## INTRODUCTION

As Karl Mallon points out in his *Renewable Energy Policy and Politics; a handbook for decision-making*, none of the electricity capacity of 2050 is, as of yet, currently installed.<sup>1</sup> The dams currently in use will likely remain in commission, but this date is beyond the lifespan of the actual turbines, be it hydro, wind or gas, now generating electricity in the province of British Columbia (BC). This gives a huge opportunity to government, the public, and private enterprise, to determine the composition of their future electricity generation mix. This project examines how each electricity generation source available in BC measures up to key criteria, in order to determine if the BC government should base its Energy Plan on 100% renewable electricity. The evaluation of generation sources in this paper will employ criteria used by other energy analysts, namely: cost, reliability, employment opportunities, technological innovation, and environmental impacts.

All recommendations provided here are based on the BC government's own stated priorities. One of these priorities is to reduce the impact of energy on the environment through using more clean, alternative, and renewable energy sources.<sup>2</sup> While the BC Energy Plan uses these three terms interchangeably, they are not synonymous. The Task Force on Energy Policy includes large hydro and superefficient natural gas turbines as 'alternatives',<sup>3</sup> but as large hydro is the status quo in BC, it cannot be considered 'alternative' to conventional sources, and natural gas should not be defined as 'renewable', regardless of the extent to which it minimizes its emissions. 'Renewable' forms of energy, as defined by Mark Jaccard, are those "that flow through Earth's biosphere, available for human use indefinitely, provided that the physical basis for their flow is not destroyed."<sup>4</sup> 'Clean' is a more subjective term and will not be used here.

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<sup>1</sup> Mallon, Karl, ed. 2006; foreword

<sup>2</sup> BC Ministry of Energy... 2007a

<sup>3</sup> Task Force on Energy Policy. 2002; p.24

<sup>4</sup> Jaccard, Mark. 2004; p.413

While the discussion focuses on the provincial government's priorities, it must be acknowledged that the provincial government does not operate in a policy vacuum. Provincial initiatives must ascribe to Canadian federal government energy policy, as well as provisions of the North American Free Trade Agreement, the Western Electricity Co-ordinating Council and thus also the US Federal Energy Regulatory Commission. The province is not a self-contained political entity nor can it attain full self-sufficiency in electricity, but it is the prime mover for policy decisions in BC, including the aim to move towards greater self-sufficiency. These other policy actors cannot change BC's ultimate goals, but only modify the manner and speed in which they are achieved. Therefore, while they do not fall under the scope of this paper, they also do not detract from its conclusions, which are applicable to a wide variety of jurisdictions and their policy movers.

## Research Methodology

### Secondary Sources

Through a comprehensive examination of the emerging literature, this project explores the many facets of the BC electricity environment and global renewable energy policies. The provincial government document, *The BC Energy Plan; A Vision for Clean Energy Leadership*,<sup>5</sup> has been examined to determine where it falls short in providing British Columbians with the optimum benefits in regard to the provision of electricity in the province. This secondary source review is based on documents from the BC Ministry of Energy Mines and Petroleum Resources, BC Hydro, and reports solicited by these actors, as well as a variety of critiques and analyses of these works. This includes recommendations made before the creation of the Energy Plan, as well as reactions to it, by sources from the non-for-profit sector, private energy developers, and the government itself. Using a cost-benefit analysis, the project will determine how the major categories of electricity sources fair in terms of costs, supply security, employment opportunities, creating innovation clusters, and impacting the environment. From this analysis, the project offers new insights on the possibilities for BC's electricity system.

In addition to articles from energy policy analysts in BC, it is important to gain a perspective from comparable jurisdictions upon which a relationship can be built. For this comparison, those jurisdictions whose energy plans could be considered more progressive than BC's have been utilized to see how that leadership is provided. Germany, with its profound growth in renewables, especially wind; Spain, with its experiments using both major renewables incentives - the feed-in tariff and the renewable portfolio standard; as well as Denmark, with the highest per-capita growth and usage of new-age renewables, are the models upon which to compare. The conclusions of other energy analysts examining conventional and renewable energy, both in BC and internationally, will help tease out the reasons why BC should aim to derive all generation from renewable sources.

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<sup>5</sup> BC Ministry of Energy... 2007a

These state-level comparisons are justified by BC's geographical size, which is larger than any of these countries, and thus has an equal or greater access to natural resources. Canada is also not easily defined as a single entity in regards to electricity policy as its utilities operate on a provincial basis, with dissimilar generation mixes, there are large policy discrepancies between the provinces, and there is no pan-Canadian transmission grid. The mix of generation sources between the Canadian provinces is equally disparate as between BC and these international jurisdictions, yet the need to develop new generation is shared by all these examples. While the comparison between Germany's and BC's generation mix might seem tenuous as that country's electricity is mostly derived from coal derivatives, compared to BC's large hydro, both jurisdictions see the need politically to move away from fossil fuel-based generation and desire to be on the cutting edge of renewable technology.

## **Interviews**

The literature discusses at length how the Energy Plan could be improved, but leaves gaps in regard to more recent stakeholder experiences. The Energy Plan is relatively new (2007), and reactions to it stem mostly from the predicted, not actual, effects of the Energy Plan on those directly or indirectly affected by its provisions. In order to rectify this deficit, a series of interviews were conducted in April 2009 with individuals from: BC Hydro, private power producers, and third party organizations representing industrial electricity consumers and the bioenergy sector, to determine what faults they see in the current plan, what have been its major successes thus far, and whether the plan should aim for a 100% renewable electricity system. The responses from these interviews were useful in filling gaps in the discussion, as well as presenting ideas that otherwise could have been overlooked. Their contributions have been interspersed throughout to augment the project.

## Interview Questions

The standardized questions used for the interviews are as follows<sup>6</sup>:

1. Would you prefer your identity for the purposes of this interview to remain anonymous?
2. If so, would you prefer for all information regarding your employer or affiliated organization to also remain anonymous?
3. In what manner has the current BC Energy Plan; “A Vision for Clean Energy Leadership” impacted on you and your organization’s work?
4. What suggestions would you provide for improving the current Energy Plan in regards to facilitating your work? More generally?
5. How feasible do you believe it is for the BC government to aim towards a electricity system based 100% on renewable generation? Why/ why not?
6. Do you believe that the BC government should aim towards a 100% renewable energy mix?
7. What problems would the province face if they were to do so/ not do so? What benefits?

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<sup>6</sup> All participants were asked to sign a consent form, which included details of the study, how the data would be used, how it would be secured, and who to contact with any range of concerns or to receive a final copy of the report. The participants were also given a copy of the consent form and questions to keep for their file. They were provided with the interview questions three business days before the interviews took place and were allowed to refuse any particular question, or to end the interview, as they desired. For further information, please see the attached consent form in Appendix A. The suggestions and comments made by these individuals are their own and do not necessarily represent their associated organization.

# CHAPTER 1: COST AND RELIABILITY

## Cost

When purchasing electricity, cost is the primary concern of most industrial, commercial, and residential consumers. Thus, the BC Energy Plan includes the priority ‘to maintain BC’s competitive rate advantage.’<sup>7</sup> BC Hydro takes its low rates seriously, but coming out of an almost decade-long rate freeze, and facing generation constraints, the utility needs to balance the need of adapting its rates to the cost of generation, and ensuring it maintains the low-rate advantage BC industry now enjoys.<sup>8</sup> In addition to the economic benefits of having among the lowest electricity rates in North America,<sup>9</sup> the government realizes that public opinion of BC Hydro depends on maintaining low electricity bills.<sup>10</sup> To keep these bills low, it is necessary to minimize the costs of generation, transmission, and distribution.

The ensuing discussion focuses on generation, omitting transmission and distribution based on the presumption that there is relatively equal opportunity for both renewables and thermal generation to be expanded near the load centre in the lower mainland, thus reducing transmission costs (lower possibility for large hydro). Also, regardless of what sources BC Hydro chooses to pursue, the utility will remain liable for the costs of maintaining and upgrading transmission and distribution infrastructure,<sup>11</sup> and not the independent power producers (IPPs) generating the electricity. Additionally, the cost estimates below reflect the 20-year planning timeline used by BC Hydro and thus ignores any residual values incurred by these investments through using these assets beyond this financial cycle.

A pertinent issue concerning generation is the contention that low rates based on heritage costs might be driving up demand, incurring higher costs for the

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<sup>7</sup> BC Ministry of Energy... 2007a; p.4

<sup>8</sup> BC Ministry of Energy... 2002; p. 6

<sup>9</sup> Hydro-Québec. 2008.

<sup>10</sup> BC Hydro. 2009; p. 34

<sup>11</sup> BC Ministry of Energy... 2007b; p. 1 & 4

utility and its customers in the long run. Once these issues are addressed, we can compare the costs of generation for fossil fuel and renewable-based sources. By following this primary goal, the chapter will answer the question: Will the price of electricity and supply reliability in BC be detrimentally affected by a wholesale shift to renewable energy? And should renewables be favoured over conventional in terms of cost and energy security?

### **Public vs. Private Ownership**

There is substantial debate in the province over who should provide electricity generation, transmission, and distribution: BC Hydro/ BC Transmission Corporation, or private companies. This paper works within the framework of current government policy where new generation will mostly come from IPPs, as BC Hydro is barred from developing new projects not already on the books,<sup>12</sup> but the transmission and distribution of electricity will remain public resources. It does not take a side in the debate over the role of privatization of the electricity system.

Two major proposals on the books of BC Hydro to increase generation are to build a third dam on the Peace River, under the moniker 'Site C', and to install additional turbines at the Mica and Revelstoke dams. Revelstoke Unit 5 and 6 are both expected to add 480 MW of capacity each, and Mica Unit 5 and 6 at 450 MW each.<sup>13</sup> The Site C project would add a hydroelectric generating station, with a capacity of 900 MW, downstream from two existing facilities and the Williston Reservoir.<sup>14</sup> Regardless if BC Hydro goes ahead with building Site C or refurbishes additional units at its current dams, it still has substantial freedom to either provide further generation itself or purchase it from IPPs and large industrial producers, such as Alcan and Cominco.<sup>15</sup> The decision of how to acquire future generation should be based on those criteria used here.

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<sup>12</sup> Calvert, John. 2007a; p.37

<sup>13</sup> BC Hydro. 2006b; p.5/8

<sup>14</sup> *Ibid.* p.7/23

<sup>15</sup> Davis, Steve. 2009.



A major concern by those who oppose the current role of IPPs cite that private companies have no incentive to encourage conservation,<sup>16</sup> but as long as BC Hydro has to cover costs through customers' rates, it will continue to push conservation first, an initiative that seems to be supported by IPPs as well the general public.<sup>17</sup> If IPP projects have to follow the same stringent environmental and public consultation processes, the question then becomes a philosophical entreaty over if public or private enterprise should own the means of electricity production. This project takes a neutral stance in the debate of market versus state-led development since ownership or leadership do not affect the basic premise of this project, that a renewable generation mix is desirable for BC.

As best exemplified by Dr. Marjorie Cohen, writing in support of public generation: "It is faulty logic to assume, because there are problems with the existing system (a public or highly regulated one), that its opposite (a private and deregulated one) will correct these problems."<sup>18</sup> This comment can also be made in reverse, showing that the problem of having to increase electricity supply to meet growing demand will not be solved by changing who generates the power, but requires a progressive and aggressive strategy to ensure BC provides a leadership role in moving towards the complete adoption of renewables to generate electricity within the province, and export both electricity and technology abroad.

### **Heritage Costs:**

The current Energy Plan confirms 'in perpetuity' that the BC Hydro Public Power Legacy and Heritage Contract Act will continue to require BC Hydro to provide electricity to customers at cost and not the going market rate.<sup>19</sup> As the costs of materials and labour were much lower in the 1960s and 70s,<sup>20</sup> it is impossible for new projects to be competitively priced with heritage projects. The legacy of ample

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<sup>16</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.31

<sup>17</sup> Griffiths, James. 2009. And BC Hydro Research Services. 2005; p.4

<sup>18</sup> Griffin Cohen, Marjorie. 2006; p.74

<sup>19</sup> BC Ministry of Energy... 2007a; p.12

<sup>20</sup> BC Ministry 2002; p.15

public expenditures on large hydro-electric projects and a flexible transmission and distribution system has enabled BC Hydro to trade surplus power with neighbouring jurisdictions, easily earning back its initial investments.<sup>21</sup> Unfortunately, the most cost-effective locations for large hydroelectric projects have already been developed, and new generation sites are often further away from the grid.<sup>22</sup>

Any new sources of generation will increase BC Hydro's costs, thus requiring higher rates. The BC Hydro 2008 Annual Report shows that it costs an average of \$6.10/ MWh to generate power from its heritage assets, compared to \$61.39/ MWh to purchase from IPPs.<sup>23</sup> Of the \$2.7 billion BC Hydro paid in 2008 towards energy costs, \$477 million went towards purchasing the 10% of power produced by IPPs, \$114 million more than in 2007.<sup>24</sup> As BC energy analyst Dr. John Calvert points out, the high prices of current purchases "are being diluted by the much larger amount of BC Hydro's own very low cost energy. If all our energy were being purchased from private power developers our electricity rates would be more than double what we are now paying."<sup>25</sup> Fortunately, BC Hydro can continue to produce power from its heritage assets, while ensuring that contracts for new power go to the lowest bidder, keeping rate increases to a minimum.

