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Geothermal Power in BC: An Environment of High Uncertainty and Risk

Executive Summary

British Columbia is entering a period of electricity supply deficit that, coupled with transmission constraints that limit imports, mean BC is facing electricity insecurity. Without additional generating capacity and/or import capacity, BC will risk damaging the economy and quality of life of its residents through lack of electricity. Geothermal power can provide a cheap, clean and reliable source of energy for the province to help meet its growing demand. However, due to risks and uncertainties associated with geothermal power in BC, the feasibility of geothermal power is inconclusive so this option should wait for the development of the Meager Creek project so technical and financial feasibility can be confirmed before other projects move ahead.

This evaluation of geothermal power in BC first examines BC's electricity profile to show that without additional generating capacity the whole of the Western Interconnect electricity trading region faces insecurity of electricity supply without additional generating capacity and that in BC generating options are limited. Next, using government information and data as well as academic sources, the prospects for geothermal power in BC are examined to show that geothermal power is competitive with other renewable technologies in terms of cost as well as being clean and reliable, that the technology is well developed and available, and that there is potential located throughout the province. However, there is much uncertainty about the unit energy price and risk associated with geothermal power and this is hindering development. Finally, options pertaining to the development of geothermal power are explored. The inconclusive results mean that when it comes to choosing technologies for electricity generation in BC geothermal power, which would be new to the province and Canada, is not the most promising source of electricity generation.

Introduction

Right now is a great time to invest in electricity generation in BC. The province is expecting a supply shortfall, desires to be electricity self sufficient by 2016, and is open to private investment in generating infrastructure. In addition, future supply options in the province are limited because Site C could be BC's last large hydro dam and the province has a restriction on GHG emitting sources and nuclear power. This means that there is lots of potential for investing in renewable energy in BC such as biomass, wind, small run-of-river hydro and geothermal.

A cost benefit analysis for each technology would be necessary before deciding on whether or not to develop it. Every technology has certain advantages, risks and limitations that

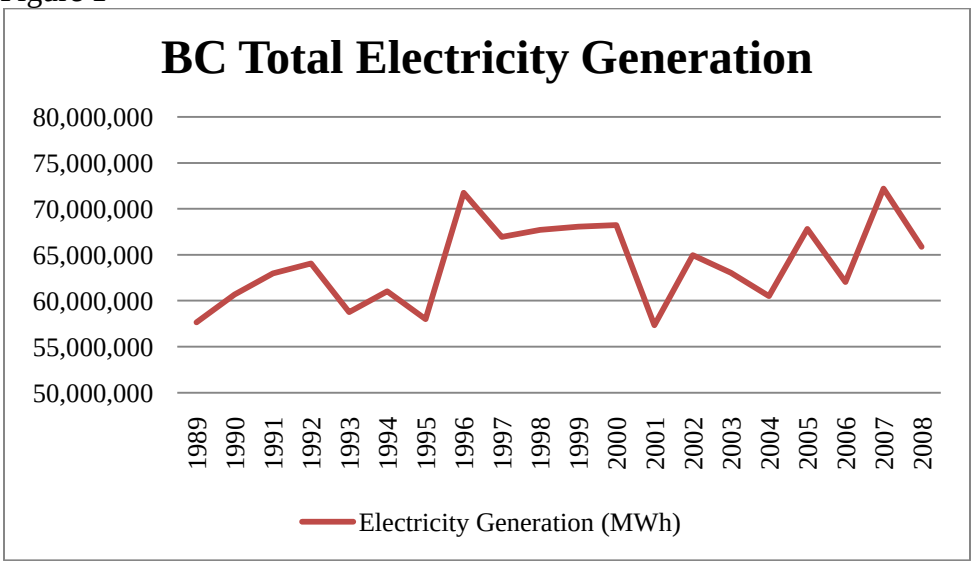
must be considered when building generating capacity. This paper will evaluate the prospects for geothermal power in BC. With this paper, policy makers will be able to compare the costs, benefits and potential for geothermal power in BC compared to other technologies in order to make a decision on which technology or combination of technologies will be best for BC.

1.0 Regional Energy Profile

This section will outline BC's current electricity profile. The first part will examine supply and demand trends, past as well as future projections, to show that BC's demand has outstripped supply. Then electricity imports and exports as well as the security of those imports will be examined. Finally, current generating technologies and the key actors in BC's electricity system will be outlined. With this profile we will see that BC's electricity supply is vulnerable unless the province expands generating capacity and/or import transmission capability.

1.1 Electricity Supply and Demand

Figure 1



Source: Canada, Statistics Canada, *Energy Statistics Handbook: First Quarter 2010*.

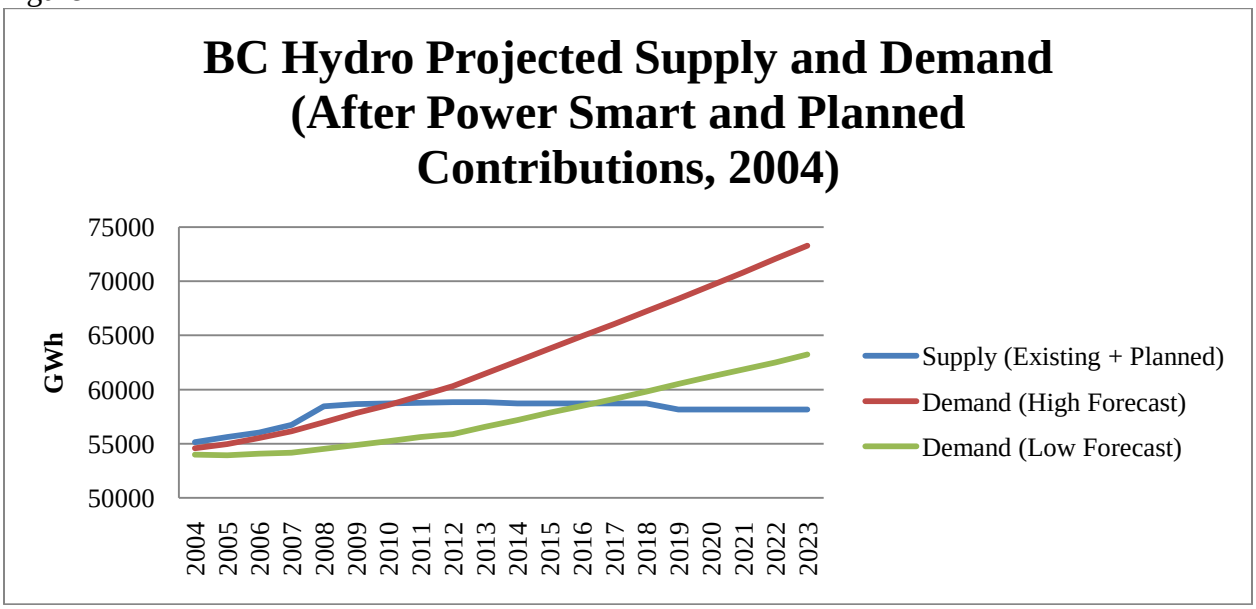
BC Hydro expects demand to grow between 20 to 35% over the next twenty years.[1] Figure 1 shows that BC has not significantly expanded its generating capacity in the past decades while electricity demand grew during this time. Figure 2 shows BC's projected supply and demand from BC Hydro using 2004 data. This figure shows that BC's demand is expected to outstrip supply between 2010 and 2016. While this data is a bit old, it is a projection that BC Hydro continues to make today. The sources of this growth will be discussed in section 1.3. Therefore, it is safe to assume that BC currently has an electricity supply deficit.

BC is expanding its generating capacity. BC Hydro is currently seeking out purchasing agreements with Independent Power Producers (IPPs) to help meet future demand. In addition,

[1] BC Ministry of Energy, Mines and Petroleum Resources, "Electric Demand," http://www.empr.gov.bc.ca/EPD/Electricity/demand/Pages/default.aspx.

BC Hydro is currently exploring adding to its own generating capacity with Site C and by adding generating capacity at existing dams. Site C would add about 900MW capacity, the Revelstoke project would add about 500MW to the current dam, and the Mica project would add about 1000MW to the dam.[2][3][4] The province is also investing in other dams to extend their lifespan. So while BC's electricity supply is increasing, BC Hydro is still expecting a supply shortfall. Therefore, it is expected that additional capacity beyond these projects is needed.