### **Rates for Consumers**

A predicament of providing customers with electricity at lower rates is that it decreases the incentive to conserve, thus increasing demand and resulting in higher costs for BC Hydro to acquire further generation. The F2006 Call for Energy cost BC Hydro an average of 8.8c/ kWh for new generation, while the utility only charges 3.63 to 7.12c/ kWh for industrial and residential customers, respectively.<sup>26</sup> By not taking into account the real economic costs of purchasing marginal power, higher

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<sup>21</sup> BC Ministry of Energy... 2002; p.15

<sup>22</sup> Bryant, Tyler. 2008; p. 18

<sup>23</sup> All prices in Canadian dollars unless otherwise noted.

<sup>24</sup> BC Hydro. 2009; p.56

<sup>25</sup> Calvert, John. 2007b; p.15

<sup>26</sup> Shaffer, Marvin & Associates Ltd. 2007b; p.7

residential rates are essentially subsidizing the costs of supplying industry with low-priced electricity at half the electricity market rate.<sup>27</sup>

As BC Hydro bases its rates on its historic costs of production and not on the incremental costs of acquiring generation to meet its capacity and annual energy requirements, this historic cost-based rate policy inflates total electricity requirements.<sup>28</sup> Consumers, especially industry at the lower end of the rate scale, are not presented an adequate price signal to push them to conserve and invest in technologies that would promote energy efficiency.<sup>29</sup> Simultaneously, this over-consumption encourages customers to use electricity where natural gas might be a more suitable replacement, thus requiring BC Hydro to burn more natural gas at a higher overall cost, due to conversion and transport, than if used directly for heating applications.<sup>30</sup>

### **Demand-Side Management**

The Energy Plan sets an ‘ambitious’ conservation target, aiming to meet half of BC Hydro’s future supply needs through demand-side management (DSM), where the utility uses various methods to encourage its customers to use less of its product.<sup>31</sup> As evidence of BC Hydro making efforts towards this initiative, it filed a ‘Residential Inclining Block Application’ with the BC Utilities Commission in February 2008.<sup>32</sup> If approved, this would allow BC Hydro to institute a two-step rate structure, where the first block of energy consumed would be sold to customers at a lower rate than the electricity consumed beyond this allocation.<sup>33</sup> As the new rate structure would be revenue neutral, the first block would be sold at a cheaper rate

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<sup>27</sup> Calvert, John. 2007b; p.18

<sup>28</sup> Shaffer, Marvin & Associates Ltd. 2007b; p.9

<sup>29</sup> BC Ministry of Energy... 2002; p.6

<sup>30</sup> BC Progress Board. 2005; p.iv

<sup>31</sup> BC Ministry of Energy... 2007a; p.4

<sup>32</sup> BC Hydro. 2009; p.5

<sup>33</sup> *Ibid.*

than currently, meaning that those with below average monthly consumption would save money, while those who consume more would be penalized.<sup>34</sup>

DSM is acknowledged by BC Hydro to lower environmental impacts and incremental natural gas costs.<sup>35</sup> Current efforts to reduce power among commercial, residential, and industrial customers, center on the Power Smart program, which has managed to exceed its conservation targets year after year.<sup>36</sup> According to the Pembina Institute, these initiatives can provide up to four times as many jobs as building generation, and are provided in a geographically diverse and incremental manner.<sup>37</sup> They also illustrate that up to 6000 GWh of electricity can be saved through DSM at a lower cost than purchasing new generation,<sup>38</sup> which is in sync with BC Hydro's own calculations.<sup>39</sup> This project accepts these projections, and allows that only half of BC Hydro's long-term demand increase will still have to be met through producing more electricity. Taking DSM targets at face value for meeting future supply, this paper will look at how to meet the remaining gap, projected to be approximately 20 000 GWh/ year by 2025, once DSM is accounted for.<sup>40</sup>

## Cost of Generation

The standard argument is that alternative energies are always more expensive than their conventional brethren.<sup>41</sup> The expectation of BC industry is that renewables will bring higher rates, as, effective April 1st, 2009, electricity rates have increased 10.3% over the preceding two years.<sup>42</sup> The *Strategic Consideration for a New BC Energy Plan: Final Report of the Task Force*, elaborates further, arguing that any shift towards renewables in BC would have to be on an incremental basis, as

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<sup>34</sup> Potts, Daniel T. 2009.

<sup>35</sup> BC Hydro. 2006b; p.7/23

<sup>36</sup> BC Hydro. 2006a; p.7

<sup>37</sup> Campbell, Barbara, Larry Dufay, and Rob Macintosh. 1997; p.i

<sup>38</sup> Cretney, Alison et al. 2007; p.37

<sup>39</sup> Bruce, Ian. 2006.

<sup>40</sup> BC Hydro. 2008a; p.71

<sup>41</sup> Jaccard 2004; p.413 & Menanteau 2003; p.799

<sup>42</sup> Potts, Daniel T. 2009.

alternatives are currently not “sufficiently reliable, available or cost-effective to warrant a total shift from conventional to alternative energy sources.”<sup>43</sup> With continuing technological innovation, rising prices of natural gas, and lower interest rates<sup>44</sup> since this report was published in 2002, this section will analyse if the shift to 100% renewable generation could now be practicable on cost-terms for the province.

Other authors elaborate on their opposition to this shift, citing issues such as the more expensive nature of alternative technology and the technical problems preventing widespread use.<sup>45</sup> With the continually declining cost of wind, solar, geothermal, and small hydro technologies<sup>46</sup> the steadily increasing costs of fossil fuels,<sup>47</sup> and the predicted cost of carbon associated with BC’s membership in the Western Climate Initiative,<sup>48</sup> this conclusion might not be as straightforward as assumed in earlier analyses. Considering BC Hydro estimates the current market cost for electricity to be at \$53.80 MWh for fiscal 2009,<sup>49</sup> how can the BC government maintain its commitment to competitive electricity rates through acquiring new energy at net costs approaching this level? Is it feasible to do so through renewables?

### **Cost of Fossil Fuels**

While hydropower was the preferred fuel source for electricity generation during the 1960s and 1970s, the Burrard thermal plant was brought online in the early 1960s to provide power during the construction of these large dams.<sup>50</sup> As the current Energy Plan points out, this plant has now become outdated, inefficient and costly<sup>51</sup> and the BC government supports BC Hydro’s decision to close the plant for

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<sup>43</sup> Task Force on Energy Policy. 2002; p.28

<sup>44</sup> Davis, Steve. 2009.

<sup>45</sup> Griffin Cohen, Marjorie. 2006; p.85

<sup>46</sup> Berry 2001; p.i

<sup>47</sup> Duancey 2005; p.9

<sup>48</sup> Western Climate Initiative. 2008; p.32

<sup>49</sup> BC Hydro. 2009; p.69

<sup>50</sup> BC Hydro. 2008b; p.5/24

<sup>51</sup> BC Ministry of Energy... 2007a; p.14

generation purposes by 2014.<sup>52</sup> The decisions to mothball the plant, as well as to terminate the proposed natural gas plant at Duke Point, Nanaimo, are based on barriers, including: the increased price of natural gas, the cost of upgrading Burrard's turbines, and local opposition against the facilities. This section will discuss why the steady increase in gas prices can be expected to continue in the near future, and why new agreements and policies signed by the government entails higher relative costs due to the addition of carbon taxes to the price of thermal generation. From this basis, we will be able to compare fossil fuel-based generation to renewables on the basis of cost predictions over the 20-year planning period of BC Hydro's long-term acquisition plans.<sup>53</sup>

### **Increasing Price of Natural Gas**

The price of oil has fallen dramatically since its all-time high of \$145 per barrel in July of 2008, to \$50 per barrel in January of 2009, but is expected to return to its upward slope as the global economy rebounds from the current recession.<sup>54</sup> The downturn in the economy means that exploration of further sources has also declined, exacerbating the trend of reserve depletion. When economic engines rev up after the recession, it can be expected that demand for fossil fuels will drive up prices, as it has in the past. The following graph, Figure 1, outlines the yearly average costs to import a barrel of oil to Canada over the last ten years, including the recent price drop in January of 2009:

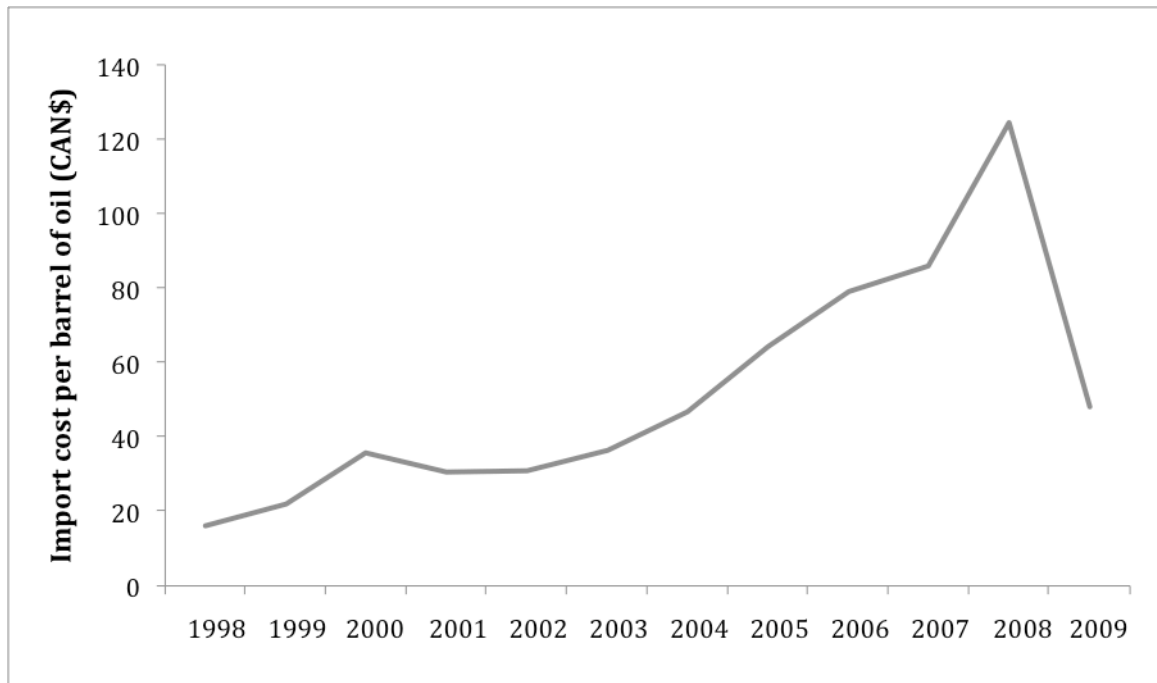
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<sup>52</sup> BC Ministry of Energy... 2007b; p.6

<sup>53</sup> BC Hydro. 2008b.

<sup>54</sup> Hester 2009; p.1

**Figure 1: Import costs per barrel of oil into Canada<sup>55</sup>**



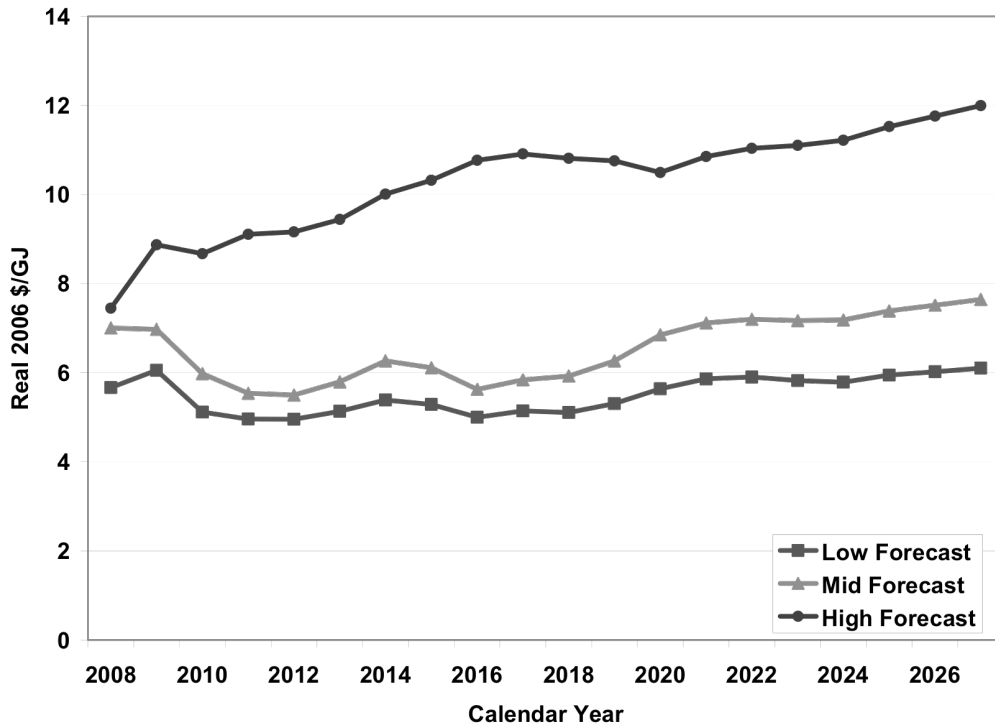
Taking into account a year to recover from the recent price drop, the US Energy Information Organization expects the price of crude oil to increase at an average 2.6% per year from 2008 to 2030.<sup>56</sup> BC Hydro's own predictions for the rising price of natural gas use three different models or forecasts, as shown in their graph, Figure 2 reproduced below.