Figure 2



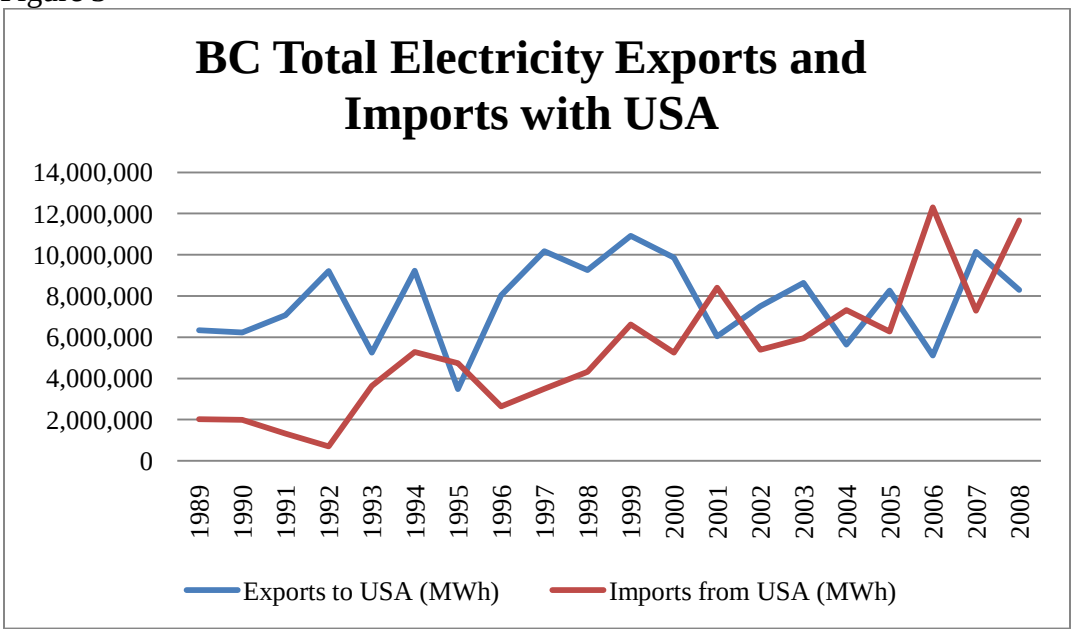
Source: BC Hydro, *2004 Integrated Electricity Plan: Part 2: Demand-Supply Outlook*.

1.2 Electricity Imports and Exports

Due to the growing supply shortage, BC's electricity imports have increased steadily over the past decades (see Figure 3). In three of the six years leading up to 2008 BC imported more electricity than it exported. IF BC does not expand its electricity generation, then this trend is expected to continue.

[2] BC Hydro, "About Site C," http://www.bchydro.com/planning_regulatory/site_c/site_c_an_option.html.
[3] BC Hydro, "Revelstoke Unit 5 Project," http://www.bchydro.com/planning_regulatory/projects/revelstoke_unit_5.html.
[4] BC Hydro, "Mica Units 5 & 6 Projects," http://www.bchydro.com/planning_regulatory/projects/mica_generating_station_upgrade.html.

Figure 3



Source: Canada, Statistics Canada, *Energy Statistics Handbook: First Quarter 2010*.

BC trades electricity with the 'Western Interconnect' that includes Alberta, fourteen western US states, and the northern portion of Baja California, Mexico.[5] Having such a large number of trading partners ensures reliability of imports and exports across the grid.[6] However, within the Western Interconnect, BC and Alberta are in need of either additional generating capacity or additional import capacity;[7] this is because a "transmission constraint [exists] that limits imports from the Northwest into BC as well as a constraint between BC and Alberta."[8] Therefore, without additional capacity in generation or transmission with Alberta and the US, BC's electricity security is vulnerable. The Northwest region of the Western Interconnect has a large surplus that could be imported but even with that surplus the whole of the Western Interconnect is projected by the Western Electricity Coordinating Council to be in an electricity deficit by 2012.[9] Therefore, even if BC decides to expand transmission capacity for imports the members of the Western Interconnect need to come up with additional generating capacity to maintain the reliability of the whole system.

1.3 Electricity Demand Profile

Growth in electricity demand is expected from an expanding population, economic growth, and changing technology that results in increasing use of electronic devices.[10] The largest consumer of electricity in BC is the manufacturing sector, followed by residential users,

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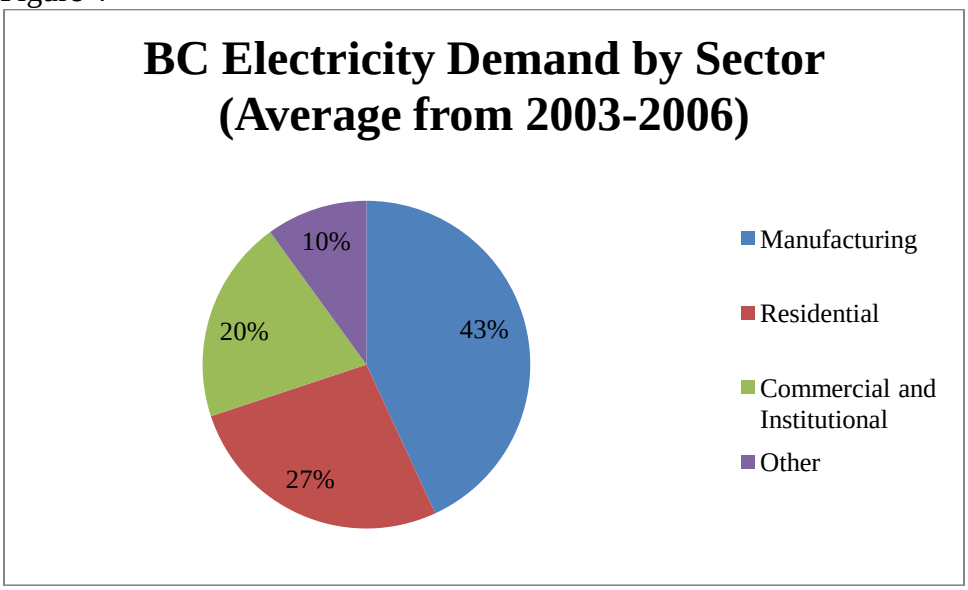
[5] BC Ministry of Energy, Mines and Petroleum Resources, "Transmission and Distribution System," http://www.empr.gov.bc.ca/EPD/Electricity/TD/Pages/default.aspx.
[6] Ibid.
[7] Western Electricity Coordinating Council, *2009 Power Supply Assessment*, (2009): 41, http://www.wecc.biz/Planning/ResourceAdequacy/PSA/Documents/2009%20Power%20Supply%20Assessment.pdf.
[8] Ibid., 25.
[9] Ibid., 39.
[10] BC Ministry of Energy, Mines and Petroleum Resources, "Electric Demand."

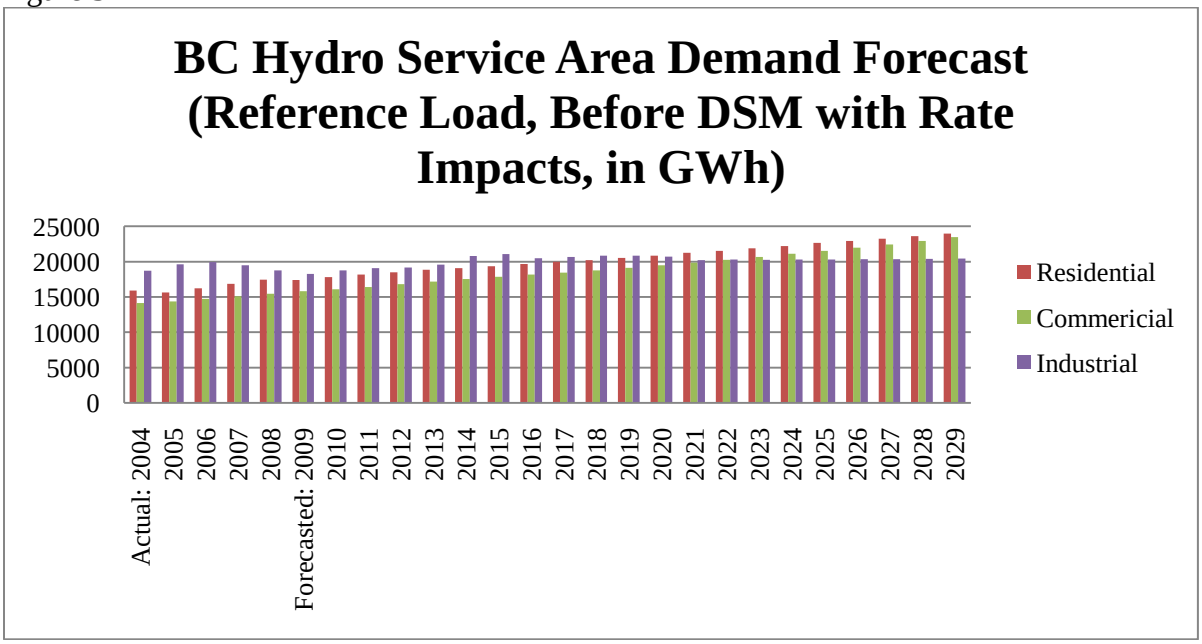
then the commercial and institutional sector (see Figure 4). With expected growth the overall major consumers of electricity are unlikely to change. However, figure 5 also shows that demand is expected to increase in the residential and commercial sectors, but will remain relatively stagnant in the industrial sector. As a result, residential and commercial demand is expected to surpass industrial demand.