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<sup>55</sup> International Energy Agency. 2009.

<sup>56</sup> Energy Information Organization. 2009.

**Figure 2: Natural Gas Price Scenarios at Sumas Hub<sup>57</sup> by Calendar Year<sup>58</sup>**



Using a risk framework assessment, the utility calculates the likelihood that gas prices will follow the middle scenario is approximately 53%, with only a 10% probability that prices will be below this, and 36% they will be above.<sup>59</sup> Even with the middle scenario, BC Hydro predicts current and future CCGT natural gas facilities in the province to produce power at \$72 – 106 /MWh, depending on interest rates and facility size.<sup>60</sup>

If we return to oil, as both fossil fuel sources are used in thermal electricity generation, the Hubbert’s model of peak oil ascertains that a point will soon be reached where new discoveries of reserves will fail to keep up with production.<sup>61</sup> At that point, global demand will be higher than supply, and dramatic price increases will likely follow. While the concern is real, this peak is probably much further away

<sup>57</sup> Sumas Hub is a natural gas trading hub located near the Canada/ US border.

<sup>58</sup> Taken from BC Hydro. 2008a; p.153

<sup>59</sup> BC Hydro. 2008a; p.180

<sup>60</sup> *Ibid.* p.115

<sup>61</sup> Jaccard Mark. 2007; p.155



than the common estimates placing it within the next few years.<sup>62</sup> Oil companies keep their reserve estimates low, to artificially increase the scarcity of the resource, thus driving up prices.<sup>63</sup> But, as Michael Jefferson points out in his “Accelerating the transition to sustainable energy systems:”

Under the highest widely accepted estimate of conventional oil resources (3 trillion barrels), this resource is expected to be exhausted within 35 years given current oil demand projections.<sup>64</sup>

Even if peak oil occurs later than predicted or if production ‘plateaus’ rather than ‘peaks’, oil, and its natural gas brethren, are finite resources that will become increasingly expensive to extract as more marginal deposits are exploited and global demand for the resource continues to expand. Dale Marshall even argues that the province should slow down their own production of oil and gas to maintain reserves for the future, when competition for global supplies will make them less available for import.<sup>65</sup> Fossil fuel policies, he points out, should be carefully considered in the long-term, due to the vital nature of energy to BC’s economy and how this impacts on the well-being of its citizens.<sup>66</sup>

## **Carbon Taxes**

It is important to note that the economic rigours of supply and demand are not the only force driving up the cost of fossil fuel-based generation. Although perhaps less crucial economically, as a signatory to the Western Climate Initiative (WCI), BC will be subject to a cap-and-trade regime, where it will be penalized for each tonne of CO<sub>2</sub> equivalent produced above its annual allocation. As carbon credits will be subject to market forces, it is not known what their cost will be, but the WCI estimates prices of \$6 a metric tonne in 2015, rising to \$24 a tonne by 2020 as stricter limits on total emissions are introduced.<sup>67</sup>

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<sup>62</sup> Dauncey, Guy. 2005; p.4

<sup>63</sup> Jaccard Mark. 2007; p.154

<sup>64</sup> Jefferson, Michael. 2008; p.4418

<sup>65</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.44

<sup>66</sup> *Ibid.* p.21

<sup>67</sup> Western Climate Initiative. 2008; p.66

To lower the extent to which the province will have to purchase carbon credits, and to pursue a more stringent greenhouse gas (GHG)-reduction program, the province recently instated the Carbon Tax Act. Under this act, the province will charge major emitters \$10 per tonne of CO<sub>2</sub> equivalent as of July 2008, rising to \$30 per tonne over five years.<sup>68</sup> While the WCI estimates that reduced energy expenditures will actually exceed the direct costs of reducing GHGs overall, these charges on carbon are expected to add \$2 – 4/ MWh to the market rate of electricity for the Western Electricity Co-ordinating Council (WECC) region.<sup>69</sup> The financial viability of thermal generators is further exacerbated in BC by the 2008 Emissions Standards Act, which requires all generating facilities to have zero net GHG emissions by 2016.<sup>70</sup> Although this law does not herald closing down all existing thermal generators, they will have to offset their emissions beginning in 2016.<sup>71</sup>

The WCI expects offsets will be available at approximately \$20/ tonne,<sup>72</sup> but as these are not required to occur within the province, they could entail an automatic payment from BC Hydro customers for GHG-reduction projects outside BC. Emission reductions are defined as a ‘change in a behaviour, management practice, or technology from what it otherwise would be’, which cannot be sufficiently guaranteed when using offsets outside the province.<sup>73</sup> To best ensure the government’s goals to reduce emissions are effectively met, the reductions should be made within the province, allowing efficiency improvements to benefit the BC economy.

## **Cost of Renewables**

Renewable technology has improved sufficiently over the last two decades that exorbitant costs are no longer characteristic of renewables. More widely-adopted forms of generation, such as solar and wind power, declined in price by 60

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<sup>68</sup> BC Hydro. 2008a; p.51

<sup>69</sup> *Ibid.* p.179

<sup>70</sup> *Ibid.* p.46

<sup>71</sup> Bailie, Alison, et al. 2007; p.58

<sup>72</sup> Western Climate Initiative. 2008; p.66

<sup>73</sup> Jaccard, Mark, et al. 2003; p.50

and 30%, respectively, from 1990 to 2000<sup>74</sup> and are expected to continue their descent. These cost decreases can be attributed to technological innovation and economies of scale achieved through increased manufacturing.<sup>75</sup> According to the Western Climate Initiative, small hydro and wind-generated electricity were already cost competitive to build over coal and nuclear in 2005 in the Western North American market, although natural gas still undercuts these sources.<sup>76</sup> This ability of fossil fuels to maintain relatively cheaper prices is due to a general trend of healthy subsidies to this sector, which Michael Jefferson calculates at approximately (US) \$150 billion annually across the globe,<sup>77</sup> which includes, among others, direct subsidies of \$50,000 per coal-bed methane well drilled in BC.<sup>78</sup> BC energy analyst Dale Marshall argues that renewable sources would already undercut the costs of gas and other conventional sources if they operated on a more level playing field, devoid of government subsidies to conventional energy generation, with the full costs of pollution included in cost calculations, and if the same economies of scale were enjoyed by renewables.<sup>79</sup>

The following example demonstrates that when relatively advanced wind turbine technology enjoys a level playing field, it competes in price with fossil fuel technology and dominates new generation in countries as geographically diverse as Denmark, Germany, and Spain.<sup>80</sup>

### **Blowing in the Wind**

The growth of wind turbine technology in Western Europe demonstrates how increased market share, based on government incentives, can lead to dramatically reduced costs, competitive with conventional sources of generation. During the 1980s, turbines increased in size from 10 to 50 kW, while 300-500 kW

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<sup>74</sup>Wüstenhagen, Rolf & Michael Bilharz. 2004; p.1689

<sup>75</sup> Berry, Trent. 2001. p.i

<sup>76</sup> Western Climate Initiative. 2008; p.81

<sup>77</sup> Jefferson, Michael. 2008; p.4122

<sup>78</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.21

<sup>79</sup> *Ibid.* p.39

<sup>80</sup> Lipp, Judith. 2007; p.5486+5488 and Del Rio, Pablo & Miguel A. Gual. 2007; p.1001

turbines were added in the early 1990s, and 1500 kW turbines were in production by 2003.<sup>81</sup> The data are derived from a 2004 article which also states that “manufacturers are currently testing 2-5 MW prototypes,”<sup>82</sup> which we know are already becoming out of date with plans to put up 6MW turbines off the coast of Denmark.<sup>83</sup> This increase in size corresponds with a dramatic increase in the number of projects on line, with Germany building another 15 000 MW of capacity from 2000 to 2007, to reach 21 000 MW of capacity by mid-2007.<sup>84</sup> The two factors combined have led to an 80% decrease in the cost of producing wind electricity,<sup>85</sup> with prime wind sites costing from €64-82/ MWh<sup>86</sup> to develop in Germany in 2006, and €41-50/ MWh in the best locations in China and Canada.<sup>87</sup>

These lower rates are now competitive with other sources in Germany, but the costs to develop these renewable technologies were paid by consumers through higher rates, averaging €31.5 per year.<sup>88</sup> Spain, to give another example, has maintained rates comparative to other countries since greatly increasing the portion of renewable electricity, and is expected to install wind generation at only €70/ MW by 2010,<sup>89</sup> while Danish utilities provide generators an average of only €57 per MWh of wind-generated electricity produced.<sup>90</sup>

Depending on the level of penetration, BC Hydro predicts wind could be produced in BC at prices between \$70-80/ MWh (approximately €44-50/ MWh).<sup>91</sup> The integration of these power sources will entail costs of integrating an inherently intermittent supply into the grid at a predicted additional \$10/ MWh, thus bringing

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<sup>81</sup> Wüstenhagen, Rolf & Michael Bilharz. 2004; p.1682

<sup>82</sup> *Ibid.*

<sup>83</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.20

<sup>84</sup> *Ibid.* p.7

<sup>85</sup> Lipp, Judith. 2007; p.5487

<sup>86</sup> € Euros will be used in their original currency as exchanging values to \$ Canadian dollars would ignore the higher price of materials, labour, and wages in the Euro zone.

<sup>87</sup> Milborrow, David. 2007; p.4

<sup>88</sup> Frondel Manuel, Nolan Ritter, Christoph M. Schmidt. 2008; p.4199

<sup>89</sup> Del Rio et al. 2007; p.1007

<sup>90</sup> Lipp, Judith. 2007; p.5492

<sup>91</sup> BC Hydro. 2008a; p.110

the price of a number of projects to approximately \$90/ MWh.<sup>92</sup> The utility sees slightly over 5000 MW of potential projects at this rate in the province, a threshold below the 20% penetration already achieved in Denmark,<sup>93</sup> but warns that the current spike in demand for turbines has raised the price of these units in the short term.<sup>94</sup> If the market pull provided by the European Union's renewable energy target of 20% by 2020 (compared to 6.5% now) and China's 2005 bill encouraging more renewables<sup>95</sup> are added to this, one can predict the price of turbines to fall further as more countries, including renowned cost-leader China, bring their turbine manufacturing online to compete with the efforts of the Danish and German heavyweights.

As BC Hydro does not discriminate as to the type of energy source in its calls for power and standing offers, low-cost small hydro has dominated new generation thus far with over half of successful bids from the 2006 call for power.<sup>96</sup> But, as the best sites near the load centre are developed, and the cost of wind and other technologies continues to decline, more IPP projects should use these types of sources. There remains an abundance of low-hanging fruit in BC, such as particularly well-suited Vancouver Island for wind sites,<sup>97</sup> and private developers will continue to have a choice in regard to what type of sources could offer them the highest return on investment.<sup>98</sup>

### **Cost Comparison**

This section has shown why renewables will continue to decline in price, while gas will rise, resulting in a change in the current cost equilibrium between conventional and alternative sources. The pendulum will swing further in the direction of those sources not restricted by finite resource constraints. In regards to

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<sup>92</sup> *Ibid.* 111

<sup>93</sup> Lipp, Judith. 2007; p.5484

<sup>94</sup> *Ibid.* 109

<sup>95</sup> Chien Taichen & Jin-Li Hu. 2008; p.3045

<sup>96</sup> BC Hydro. 2008a; p.76

<sup>97</sup> Archer, Cristina L. & Mark J. Jacobson. 2005; p.6

<sup>98</sup> Davis, Steve. 2009.

BC Hydro's forecasts presented above, the utility recognizes that: "if the world unfolded as per [their] most probable scenario [high gas/mid GHG], gas would not be economic."<sup>99</sup> In a subsequent comparison between potential generation projects, the utility presents a number of small hydro and wind projects as most likely costing less than upgrading its current thermal facilities,<sup>100</sup> let alone building new ones.

As the former cost argument against renewables now seems to be neutralized, and likely leaning in favour of renewables over the medium and long term, it is necessary to examine other variables making up the 'consumer's surplus' of electricity generation - the additional value gained by consumers in addition to the financial costs of generation technologies.<sup>101</sup>

## **Reliability**

After maintaining low rates, the most important consideration of utilities and their customers is the reliability of their electricity supply. BC Hydro holds reliability as one of its three main priorities, in conjunction with low costs and sustainability.<sup>102</sup> To ensure reliability, a utility must procure secure and ample generation. In examining this goal of energy security, this section will compare renewable and conventional sources in terms of the intermittency of their supply, before examining the influence of self-sufficiency targets on the export and import of electricity in BC.