Figure 4



Source: BC Ministry of Energy, Mines and Petroleum Resources, "Electric Demand."

Figure 5



Source: BC Hydro, *Electric Load Forecast: 2008/09 to 2028/29, "Table A4.6".*

1.4 Electricity Supply Sources and Actors

Figure 6

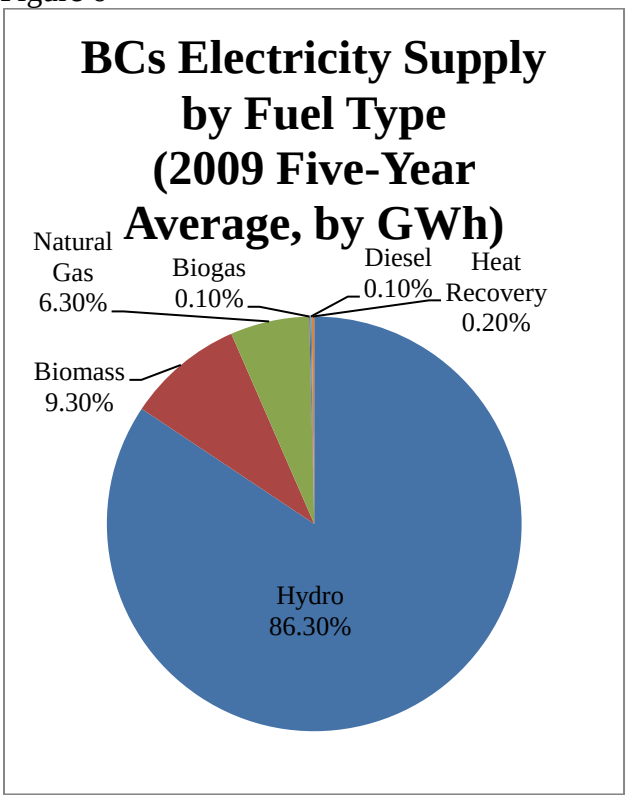
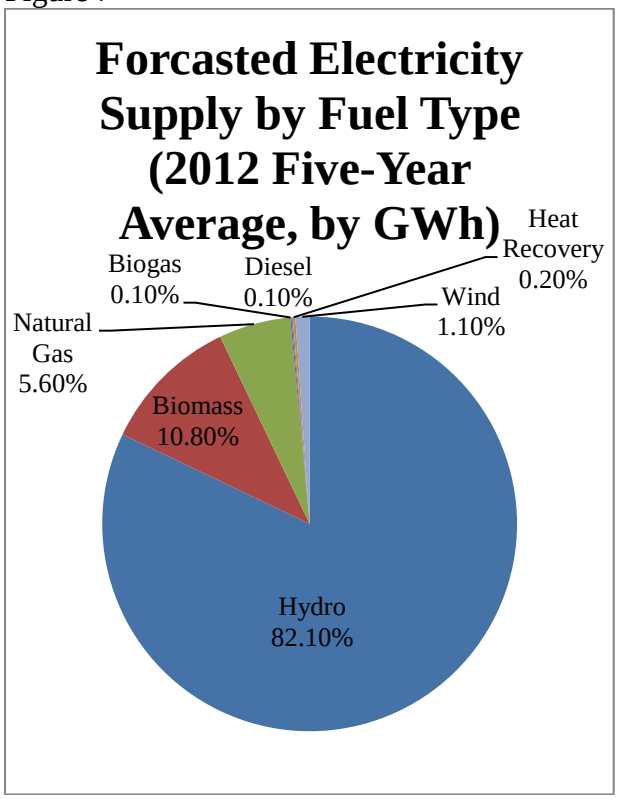


Figure 7



Source: BC Ministry of Energy, Mines and Petroleum Resources, "Electric Generation and Supply."