## **Security of supply**

One can expect the wholesale market price of electricity to be driven up in the long-term by the cost of natural gas, but it is much harder to predict in the short term because of fluctuations in fuel costs and demand based on the state of the economy.<sup>103</sup> As a fuel that needs to be transported to the electricity generator,

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<sup>99</sup> BC Hydro. 2008a; p.228

<sup>100</sup> *Ibid.* 125

<sup>101</sup> Jaccard, Mark, et al. 2003; p.52

<sup>102</sup> BC Hydro. 2009; p.7

<sup>103</sup> BC Hydro. 2008a; p.138

natural gas is subject to changing market prices, making the cost of thermal generation difficult to predict. Since BC Hydro lacks its own natural gas storage capacity in the Lower Mainland,<sup>104</sup> it remains subject to the peaks and valleys of market prices as well as the possibility of more extreme circumstances where supply might not be readily available. It must be acknowledged that these 'extreme circumstances' are few and far between in comparison to the regular occurrence of days without wind or sun and lower water years. In order to compare conventional to renewable sources in terms of intermittency, a value judgment needs to be made in respect to variability in supply versus variability in price, as the supply of fossil fuels has an extensive track record, while the cost of an inherently free fuel (sun, wind, water, etc) should remain equally constant.

This value judgment is easier to make when the influence of one side, variability in either supply or price, is reduced. While the reliability of supply is an issue with renewables due to their intermittent nature, BC's current generation mix is ideally suited to provide storage capacity when renewable IPPs are unable to generate sufficient power. Hydro turbines can be quickly ramped up when circumstances merit and the reservoir network will have ample capacity even at peak times, once BC Hydro adds the extra turbines to its Revelstoke and Mica dams.<sup>105</sup> The largest capacity concerns will be for BC Hydro to pay close attention to weather reports to remain vigilant in ramping up their turbines before it is necessary and to maintain adequate transmission capacity to meet peak demand.<sup>106</sup>

Biomass or natural gas turbines are easily dispatchable when required, but to the detriment of efficiency. Fluctuating turbine speeds increase fuel consumption per MW of electricity produced, as does running at less than optimum capacity.<sup>107</sup> Changing the output from these facilities increases costs and CO<sub>2</sub> emissions as these vary in direct correlation with the change in fuel consumption.<sup>108</sup> Both forms of combustion generation can thus be used for changing capacity requirements, but to

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<sup>104</sup> Task Force on Energy Policy. 2002; p.93

<sup>105</sup> Cretney, Allison et al. 2007; p.40

<sup>106</sup> Maddaloni, Jessie D., Andrew M. Rowea, G. Cornelis van Kooten. 2008; p.591-592

<sup>107</sup> *Ibid.* 593

<sup>108</sup> *Ibid.*

the detriment of efficiency. With BC's large dam network, it can halt production from one turbine altogether rather than reduce the efficiency of others. Biomass and geo-thermal use a reliable fuel source that can be depended on to maintain a constant electricity supply.

### **Distributed generation**

When wind turbines or solar panels are located around a large enough area (*ie.* Southern BC), there is usually sufficient wind or sun in one area to make up for lulls in others. This then contributes to the yearly output of the electricity system, while requiring less aid in meeting capacity requirements, lowering the opportunity cost of using the reservoirs otherwise. Shaffer et al. discuss this issue of opportunity cost as one of their major qualms with BC Hydro backing up IPPs, as the short-term marketing capability of its hydropower would be reduced when forced to use its capacity domestically, thus not being able to take full advantage of high market prices for export.<sup>109</sup> This is an interesting argument, but as the utility's primary mandate is to provide its own customers with electricity, the ability to produce enough energy in the year to meet demand should be a higher priority. The extent of the handicap on export is also extremely small considering the small role of intermittent sources in the overall electricity mix, and if more generation is not built, more of the reservoir capacity will need to be stored for future use when it otherwise could turn a profit on the open market.

A distributed generation system incorporates other benefits in addition to aggregate reliability, including locating generation closer to markets - leading to lower line losses and avoided grid construction,<sup>110</sup> greater diversity in fuels - resulting in reduced volatility of prices,<sup>111</sup> local control - providing for greater stakeholder input in the production of power, and jobs in rural areas of the province.<sup>112</sup> The Energy Plan recognizes these values and aims to "create a more

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<sup>109</sup> Shaffer, Marvin & Associates Ltd. 2007c; p.12

<sup>110</sup> Portfire Associates (Marc Godin). 2007; p.4

<sup>111</sup> Tu, Alex. 2005; p.14

<sup>112</sup> Marshall 2004; p.40



level playing field by considering the aggregate value of a portfolio of various sources and regions of intermittent supply compared to their individually less-secure generation capabilities.”<sup>113</sup> This helps remedy the complaint from IPPs that BC Hydro discourages intermittent power through considering projects on an individual basis and giving penalties for not producing power on demand, negatively impacting on IPP’s ability to place lower bids during the calls for power. The nature of a ‘smart grid’ allows for greater modularity and shortened lead-time as generation projects are smaller in scope and capital requirements. It also reduces the costs of grid construction by decreasing the distance between generation and consumers,<sup>114</sup> and, optimally, shares the cost of new power-lines between numerous projects.<sup>115</sup>

To gain these numerous benefits, a smart grid requires the installation of hardware, software, and electronic transmission controls to automate management of the power grid.<sup>116</sup> A major component of this update is the installation of advanced meters, mandated for BC-wide completion by 2012.<sup>117</sup> These meters are produced in BC,<sup>118</sup> creating jobs and aiding in the development of a technology that will be able to compete in global markets. Net metering, a function of the advanced meters, allows consumers to generate electricity themselves and sell excess back to the grid.<sup>119</sup>

### **Self-sufficiency Targets**

To add to the prerogative of guaranteeing sufficient electricity generation to supply BC Hydro’s customers, the provincial government explicitly mandates, through the BC Utilities Commission’s *Special Direction No. 10*, that BC must be self-sufficient by 2016 and exceed low-water year requirements by 3000 GWh annually

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<sup>113</sup> BC Ministry of Energy... 2007b; p.7

<sup>114</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.40

<sup>115</sup> Cretney, Alison et al. 2007; p.39

<sup>116</sup> Umedaly, Mossadiq S. 2006; p.5

<sup>117</sup> BC Hydro. 2009; p.23

<sup>118</sup> Umedaly, Mossadiq S. 2006; p.20

<sup>119</sup> BC Progress Board. 2005; p.29

by 2025.<sup>120</sup> To meet these targets, BC would have to expand the growth of generation beyond the rate of demand increase to compensate for current supply met through energy imports. This shift towards a BC-exclusive energy policy would keep more jobs in BC, add to domestic energy security, and reduce import risks.<sup>121</sup>

The cost of self-sufficiency is estimated by Shaffer et al. to cost \$160 million per year, to double when the 3000 GWh insurance policy is included.<sup>122</sup> They expand on this analysis to report that “[t]he only certain thing self-sufficiency will do is ensure that BC resources are used to meet BC requirements regardless of the cost.”<sup>123</sup> This analysis is correct in saying that BC resources will be given preferential treatment through the policy – ensuring the province maximizes the employment benefits of producing all its own electricity itself – but the cost analysis is questionable. The \$160 million ‘cost’ only looks at historical electricity surpluses that no longer exist. It ignores annual energy constraints, which prevent BC from selling significant quantities of electricity at higher market prices as its reserves are needed for domestic consumption.<sup>124</sup> This cost estimate must also be weighed against the benefits of increased reliability in terms of certainty and predictability of electricity prices.

The primary reason given by the Energy Plan to promote self-sufficiency is to ensure abundant lead-time for new projects, thus, guaranteeing it will have enough electricity to supply all its customers, even in low-water years.<sup>125</sup> Additionally, BC Hydro will have more control to buy low and sell high when trading electricity with other jurisdictions, and will be less susceptible to price fluctuations on the electricity market. As a net importer, BC is a ‘price taker’, thus the room provided by the self-sufficiency target will help BC gain a fairer price for its exports.<sup>126</sup>

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<sup>120</sup> Province 2007; p.3

<sup>121</sup> BC Progress Board. 2005; p.viii

<sup>122</sup> Shaffer, Marvin & Associates Ltd. 2007a; p.5

<sup>123</sup> *Ibid.* p.12

<sup>124</sup> Bryant, Tyler. 2008; p.14

<sup>125</sup> BC Ministry of Energy... 2007b; p.1

<sup>126</sup> BC Progress Board. 2005; p.19

This shift could also be interpreted as barring generation projects whose fuel source could be exported elsewhere. While BC does produce sufficient quantities of fossil fuels for electricity generation, it forgoes higher foreign exchange if the fuels are used domestically, and still remains susceptible to fluctuating oil prices and the possibility of having to import these fuels in the future if prices rise significantly<sup>127</sup> or supplies are cut off. This leaves renewables as the only energy type whose on site fuel production will never be subject to market fluctuations or import supply issues.

The other major implication for the argument between renewables and conventional sources is that this shift to domestic supplies would certify that electricity based on coal would not be imported, thus aiding the government's goal to reduce the emissions of GHGs. Leading export markets for BC's energy - California, Washington, and Oregon - are accepting responsibility for the GHGs produced by generation for electricity they import.<sup>128</sup> Fortunately, electricity produced by small hydro and wind from BC fit the renewable portfolio standards (RPS) requirements set by these states and others in the WECC.<sup>129</sup> Because these portfolio standards require a certain percentage of electricity to be from renewable sources, over 80 000 additional GWh of renewable energy will be needed by 2015 in the WECC.<sup>130</sup> This supply gap will partially come from BC, as it should have 6000 to 8000 GWh/ year of extra energy available in regular water years for export, and has the transmission capacity to export South of the border.<sup>131</sup> Powerex, BC Hydro's subsidiary in charge of electricity trading outside the province,<sup>132</sup> could gain higher prices for its electricity exports under other's RPSs if the provincial electricity supply could be branded as 100% green. James Griffiths from Sea Breeze Power Corp points out that BC should not be selfish with its natural resources, as exporting

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<sup>127</sup> Dinica 2007; p.3568

<sup>128</sup> Bailie, Alison, et al. 2007; p.57

<sup>129</sup> BC Hydro. 2008b; p.15

<sup>130</sup> *Ibid.* p.19

<sup>131</sup> BC Hydro. 2008a; p.164

<sup>132</sup> BC Hydro. 2006a; p.3

this green power would replace dirtier power produced elsewhere, thus helping those jurisdictions reduce their GHG emissions and local environmental impact.<sup>133</sup>

As the self-sufficiency targets are based on low-water years, BC will normally have an abundance of extra electricity each year to sell. In order to earn back the costs of maintaining this surplus, the electricity will have to sell at the highest export market rates, which may be reserved for 'green' electricity to meet government requirements in other jurisdictions.

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<sup>133</sup> Griffiths, James. 2009.

## **CHAPTER 2: EMPLOYMENT AND TECHNOLOGY CLUSTERS**

Policies directed towards the provision of employment are a primary expectation of government for Canadian citizens. As the primary regulator of the economy, government aims to ensure maximum employment and job creation through maintaining a fertile economic climate. Managing a public utility, such as BC Hydro, enhances the ability to achieve this goal, as the utility employed 5185 people in 2008<sup>134</sup> as part of the province's energy sector total of over 35 000 people (2001 figure).<sup>135</sup> The manner in which the utility acquires new generation has large implications for the number of positions created in the electricity sector. This chapter will examine how electricity generation can be manipulated to create higher employment through the selection of employment-intensive technologies, the creation of technology clusters, and the optimum use of government funds to support growth in this sector.

### **Jobs**

#### **Renewables vs. Conventional**

The President and CEO of BC Hydro, Bob Elton, recognizes the central role the utility plays in the provincial economy in his opening message to the 2006 Integrated Electricity Plan: "Clean, abundant electricity has been, and always will be, the key to our province's economic prosperity and our quality of life."<sup>136</sup> The energy sector as a whole generates more than \$2.5 billion in provincial revenues,<sup>137</sup> with investments in renewable energy resulting in 60% more jobs per dollar invested

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<sup>134</sup> BC Hydro Annual Report. p.9.

<sup>135</sup> BC Ministry of Energy... 2002; p.5

<sup>136</sup> BC Hydro. 2006a; p.1

<sup>137</sup> BC Ministry of Energy... 2002; p.5

than conventional energy production.<sup>138</sup> Developing a research and manufacturing base for these technologies can further increase job-creation in BC.<sup>139</sup>

Guy Duancey, as President of the BC Sustainable Energy Association, calculates the province's renewable potential at over 32 000 GWh/ year, at a cost in the range of \$40 to \$90 per MWh, with a few wind projects costing up to \$120/ MWh.<sup>140</sup> Furthermore, he amalgamates employment figures from a number of sources to conclude that up to 44 000 jobs can be created in BC over the next 25 years if the province maximizes its potential in wind, small hydro, biomass waste, and geothermal electricity production.<sup>141</sup> These employment figures agree with those of the Pembina Institute, which estimates 37 jobs are created in renewables per million dollars of investment, compared to 7 for natural gas and coal.<sup>142</sup> Mossadiq Umedaly, with the government-created Alternative Energy and Power Technology Task Force, calculates that the revenues of the Sustainable Energy sector in BC total \$700 million for the approximately 100 companies and 3000 employees operating in the sector.<sup>143</sup> More importantly, the Task Force ascertains that this sector can potentially triple in size, both in terms of revenue and jobs, over the next decade.<sup>144</sup>

While the maintenance of small hydro projects is not labour intensive<sup>145</sup>, wind installations require a high number of labour-hours for maintenance and operation per unit, and both bring jobs to rural areas of the province.<sup>146</sup> The socioeconomic benefit of creating rural jobs was a priority for Spain in designing its electricity system, and it now has over 17 000 employees in the wind sector, mostly in job-hungry rural areas.<sup>147</sup>

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<sup>138</sup> Campbell, Barbara, Larry Dufay, and Rob Macintosh. 1997; p.10

<sup>139</sup> *Ibid.*

<sup>140</sup> *Ibid.*

<sup>141</sup> Dauncey, Guy. 2005; p.8

<sup>142</sup> Campbell, Barbara, Larry Dufay, and Rob Macintosh. 1997; p.7-8

<sup>143</sup> Umedaly, Mossadiq S. 2006; p.6

<sup>144</sup> *Ibid.*

<sup>145</sup> Calvert, John. 2007a; p. 184

<sup>146</sup> Tu, Alex. 2005; p.15

<sup>147</sup> Del Rio, Pablo & Miguel A. Gual. 2007; p.1008

In addition to jobs created in project development, manufacturing, and, less so, in maintenance, Guy Duancey argues that the tourism sector could benefit from BC branding itself as a province solely reliant on green energy, thus marketing BC as a ‘sustainability tourism destination’.<sup>148</sup> This could add to the \$5 billion in economic activity currently attributed to this sector.<sup>149</sup> Against this argument, Dr. John Calvert contends that power lines and river usage can have a negative impact on tourism in certain cases, as was recognized by the Squamish-Lillooet Regional District.<sup>150</sup> This ‘unsightliness’ might be lower for renewables than thermal generation, but may still negatively impact on tourism, leaving the overall impact on tourism as negligible.

### **Germany – Employment Growth**

With massive offshore and onshore fields of gargantuan wind turbines majestically turning in the wind, one can imagine that the sheer size of Germany’s wind industry could be a draw to tourists. The renewable industry in Germany has created over 200 000 jobs, according to the German government, with 70 000 of these in the wind industry alone.<sup>151</sup> The 750 companies working in the wind industry generate annual revenue of €7.2 billion, €4.1 billion of which is through exporting turbines,<sup>152</sup> part of the “ripple effect on partner countries in which German energy plants are being built and subsidiaries are being established.”<sup>153</sup> According to Ulrike Lehr et al. in their article “Renewable Energy and Employment in Germany,” if government support continues in the same manner, through favourable green energy tariffs and portfolio standards, incentives to companies, and export promotion abroad, the renewables sector could double to 400 000 by 2030.<sup>154</sup> In neighbouring Denmark, the impact of the wind sector has been similar,

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<sup>148</sup> Dauncey, Guy. 2005; p.16

<sup>149</sup> BC Ministry of Management Services. 2004. Tourism Sector Monitor. (February). Victoria. p.7

<sup>150</sup> Calvert, John. 2007a; p.173

<sup>151</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.7-8

<sup>152</sup> *Ibid.* p.22

<sup>153</sup> *Ibid.* p.8

<sup>154</sup> Lehr, Ulrike, et al. 2008; p.117

with 20 000 Danish workers in their wind industry, with 40% of the global wind turbine market.<sup>155</sup>

Frondel et al. take a more negative perspective of this progress, arguing that “[t]he resulting drain of purchasing power and investment capital of private and industrial electricity consumers causes negative employment effects in other sectors [casting...] doubt on whether the [...] employment effects are positive at all.”<sup>156</sup> This argument is questionable for Germany’s diverse and robust economy, as it relies on the debatable premise that competition in the economy takes investment away from other sectors, thus negatively impacting employment prospects in these other sectors.

Germany’s early push towards wind and solar technology has placed it as the global leader in developing sustainable energy technologies, and employment creation in this field. BC and other jurisdictions should look to how they can manipulate their own electricity sector to accrue the benefits in employment and revenue enjoyed by Germany. As BC has ample resources in wind, water, and sun (outside the lower mainland), it should emulate Germany in creating employment in this field instead of subsidizing the oil and gas industry, which has little chance of occupying a leadership role in the field considering the current high costs driven by development in Alberta, BC’s neighbour and a fossil fuel juggernaut.

## **Innovation and Technology Development**

To continue with the German example, this section will discuss another lesson learned from the progress in this jurisdiction – how best to encourage technological development in renewable technology. Germany will offer an example of how government might be involved through comparing its efforts in wind to its lead in solar technology.

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<sup>155</sup> Lipp, Judith. 2007; p.5492

<sup>156</sup> Frondel Manuel, Nolan Ritter, Christoph M. Schmidt. 2008; p.4201



## Germany – Innovation Leader

The Frondel et al. article also offers a much less effective argument against PV in the country in respect to jobs per dollar spent on these technologies: “[g]iven our net cost estimate of about €7.2 billion for 2006 [...], per-capita subsidies turn out to be as high as €205,000, if indeed 35,000 people were employed in the PV sector.”<sup>157</sup> The problem with this argument is three fold: it is based on false statistics, false math, and ignores indirect employment and other benefits. The German government’s statistics show there were 40 000 employed in the PV industry in 2006,<sup>158</sup> not 35 000. The industry gained €5.4 billion in revenue that year,<sup>159</sup> less than €1.4 billion of which came from the feed-in tariff, not €7.2 billion, if you calculate the nominal cost, and not the cumulated cost going back to 2000, as the article had wrongly<sup>160</sup> done.<sup>161</sup> Using this more accurate data and calculations, per-capita subsidies for direct employment were €35 000, still very costly, but much less than the €205 000 offered in the article.

By measuring only the number of direct jobs created, this equation also ignores the extensive external benefits accrued through the promotion of research and innovation by a government and becoming a global technology leader. Germany, through other market-led incentives, has managed to use more cost-effective solar technology through installing over a million roof-based solar water heaters by 2006.<sup>162</sup> It should also be noted that the German electricity sector is responsible for 40% of CO<sub>2</sub> emissions in the country as half of its electricity is produced from lignite and coal,<sup>163</sup> and is a sector where the government aims to reduce emissions. Through innovative programs, including promoting the greater use of renewables, the government has helped private citizens and industry reduce their GHG

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<sup>157</sup> *Ibid.* 4201

<sup>158</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.24

<sup>159</sup> *Ibid.*

<sup>160</sup> ‘Wrong’ as using cumulative spending figures requires calculating the employment positions associated with this spending for each year from 2000 to 2006, and not just one year on its own.

<sup>161</sup> Frondel Manuel, Nolan Ritter, Christoph M. Schmidt. 2008; p.4201

<sup>162</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.26

<sup>163</sup> Schumacher, Katja, Ronald D. Sands. 2006; p.3931

emissions by 15% over 1990 levels,<sup>164</sup> making it on-track to meeting its Kyoto targets, while enjoying a 25% growth in GDP.<sup>165</sup> In addition, while the installation of solar panels has not been cost-competitive with other sources up to date, neither were wind turbines in the first few years of large-scale use. Indeed, Karl Mallon demonstrates how market growth correlates positively with a decrease in the price of solar-based technology.<sup>166</sup> Some analysts believe that PV should become cost-competitive with other sources by 2015, due to the high-deployment and incentives offered in countries at the forefront of this technology.<sup>167</sup> As Michael Jefferson emphasizes, there should be “effective barriers to the pursuit of sub-optimal renewable energy proposals [...] when largely funded by taxpayers or electricity consumers.”

Only time will tell if investments in solar technology have been cost-effective for Germany, but other energy investments should have been made more carefully. Spending by the German government up to 2001 was 80% higher for nuclear power than for renewables as it was seen as a more cost-effective energy source.<sup>168</sup> Due to public opposition and environmental concerns, the Anti-Nuclear Act was passed in 2000, forbidding new nuclear facilities in the country.<sup>169</sup> Thus, while Guy Duancey argues that BC could “create over 200 000 jobs through maximizing its solar PV potential,” the government should first calculate whether BC enjoys a comparative advantage in developing this technology. To calculate if solar is the best option, the government would have to consider the availability of this industry’s primary resource (sunlight), how the benefits of a solar technology cluster compare to other technologies where BC does enjoy a resource advantage (high-flow creeks and rivers, high coastal and mountain winds, ocean currents, and abundant forestry biomass), and if it has the necessary industrial (companies involved in the technology), human (people with the requisite training), and research (developed

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<sup>164</sup> *Ibid.* p.3929

<sup>165</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.39

<sup>166</sup> Mallon, Karl, ed. 2006; p.8

<sup>167</sup> Peters, Roger, Paul Cobb, Mark Winfield. 2007; p.4

<sup>168</sup> Wüstenhagen, Rolf & Michael Bilharz. 2004; p.1683

<sup>169</sup> *Ibid.* p.1684

research sector) resources. Government must carefully weigh the options available before considering offering any source an economic or other advantage over other sources through generation subsidies or encouraging the formation of a technology cluster to accrue the maximum benefits from that resource. Proponents of each generation technology will always argue that their own is best.

### **Technology Clusters**

Developing a technology cluster can add to a comparative advantage that already exists and increases a region's advantage in the technology through the collaboration of multiple companies and organizations, each occupying a niche in a larger effort. Many well-known examples present themselves, such as Silicon Valley, California for information technology, Fort McMurray, Alberta, for petroleum technology, or, Germany for wind energy technology, where knowledge, technology, and efforts coalesce in the aggregate supply of all three variables. As technological change happens rapidly, Mans et al. point out that it is impossible for one organization to "possess all capabilities and resources required for research and develop activities in-house."<sup>170</sup> Competences are thus distributed across an industry, making it necessary to work with partners whose work is complementary to one's own. When such a cluster exists, the cost of the technology quickly declines as multiple advances are made. Jobs associated with the primary resource are multiplied exponentially as companies pursue a myriad of opportunities available in value-added manufacturing and research. These advances could also be considered legacy contributions to the economy as they are not associated directly with the building of new electricity infrastructure, but remain viable in terms of revenue and employment in the long-term, with technology and equipment exported to other jurisdictions.

In order for BC to take advantage of such a cluster for a renewable technology suitable to the province's needs and resources, the cluster would need to cooperate and communicate well amongst its members and receive extensive

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<sup>170</sup> Mans, Pieter, et al. 2008; p.1375

support during its formative period.<sup>171</sup> This type of funding should not be provided to commercially viable technologies, because, as Karl Mallon amusingly comments, this is akin to putting ‘nappies on a teenager’,<sup>172</sup> but instead should be aimed towards a very limited array of associated technologies near the beginning of their development cycle, in order to focus all energy and efforts on a single goal. Companies are more vulnerable during the stage of innovation when the technology is not yet commercialized and before significant market growth has been achieved.<sup>173</sup> If the government would like BC Hydro to meet its goal to “build on our province’s record of foresight, innovation and sustainability,”<sup>174</sup> it needs to follow the advice of its Alternative Energy and Power Technology Task Force and promote conservation, invest in research and development (R&D), and build a sustainable energy portfolio.<sup>175</sup> While the self-sufficiency target will help establish clusters, the BC government needs to provide leadership for the development of a technology cluster around a particular budding renewable technology.

## **BC Potential**

“BC has the people and the resources to help drive the global shift toward alternative energy and power technology as part of our goal of leading the world in sustainable environmental management. [...] Demand for that expertise will only continue to grow.” – Premier of BC, Gordon Campbell

As the home to a plethora of companies involved in every facet of alternative energy production, BC is ‘well-positioned to take advantage of this growth’.<sup>176</sup> In addition to the 137 IPPs who are, or hope to soon be, involved in small-hydro electricity generation,<sup>177</sup> Xantrex Technology, with revenues over \$150 million, is

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<sup>171</sup> *Ibid.*

<sup>172</sup> Mallon, Karl, ed. 2006; p.9

<sup>173</sup> Umedaly, Mossadiq S. 2006; p.18

<sup>174</sup> BC Hydro. 2006a; p.4

<sup>175</sup> Umedaly, Mossadiq S. 2006; p.64-70

<sup>176</sup> Task Force on Energy Policy. 2002; p.19

<sup>177</sup> [www.citizensforpublicpower.ca/node/381](http://www.citizensforpublicpower.ca/node/381)

Canada's largest company in the renewable power technology sector.<sup>178</sup> This company manufactures power electronics products, develops systems for a variety of electricity system applications, and helps produce smart grid technology needed for incorporating a large percentage of intermittent renewables in the generating mix.<sup>179</sup> Xantrex, numerous IPPs, an advanced manufacturing sector, and the research potential at the province's larger universities, demonstrate the province's potential for leadership in sustainable energy technology.

Having produced \$3.5 billion in electricity in 2004, BC has the domestic market potential to encourage growth of its current base in experimental tidal energy, hydrogen fuel cells, and local geo-thermal energy solutions.<sup>180</sup> Mossadiq Umedaly believes "[w]e can work together to accelerate this sector by retaining and growing existing companies, encouraging new start-up activity, and attracting additional companies large and small from outside the region to aid in integrating our local innovations into complete solutions." Doing so requires leadership from the government, such as the recent creation of the Premier's Technology Council, which concluded in its report that it "believes BC is poised on the edge of the next big market growth opportunity." To take advantage of this opportunity, BC has to provide the largest domestic market for renewable technology and create a long-term strategy that promotes manufacturing components in BC over importation. It must also eschew the technology-neutral approach now followed, which fails to encourage manufacturing<sup>181</sup> for those technologies that are the most competitive options in BC, and have the most long-term potential.

This presents a tremendous opportunity for today's government to decide on the future configuration of BC's growing electricity generation while accruing benefits in employment, research, and innovation through the use of technology clusters. One necessary step is to determine where the best opportunities lay for BC to exploit its comparative advantages in electricity generation. Coal, gas, or nuclear,

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<sup>178</sup> Umedaly, Mossadiq S. 2006; p.50

<sup>179</sup> *Ibid.*

<sup>180</sup> BC Progress Board. 2005; p.2

<sup>181</sup> Mallon, Karl, ed. 2006; p.48

have too tiny a market opportunity in BC compared to their global reach, and thus will never partake in cluster formation in the province. The 'hydrogen highway' receives major funding and attention from the provincial government, with 20 hydrogen fuel-cell buses to be showcased and used by BC Transit during the 2010 Olympics in Whistler,<sup>182</sup> demonstrating the province's potential in the field of alternative technology. Large hydro is already BC's specialty, but while small and large-hydro require specialty manufacturing for their turbines, this technology is well developed and has not progressed significantly in recent history. Wind technology is also well on its way, although BC might work to adapt this technology to more extreme environments, such as on icy mountain ridges or in deepwater offshore, where BC has its highest average wind speeds. Solar, as mentioned, is already being improved in other areas that have higher annual levels of sunshine overall, and thus more potential applications. Biomass might have high potential in the province. With the current downturn in forestry sector profits and employment, and the pine beetle infestation reaping havoc on BC forests, the \$150 million of energy produced by this sector in 2005 could grow quickly, using an otherwise wasted feedstock.<sup>183</sup> Tidal and ocean current technologies are in their infancy and could benefit the province from a wide range of cluster-based opportunities if the technology is promoted early on and progresses to cost-viability in the future.

### **Tides of Change**

The test tidal power project at Race Rocks (Southwest of Victoria) was developed as a partnership between government, industry, and academia, and is expected to produce 77 MWh per year at a cost of \$100-300/ MWh, less than one fifth of what BC Hydro expects its PV installations to cost.<sup>184</sup> This is impressive considering it is a one-off, experimental, and small-scale project, and demonstrates that BC could find the know-how to produce its ample tidal resources. BC Hydro asked Triton Consultants to complete a tidal current resource inventory for BC in

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<sup>182</sup> BC Ministry of Energy... 2007a; p.22

<sup>183</sup> *Ibid*; p.18

<sup>184</sup> *Ibid*; p.24

2002, which showed ample potential in the province, much of it close to the load center.<sup>185</sup> Work is now also underway to develop an Ocean Energy Atlas for Canada.<sup>186</sup> Equipped with this information and a favourable investment climate and incentives regime, BC could develop the required technology in ocean-turbines and small-gauge under-sea electric cables, and market its products and knowhow to other jurisdictions if given adequate opportunity to develop first in BC. As mentioned in the 2006 *Ocean Energy on Crown Land in BC; Discussion Paper*, BC has the opportunity to provide leadership on this front, but “despite the high degree of risk involved in ocean energy projects, there are no explicit incentives to industry at this time to foster the development of this renewable resource,” and this major hurdle will first need to be overcome before accelerated technology development will occur.<sup>187</sup>

### **Feed-in Tariff vs. Renewable Portfolio Standard**

The debate over the best policy for government to use to shift the cost equation further towards renewables over existing fossil fuel generation is dominated by the merits of the Renewable Portfolio Standard (RPS) versus the feed-in tariff (FIT). The RPS requires that a certain percentage of a utility’s supply comes from renewable generation, leaving it more open to the utility to decide among the best options, while the FIT guarantees a certain price for each MWh of renewable electricity produced, usually at higher rates than conventional supplies.

While 25 US states<sup>188</sup> and four Canadian provinces<sup>189</sup> are in the process of implementing an RPS, this option would make less sense for BC as, depending on the criteria, 90% of its generation might already qualify as renewable. BC Hydro’s older 2001 voluntary standard that 10% of new generation come from alternative sources was regressive considering 86% of its generation was already from renewable

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<sup>185</sup> BC Ministry of Energy... and the Ministry of Agriculture and Lands. 2006; p.27

<sup>186</sup> *Ibid.*

<sup>187</sup> *Ibid.*

<sup>188</sup> BC Hydro. 2008b; p.9

<sup>189</sup> Rowlands, Ian H. 2005; p.54

sources.<sup>190</sup> By taking the advice of this paper and employing a 100% renewable Energy Plan, to be implemented by 2016, this would effectively be congruent to an RPS set at 100%. A prerequisite that all new generation be renewable, and that current non-renewable facilities be replaced over time, would allow the province to enjoy the positive attributes of an RPS. Marc Jaccard, in his “Renewable portfolio standard” article, extols the benefits of an RPS by explaining that an RPS “maintains continuous incentives for renewable producers to seek cost reductions through continuous cost competitions among renewable producers,” “can be linked to government policy objectives,” and “minimizes government involvement.”<sup>191</sup>

Leaving technology choice up to the market by accepting the lowest bidders for each call for power, regardless of generation source, does not distinguish between different technologies and where they are located in their technology development cycle, eroding early-adopter benefits.<sup>192</sup> Without a FIT or similar mechanism, the BC government will find it difficult to encourage the development of emerging technologies, or to increase the diversity of its power supply away from hydro sources. It has also been shown by Italy and Denmark that removing a FIT results in a subsequent stagnation in the installation of new renewable generation,<sup>193</sup> while the UK, with an RPS but no FIT, has shown how difficult it is to reach targets without the incentive of stable, guaranteed prices for electricity from renewable sources.<sup>194</sup> Using a FIT would also allow the government to have more influence over the location of generation in addition to technology type, and would allow it to emulate Germany in setting rates for each type of technology to decline as they progress along their learning curve.<sup>195</sup> The FIT has proven to be more effective and efficient a mechanism than any other across Europe,<sup>196</sup> and BC should consider

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<sup>190</sup> Task Force on Energy Policy. 2002; p.31

<sup>191</sup> Jaccard, Mark. 2004; p.415

<sup>192</sup> Lipp, Judith. 2007; p.5483.

<sup>193</sup> Rowlands, Ian H. 2005; p.57

<sup>194</sup> Lipp, Judith. 2007; p.5489

<sup>195</sup> *Ibid.* p.5488

<sup>196</sup> Erdmenger, Christoph, et al. 2009; p.162



adopting a similar approach if it wishes to diversify the source of its electricity away from a dominance of hydro and towards emerging technologies.

### **Governmental Support**

As verified by BC Hydro employee, Kenna Hoskins, the BC Energy Plan provides a specific direction for how BC Hydro should acquire its generation, through 'buying, building, and conservation' and is thus able to have far-flung impacts on BC's future generation mix.<sup>197</sup> Judith Lipp, recognizes that to move alternatives beyond 'treehuggers and tinkerers', the playing field with conventional energies has to be levelled through "addressing administrative barriers, allowing grid access, encouraging financing and bringing the public onside."

The 2007 *Energy Independence and Security Act* (P.L. 110-140, H.R. 6) set US strategy encouraging the availability of renewable energy.<sup>198</sup> A major provision of the Act is to accelerate R&D in renewable energy through providing funding for solar and geothermal energy, as well as grants towards secondary institutions to create National Marine Renewable Energy Research, Development, and Demonstration Centers, and \$125 million (USD) to fund training for jobs in 'green' industries, including renewable energy.<sup>199</sup> It will be exciting to see how the new US administration will follow through with its pledge to place the US at the forefront of innovation in green technologies. The BC government cannot afford to allow this sector to fall behind while companies in other jurisdictions, such as the US, continue to receive government help through a variety of measures, including subsidies, support for R&D, streamlining procedures, and renewable-friendly policies.

To enjoy the greatest benefit from the formation of renewable energy technology clusters, they must be competitive with other similar clusters, and play a leadership role in their respective technology. In order to do so, the BC government needs to provide funding for R&D in renewable technologies, to the tune of the \$25 million budgeted towards the Innovative Clean Energy Fund to aid in the

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<sup>197</sup> Hoskins, Kenna. 2009

<sup>198</sup> Sissine, Fred. 2007; p.1

<sup>199</sup> *Ibid.* p.12 & 23

development of new technologies across a range of fields.<sup>200</sup> While BC Hydro has declared support for private involvement in developing renewable energy technologies,<sup>201</sup> IPPs argue that it needs to streamline contract approval procedures and make clearer signals over what types of proposals will be approved.<sup>202</sup> To bring more innovative projects online sooner, James Griffiths believes “BC Hydro should provide much clearer direction to IPPs in terms of when the market opportunities will occur, how large these opportunities will be, what fuel types and locations will be preferred, and what evaluation methods will be applied by BC Hydro”, as this transparency would increase the possibility of gaining a contract, thus helping to raise confidence and corporate financing on the stock market.<sup>203</sup> Making the Energy Plan 100% renewable would be a first step in sending the signal to citizens and investors of what type of generation will be built in the future, while adopting a FIT with specific rates depending on how extensively the government would like to encourage each type of technology would give this certainty to the many IPPs without a contract.

The specific price signals of a FIT seem biased away from renewables, as prices are higher at certain times of the year (*ie.* 125% of the normal price is paid during high-load hours in January compared to 70% during low-load hours in June),<sup>204</sup> which renewables, dependent on seasonal and weather variability, cannot take advantage of. As renewable generation is based on intermittent sources, Steve Davis contends, it faces the “challenge, thus, that Mother Nature does not have a dispatch office.”<sup>205</sup> While Davis does not dispute the FIT mechanism and seasonal pricing, he contends the utility of the ‘liquidated damages’ BC Hydro charges renewable IPPs when they cannot meet their GWh forecast for a given month, based on bid forecasts made years earlier.<sup>206</sup> By not taking into account BC’s extensive dam network and

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<sup>200</sup> BC Ministry of Energy... 2007a; p.17

<sup>201</sup> BC Ministry of Energy... 2002; p.9

<sup>202</sup> Griffiths, James. 2009.

<sup>203</sup> *Ibid.*

<sup>204</sup> Davis, Steve. 2009.

<sup>205</sup> *Ibid.*

<sup>206</sup> *Ibid.*

surplus capacity, these price signals are artificial and not based on true costs. This is compounded by not taking into account the aggregate reliability of numerous sources, which reduces overall variability. The effect of these skewed price signals is that the overall bid for each project has to be higher to make up for the discrepancy, thus reducing the cost-viability of renewable projects.

Furthermore, the BC government needs to aid in selling the services and competitive advantage of the cluster abroad, as the German government does through making contacts abroad, inviting them to visit German companies and facilities, and providing space for German companies at trade shows abroad.<sup>207</sup> By taking a more active role in growing and promoting a renewable energy cluster in BC, the province can reap the benefits of higher revenue and employment. To pursue those avenues open to the government as described above, the *Alternative Energy and Power Technology: A Strategy for BC*, produced by the BC Ministry of Energy and Mines, sets out the goal to showcase BC solutions for power issues in high-growth markets abroad.<sup>208</sup> But, as the strategy emphasizes “[w]e must apply our integrated and innovative solutions in BC first, then showcase them to eager customers abroad.”<sup>209</sup>

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<sup>207</sup> Sendner, Helmut for the Federal Ministry of Economics and Technology. 2008; p.9

<sup>208</sup> BC Ministry of Energy and Mines. 2005; p.3

<sup>209</sup> *Ibid.*

## CHAPTER 3: ENVIRONMENTAL IMPACT AND PUBLIC OPINION

### The Environment

*“The BC Energy Plan: A Vision for Clean Energy Leadership is British Columbia’s plan to make our province energy self-sufficient while taking responsibility for our natural environment and climate.”*<sup>210</sup> – Premier Gordon Campbell

The BC government’s fourth ‘Great Goal’ (as set out in the province’s strategic plans from 2006 to 2009) is to “lead the world in sustainable environmental management, with the best air and water quality and fisheries management, bar none.”<sup>211</sup> The electricity sector cannot be ignored while pursuing this goal as its generation mix has significant environmental impacts. This section will discuss how the government can meet this goal by reducing the impact of the electricity sector on the environment, thus affecting human quality of life and health, and public opinion of the electricity system.

### GHG Emissions

The argument for reducing GHG emissions is not only for the inherent benefit of the environment. Ian Bruce from the David Suzuki Foundation warns that climate change might result in “[h]otter summer temperatures, threatening water supplies and salmon populations. In years to come, rising sea levels could threaten B.C. coastal communities.”<sup>212</sup> The reduction of GHGs will also reduce costs associated with carbon cap and trade, as mentioned earlier, and will help meet the

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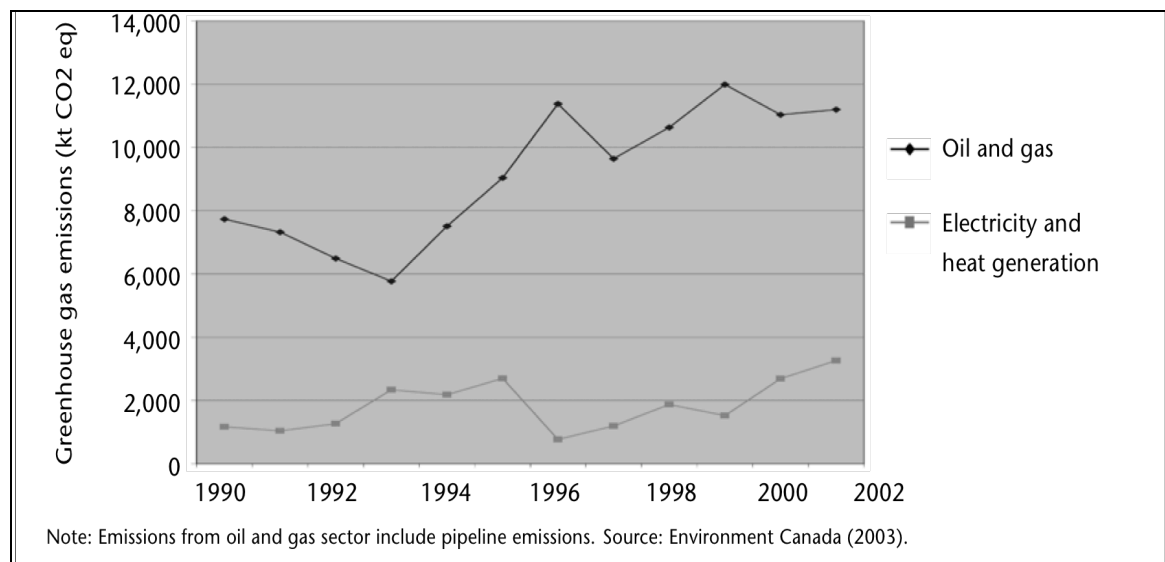
<sup>210</sup> BC Ministry of Energy... 2007a; p.1

<sup>211</sup> As cited in Bruce, Ian. 2006.

<sup>212</sup> Bruce, Ian. 2006.

government's target of reducing GHG emissions by 33% by 2020.<sup>213</sup> *Mind The Gap; A Blueprint for Climate Action in BC*, a report produced by The Pembina Institute, outlines how the province could meet its commitments through significant reductions across all economic sectors.<sup>214</sup> While most sectors need to reduce emissions on average by one third, the report sees reductions for the electricity sector as among the most expedient and easiest to pursue, and thus suggests cutting all emissions associated with the sector.<sup>215</sup> Using Environment Canada data, the David Suzuki Institute shows the steady increase in the level of GHGs emitted by the BC electricity sector, reproduced in Figure 3 below,<sup>216</sup> which have leveled off since 2003:<sup>217</sup>

**Figure 3: BC GHG Emissions from the Oil and Gas and Electricity Sectors**



The comparison to the Oil and Gas sector (discussed further below) shows that electricity's overall contribution to GHG emissions is relatively small, but there are opportunities in the sector to help meet the government's GHG-reduction commitments. The potential of electric cars gaining market share over their internal-combustion counterparts could herald an even greater increase in

<sup>213</sup> BC Hydro. 2009; p.43

<sup>214</sup> Bailie, Alison, et al. 2007; p.1

<sup>215</sup> *Ibid.* p.10

<sup>216</sup> Table found in Marshall, Dale with Jodi-Lyn Newnham. 2004; p.6

<sup>217</sup> BC Hydro. 2009; p.44

electricity demand and mean that cleaner electric sources will power more of the transportation sector, now reliant on diesel and gasoline.

The personal view of many Canadians, exemplified by Daniel T. Potts, from the Joint Industry Electricity Steering Committee, is that Canada only produces 3%<sup>218</sup> of global GHG emissions, so if BC reduced its own share it would barely make a dent globally, and thus a move towards renewables would be a ‘feel good’ strategy, without any true impact.<sup>219</sup> This point does not consider the plethora of other benefits associated with this shift to renewables raised above, and can be attributed to the ‘free-rider’s’ problem, where non-participants in a cooperative effort still benefit from the rewards. The Western Climate Initiative and other international efforts attempt to remove the temptation to cheat on climate change commitments. Although BC’s own efforts would do little to reduce the impact of global climate change on the province, by taking this stance, BC would fail to reap the cost-reduction, employment, innovation, and environmental benefits that are the focus of this project.

### **Environmental Impacts of Competing Sources**

The detrimental effects of generation extend significantly beyond emitting gases that exacerbate the pattern of global warming. Emissions can also be hazardous to human health, and the land impacts of various facilities harm quality of life, cultural histories, and can endanger wildlife. The remainder of this chapter takes a human-centric approach to environmental degradation in relation to its impacts on health and quality of life. Here, the benefits of renewable play into public support, a primary consideration of democratic governments.

Due to the environmental and financial risk of nuclear-based generation, the BC government has already made the pact that there will be ‘no nuclear generation’ in the province.<sup>220</sup> BC Hydro goes further and aims to achieve no ‘net incremental

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<sup>218</sup> Rough estimation.

<sup>219</sup> Potts, Daniel T. 2009.

<sup>220</sup> BC Ministry of Energy... 2007b; p.23

environmental impact by 2024' as their environmental priority.<sup>221</sup> To aid in meeting their long-term goals, BC Hydro takes the triple bottom line approach, considering environmental and social concerns in addition to financial.<sup>222</sup> In 2007, the utility created an Environmental Risk Management and Reporting Framework to provide a 'consistent structured approach' to Environmental Risk Assessment.<sup>223</sup> As part of this approach, the utility incorporates a comprehensive reporting mechanism including solid waste recovery, GHGs emissions, water management, and 'environmental incidents' from all of its operations.<sup>224</sup> Their efforts to reduce impacts in all of these domains include their office-based operations, electric-line work, and generation through their own facilities or purchased elsewhere.<sup>225</sup> To meet BC Hydro's goal of 'no net environmental impact', the aggregate environmental degradation of each generation source must be considered.

### **Fossil Fuel Impacts**

One of the four main goals of Spain's national Institute for Energy Saving and Diversification, their principal public energy agency, is the reduction of the environmental and health impacts of fossil fuels.<sup>226</sup> This recognition by a major government body of the detrimental health effects of burning fossil fuels is due to the emissions profile of all fossil fuels, which includes NO<sub>x</sub>, SO<sub>2</sub>, CO<sub>2</sub>, and particulate matter.<sup>227</sup> When a province that funds public healthcare, such as BC, allows for fossil fuel generation, a small fraction of health costs derived from respiratory illnesses will be directly related to this choice to use fossil fuels for electricity generation.

Beyond health, the development of fossil fuels are also responsible for 21% of total GHG emissions in the province,<sup>228</sup> and a host of other environmental issues

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<sup>221</sup> BC Hydro. 2009; p.41

<sup>222</sup> *Ibid.*

<sup>223</sup> *Ibid.*

<sup>224</sup> BC Hydro. 2009; p.42-46

<sup>225</sup> *Ibid.* p.46.

<sup>226</sup> Dinica, Valentina. 2008; p.3568

<sup>227</sup> BC Hydro. 2008b; p.10

<sup>228</sup> Bailie, Alison, et al. 2007; p.32

that may affect the quality of life of BC citizens are associated with the development and exploration of these sources.

A thorough evaluation of the environmental impacts of electricity requires examining the entire energy cycle of the fuel source as well as the generation of the electricity itself. It is important to consider this side of the equation when determining how the public will react to building more of a certain type of generation in the province. Without providing an alarmist view of the environmental impacts of fossil fuel exploration, these activities do impact water and air quality, and fish and wildlife habitat, during road construction to drilling sites, seismic testing, marine and road transportation of the fuel and equipment, and from the extraction, refining, and energy generation processes themselves.<sup>229</sup> People take into consideration how their own quality of life may be impacted by the fuel-extraction elements of a particular generation source when formulating their opinion over if BC Hydro should build or purchase more of that type of generation. Consideration of the entire energy cycle is reflected in BC Hydro's disclosure that "the increasingly stringent, but yet to be completely defined, regulatory environment [has led] BC Hydro to believe that it is better to place additional weight on clean or renewable resources than on natural gas-fired resources at the present time and in the foreseeable future."<sup>230</sup>

## **Ban on Coal**

As part of its call for power, BC Hydro introduced the possibility of including coal in the generation mix by awarding two electricity contracts for coal-powered generation in July 2006.<sup>231</sup> The two plants were to provide 2000 GWh annually, while emitting 1.83 million tonnes of GHGs per year, increasing emissions of the provincial electricity sector by 115%.<sup>232</sup> The government and BC Hydro had been open to producing coal-fired power in the province, but negative public opinion of

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<sup>229</sup> Cretney, Alison et al. 2007; p.20-31

<sup>230</sup> BC Hydro. 2008a; p.5/70

<sup>231</sup> Bruce, Ian. 2006.

<sup>232</sup> *Ibid.*



this decision<sup>233</sup> led to priority 20 of the Energy Plan, which required all coal-fired plants to “use clean-coal technology, carbon sequestration, and then offset any remaining GHG emissions.”<sup>234</sup> As carbon capture and sequestration is not yet a proven technology, BC Hydro has determined that ‘clean-coal’ is ‘not a commercial technology at this time’, and thus will not be used in BC before these technologies are adequately proven elsewhere.<sup>235</sup>

Dale Marshal and Jodi-Lyn Newnham agree with this initiative and believe coal should be banned outright from electricity generation in direct coal-fired plants as well as in co-generation facilities.<sup>236</sup> This conclusion is based on the severe detrimental impact of coal-fired generation on the environment, due to the hazardous chemicals this type of generation emits, including: sulphur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>), which contribute to acid rain and smog; and mercury, “considered ‘toxic’ under the Canadian Environmental Protection Act and [...] hazardous to human health.”<sup>237</sup> Small toxic particulates are also emitted, as are large quantities of CO<sub>2</sub>, making even ‘clean coal’ a larger emitter of GHG emissions than any other source.<sup>238</sup> Although it was easier to ban coal due to its complete absence from the BC generation mix, the other fossil fuel technologies have similar emissions profiles and should face the same fate by the 2016 due date for BC Hydro’s carbon emissions.

## **Renewable Impacts**

It is important to recall that all types of generation include some degree of impact on the environment, as they all alter nature when using natural resources for the generation of electricity. Overall, most renewables do not produce smog, GHGs,

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<sup>233</sup> Cretney, Alison et al. 2007; p.5

<sup>234</sup> BC Ministry of Energy... 2007b; p.5

<sup>235</sup> BC Hydro. 2008a; p.113

<sup>236</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.9

<sup>237</sup> *Ibid.* p.33

<sup>238</sup> *Ibid.*

or local air pollutants,<sup>239</sup> but even this is not necessarily the case when considering biofuels or the burning of municipal waste.

Municipal waste, full of petroleum-based plastic and decomposing organic matter, can be an abundant supply of readily available fuel for energy production, but should be separated into two separate categories. The first, through incinerating the waste itself, should not be considered a 'renewable' nor 'clean' source of energy as the fuel supply is not unlimited, and the emissions produced includes significant toxins derived from the plastics and other non-organic matter found in the garbage heap.<sup>240</sup> The second type of energy production captures the methane gas produced through the decomposing process and uses it for electricity generation.<sup>241</sup> While this does produce a low quantity of local toxins, they are negligible in relation to the ambient toxicity levels associated with a municipal waste site. Landfill methane, which has 21 times the impact on climate change as carbon dioxide,<sup>242</sup> is the source of 9% of BC's GHG emissions.<sup>243</sup> Legislation is in development to require the mitigation of methane release directly into the atmosphere, as burning it reduces the methane to CO<sub>2</sub>, greatly reducing final emissions.<sup>244</sup> Thus, as long as only the methane gas released is burned and not the garbage itself, using municipal waste as a generation source reduces the environmental impact of BC's landfills.

Biofuels also raises local air quality concerns, but conveniently should also be divided into two categories to determine how 'renewable' and environmentally friendly a generation source it is. The first category of biofuels is derived from 'dedicated energy crops'. These are not truly 'clean' or 'renewable', according to the BC Sustainable Energy Association, as developing land for agricultural purposes releases large quantities of carbon dioxide and reduces the carbon-mitigation benefits of higher bio-density forests that are replaced.<sup>245</sup> They also point out the

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<sup>239</sup> Berry Trent & Mark Jaccard. 2001; p.264

<sup>240</sup> Hackney, Tom. 2008; p.2

<sup>241</sup> BC Ministry of Energy... 2008; p.5

<sup>242</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.41

<sup>243</sup> BC Ministry of Energy... 2008; p.9

<sup>244</sup> Ferguson, Sandy. 2009.

<sup>245</sup> Hackney, Tom. 2008; p.1

recent public-media issue that energy crops could be competing for resources with food crops, thus raising the prices of grains on world food markets.<sup>246</sup> These concerns should be carefully considered before allowing the production of plant matter specifically for energy use, as this might not adhere to BC Hydro's mandate of social and environmental responsibility.

The second category of biofuels includes those that are produced as a byproduct of agriculture and forestry. As only 8% of food system biomass is actually eaten,<sup>247</sup> the stems, peels and leaves can be used to produce biofuels to be used in electricity generation. More critically for BC, there is an abundance of wood waste from forestry operations and beetle kill that is now being burned in beehive burners or out on the cut blocks that could be utilized in electricity generation. The *BC Bioenergy Strategy; Growing our Natural Energy Advantage* estimates that: "about 1.2 million bone-dry tonnes of mill residues per year – an amount that could produce approximately 1900 gigawatt [GWh] hours of electricity - are incinerated in beehive burners in the province with no energy recovery and impacts on air quality. These resources and wood residues [...] present an opportunity for bioenergy in BC."<sup>248</sup> These beehive burners essentially create the same emissions as if the wood was used for electricity generation, and harvesting the trees produces the impact on the environment, through loss of animal habitat, recreational opportunities and aesthetic pleasure. The Phase 1 of the Bioenergy call for power, released by BC Hydro in 2008, recognizes this opportunity to produce electricity from waste and aims for 1000 GWh/year to be produced from forestry residues, logging debris, and beetle-killed timber.<sup>249</sup> To reduce the impact of these facilities on the local environment and human health, they should be restricted to suitable locations, and utilize the best available emissions controls.<sup>250</sup>

Other renewable sources produce no emissions, but impact on the environment otherwise. In order to evaluate all sources of generation fairly, it is

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<sup>246</sup> *Ibid.*

<sup>247</sup> Dewulf, Jo, & Herman Van Langenhove. 2006; p.1

<sup>248</sup> BC Ministry of Energy... 2008; p.13

<sup>249</sup> BC Hydro. 2008a; p.48

<sup>250</sup> Cretney, Alison et al. 2007; p.40

necessary to explore the extent of these impacts on human quality of life. Some sources, such as geothermal, solar, or tidal generation, have not been shown to produce significant impacts beyond land/ sea use and those factors that impact all types of generation: the manufacturing and transportation of materials, and transmission lines. Wind turbine sites have minimal land-use impacts, as the land around their towers can still be used for livestock grazing, but they have been noted to interfere with bird and bat populations while their shadows, noise, and aesthetics can be disturbing to some people in the near vicinity.<sup>251</sup> If located properly, away from animal nesting areas and migration routes, and residential dwellings, these impacts can be virtually eliminated.

Run of the river developments, having constituted 55% of winning bids in the 2006 call for power,<sup>252</sup> have received the most attention in BC in terms of their impact on the local environment. The largest impact of these projects is on aquatic ecosystems and the fish that make a home in the rivers where the projects are located.<sup>253</sup> This can impact on British Columbian citizens when they fish, either for profit or recreation, or when their recreational endeavours, such as kayaking, are intruded upon by the change in flow of river due to headponds and creek diversion.<sup>254</sup> These impacts can be partially minimized through ensuring diverted water returns to the creek above large natural impediments to fish, such as waterfalls,<sup>255</sup> and by reviewing the cumulative effects of these projects on the entire river system, not only their individual impacts.<sup>256</sup>

## **Large Hydro**

Up to this point, large hydro has not been specifically discussed as its evaluation according to the criteria above is closely aligned with that of other 'renewable' sources - at least once these installations are built. Strangely, the source

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<sup>251</sup> *Ibid.*

<sup>252</sup> BC Hydro. 2008a; p.76

<sup>253</sup> Shaffer, Marvin & Associates Ltd. 2007c; p.11

<sup>254</sup> *Ibid.*

<sup>255</sup> Cretney, Alison et al. 2007; p.41

<sup>256</sup> Calvert, John. 2007a; p.200-1

of large hydro – yearly water flows – is by definition renewable, but building the dams and reservoirs is not. Once the reservoir is built, that land can no longer be used for other purposes, such as agriculture, forestry, or habitation. The flooding of new reservoirs also releases significant quantities of methane released by the decomposing organic material covered by the rising waters.<sup>257</sup> In addition, hunters and animals can no longer use the terrain where the reservoir is flooded, and the impact on the river system severely alters the habitat and water composition relied on by fish, thus hurting recreational opportunities for sport fisherman.

The option of large hydro must be carefully weighed as it does not add to renewable technology clusters nor mitigate environmental impacts of electricity generation in the same way as renewables. Concurrently, the cumulative cost of infrastructure, including transmission lines, roads, bridges and the electricity facilities themselves, need to be measured against the impact of the reservoirs and the dams on the river systems and the local environment. Furthermore, large hydro has more positive benefits and less negative as the coal-based electricity dominating the generation mix in some of BC's neighbours. It might thus be considered by BC Hydro for its merits to help these jurisdictions wean themselves off this bottom of the barrel technology in terms of environmental impact.

## **Public Opinion**

### **Of generation**

The BC government's and BC Hydro's extensive environmental commitments are a sufficient reason to consider the environmental ramifications of any new generation facility, but it is important to note that these commitments are based on public pressure for more progressive environmental goals on the part of government and its crown corporations. Public opinion in regards to the environment, and otherwise, helps shape the government's and BC Hydro's mandate and thus should be considered separately as well.

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<sup>257</sup> Marshall, Dale with Jodi-Lyn Newnham. 2004; p.41

BC Hydro's 2008 Annual Report concludes that customers are "happily reporting they are receiving good value for money."<sup>258</sup> This conclusion is based on reports such as BC Hydro's 2005 *Public Opinion on Emerging Issues*, which tabulates BC citizens' opinion of how BC Hydro acquires its generation. This report, conducted across the province by Ipsos-Reid, shows where BC citizens stand on a variety of issues.<sup>259</sup> Fifty-five percent of British Columbians were for withdrawing the plan to build a natural gas power plant at Duke Point, Nanaimo, while only 26% were against this decision of the utility, demonstrating contention with using even the cleanest form of fossil fuel for electricity generation in the province.<sup>260</sup> Furthermore, only 51% supported meeting future electricity demand through natural gas generation and 22% for coal, while 94% supported more wind and conservation initiatives, 74% were for small hydro, and 64% for more large hydro dams.<sup>261</sup> These statistics are important in respect to how people in BC believe BC Hydro should acquire future generation, overwhelmingly favouring renewables over fossil fuel generation.

The BC Sustainable Energy Association argues that public opinion is an important variable in planning BC's future electricity system and that any deliberations over its generation mix need to include air quality, reducing GHG emissions, preventing coal-based mercury emissions, protecting BC against future rising costs of oil and gas, and creating a vibrant green energy sector.<sup>262</sup> All these considerations align with the criteria used above, and are made by British Columbians when they evaluate the merit of the Energy Plan. The conglomeration of these evaluations show that public and rational arguments favour renewables over conventional generation, and thus government policy should move more resolutely in this direction and adopt a 100% renewable energy plan for BC.

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<sup>258</sup> BC Hydro. 2009; p.34

<sup>259</sup> BC Hydro Research Services. 2005; p.3

<sup>260</sup> *Ibid.* p.4

<sup>261</sup> *Ibid.* p.5

<sup>262</sup> Dauncey, Guy. 2005; p.9

## CONCLUSION

### Limitations

BC's "First Nations and Remote Community Clean Energy Program" aims to bring clean power to communities that are not integrated in the BC power grid.<sup>263</sup> This plan is part of a federal and provincial effort to bring power to these communities, which, as Kenna Hoskins points out, are more difficult to provide with renewable energy because their geographical location can limit the range of options available.<sup>264</sup> Until technology is adapted to local needs, it is understood that efforts should be made to move isolated communities to less expensive and more environmentally friendly sources of generation over time, but that the recommendation to move 100% towards renewable sources applies only to generation used by the BC electricity grid.

Another limitation of the recommendation is the situation of the Burrard Thermal plant, located in the lower mainland, at the load centre, and close to major transmission lines bringing power to the Vancouver area. This thermal plant fulfills many functions, including providing 3000 GWh of annual electricity to the grid,<sup>265</sup> acting as insurance against a major line failure,<sup>266</sup> and controlling the load on the grid by using the turbines as transformers to regulate voltage stability.<sup>267</sup> BC Hydro recognizes that the electricity produced by the thermal plant is more expensive than importing this energy,<sup>268</sup> and plans to shut down the plant by 2014.<sup>269</sup> The recommendation to have 100% of annual electricity generation come from renewable sources is not affected by Burrard if it is mothballed by 2016 and

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<sup>263</sup> BC Ministry of Energy...2007a; p.16

<sup>264</sup> Hoskins, Kenna. 2009.

<sup>265</sup> BC Hydro. 2008a; p.74

<sup>266</sup> Hoskins, Kenna. 2009.

<sup>267</sup> BC Hydro. 2008a; p.5/29

<sup>268</sup> BC Hydro. 2006a.

<sup>269</sup> BC Hydro. 2008a; p.5/25

remains available only for voltage regulation and backup in the event of a major transmission line failure.

## **Summary**

It has been demonstrated that the attributes and benefits of acquiring all future generation from renewables far exceeds the gains and pitfalls associated with fossil fuel generation. If BC were to aim for 100% renewable electricity, it would gain the multitude of advantages which characterize renewables: proven, maturing technology, that is environmentally benign, provides energy security, facilitates economic growth, fosters investment, encourages jobs, and whose cost is falling steadily.<sup>270</sup>

When the rising cost of natural gas is compared to the declining cost of renewable technologies, the site location currently determines which is a better fit. One can expect renewables to be the more obvious economic choice in the near future. The advantage of fossil fuels in providing a steady supply of electricity is negated by the aggregate supply of intermittent renewable sources when their generation is spread across a geographical area and a variety of sources are used. If the criterion of employment creation is used, renewables require more labour hours in the maintenance and construction of those facilities as conventional. The costs of renewables are derived mostly from labour and materials, because, unlike fossil fuel generation, the cost of fuels for renewable energy is often negligible.

Once the employment, investment, and knowledge-growth potential of technology clusters are added, the benefits of renewables help the BC government meet a variety of stated goals in employment-creation, and technology development that cannot be met through similar investments in fossil fuel generation. Public opinion data show that British Columbians prefer further development of renewable sources, due to its benefits of reducing GHG emissions and air-pollution compared to fossil fuel burning.

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<sup>270</sup> Mallon, Karl, ed. 2006; p.148-9



If BC Hydro were to follow the advice of this project and move towards 100% renewable energy by 2016, it would need to ensure more IPP projects make it to the completion stage through more aggressive calls for power, and the removal of rate structures which ignore the reserve capacity of BC Hydro's dams and the aggregate supply from renewables across a large region.

Based on BC Hydro's 2008 *Long-Term Acquisition Plan*, there is more than enough small hydro, wind, and biomass resource options proposed to meet self-sufficiency targets, and replace current generation provided by thermal sources by 2016.<sup>271</sup> If current research in geothermal and tidal facilities in BC is promoted and incubated by the BC government, or if it decides to promote advanced biomass, these technologies should become viable once the best options for current renewable technologies close to the load centre are used. The benefits of renewables in terms of long-term low rates for customers, security of supply, job-creation, innovation, and reduced environmental impacts, are too great for the government to remain technology neutral. Leadership is needed for the province to put its comparative advantage in annual rainfall, coastal winds, volcanic geology, oceanic currents, and forest bio-density to good use in electrifying its economy.

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<sup>271</sup> BC Hydro. 2008; p. 125-7

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## **APPENDIX A: PARTICIPANT INFORMED CONSENT FORM**



**Faculty of Arts, Department of Political Science**  
**We Can: Implementing a 100% Renewable Energy Policy in BC**

### **What is the purpose of this interview?**

The purpose of my study is to examine the feasibility of switching to a 100% renewable electricity supply in BC. I am interested in exploring how the different generation sources impact on delivering low rates, security of supply, employment opportunities, technology cluster growth, and environmental impact reduction.

As literature on reactions to the BC Energy Plan is scarce, I value this opportunity to hear about your experiences and perspectives working under its provisions. This opportunity gives me the chance to hear from authorities in the field on how the BC Energy Plan has impacted the energy climate in the province, and what their thoughts are on switching to a system solely reliant on renewables.

### **What will I have to do if I agree to be in the interview?**

I am inviting experts from organizations involved in the BC electricity sector to participate in a 10 to 15 minute conversation to speak about their experience, and reaction to, BC's Energy Plan, and the feasibility of a 100% renewable electricity mix.

### **Why are you recording this? What will happen to the recording?**

With your permission, I will record this conversation to ensure accurate representation of any comments made. After the interview, I will review the recording to gain a truer citation of our discussion. Only I will listen to the recording, which will remain confidential and be destroyed by August 1st, 2009.

### **Will anyone know what I said during the interview?**

Knowledge gained from the interview will likely be used to demonstrate how experts have reacted to the current BC Energy Plan. All data gathered in the interview will be used strictly for the purposes of this research project. Some of the recording may be transcribed verbatim to provide quotations to use in the final paper.

If you prefer, your name and/ or affiliated organization can remain anonymous.



**What are the benefits of being in the study?**

While material benefits of participation are minimal, this interview will provide an opportunity for you to speak about your experiences. Should you desire, I can present my final project to you via email and will be available to discuss.

**What are the risks of being in the study?**

There are no known risks from your participation in this study.

**Can I quit before finishing?**

Your participation is voluntary and you may choose to withdraw from the interview at any time. You may also choose not to answer any of the questions posed.

**Who can I contact with questions or concerns?**

Feel free to ask questions at any point before, during, or after the interview. Once the interview is finished, you are welcome to contact myself by email (RKS9@sfu.ca) or telephone (778-848-6877) with questions, concerns, or to receive a copy of the final report. If you prefer to contact my supervisor, Dr. Anil Hira, you can reach him by email (ahira@sfu.ca) or telephone (778-782-3286). For concerns in regards to ethics, please contact Dr. Hal Weinberg (778-782-6593) or hal\_weinberg@sfu.ca.

Please sign below if you consent to being interviewed and having your answers cited in the final project. Thank you for being part of this study.

Participant

Name\_\_\_\_\_

Signature\_\_\_\_\_ Date \_\_\_\_\_

Interviewer

Name\_\_Rick K.Steenweg\_\_\_\_\_

Signature\_\_\_\_\_ Date \_\_\_\_\_