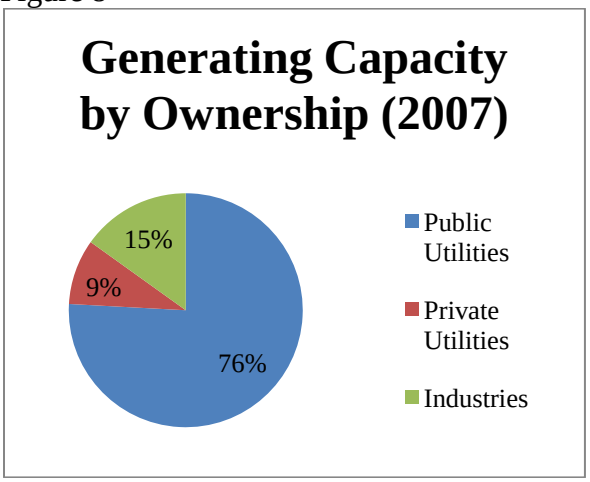
Most of BC's electricity generation is derived from large hydro (see Figure 6). A comparison between Figure 6 and 7 shows that BC's electricity generation from hydro and natural gas sources are expected to decrease while generation from biomass and wind sources is expected to increase. Future supply options for BC are limited because the Clean Energy Act will prohibit all "future development of large scale hydro-electric storage dam projects on all river systems in British Columbia," except for Site C.[11] This means that barring any change in the law Site C could be BC's last option for a large hydro dam. Other supply options are also limited in BC because all new electricity generation must have a zero net greenhouse gas emissions and the province prohibits nuclear power.[12] In addition, there is no restriction on private ownership of electricity generation in BC.

There are a number of actors that play a role in BC's electricity generation (see Figure 8). This includes public utilities consisting of BC Hydro which owns generating, transmission, and distribution assets.[13] Another public utility is the BC Transmission Corporation which controls BC Hydro's transmission system and ensures equal access to the system for all power producers.[14] A few select municipalities also play a role in generation, transmission and

[11] BC Hydro, "Press Release: Province announces Site C Clean Energy Project," April 19, 2010, http://www.bchydro.com/news/articles/press_releases/2010/province_announces_site_c_clean_energy_project.html.
[12] BC Ministry of Energy, Mines and Petroleum Resources, "The BC Energy Plan: A Vision for Clean Energy Leadership," (Victoria), http://www.energyplan.gov.bc.ca/PDF/BC_Energy_Plan.pdf.
[13] BC Ministry of Energy, Mines and Petroleum Resources, "Transmission and Distribution System."
[14] Ibid.

distribution.[15] Regulated private utilities such as FortisBC who owns transmission and distribution systems in south-central BC also play a role in BC's system.[16] Finally, private companies that include IPPs, large industrial customers and industrial self generators have their own their own generation facilities and transmission lines that connect them to BC's grid.[17] IPPs then sell their electricity to BC Hydro through purchasing agreements.[18] In 2008/09, $436 million was paid out to IPPs, 46.5% of which went to international companies based in the USA, France and Australia, 34.7% to companies located in other provinces within Canada, and 16.1% to companies located within BC.[19] Therefore, the province is open to all those willing to invest in electricity generation in BC regardless of which country they are from.

Figure 8



Source: Statistics Canada. Electric Power Generation, Transmission and Distribution – 2007, Table 1.

1.5 Conclusion

BC is facing not only a supply shortfall in electricity generating capacity but insecurity of electricity supply as well. This is in part due to expected demand being greater than expected supply. In addition, transmission constraints that limit import capacity and a projected supply shortfall for the whole of the Western Interconnect starting in 2012 add to BC's electricity insecurity. Therefore, BC needs to expand generating and/or transmission capacity. BC relies heavily on large hydro dams for electricity generation but that share is expected to fall along with natural gas generation as biomass and wind generation increase. BC's future supply options are limited due to legislation that restricts more large hydro dams except for Site C and any GHG emitting or nuclear generating source. It is against this backdrop that we will explore the opportunities for private investment in geothermal power in BC.

2.0 Prospects for Geothermal Power in BC

[15] BC Ministry of Energy, Mines and Petroleum Resources, "Transmission and Distribution System."
[16] Ibid.
[17] Ibid.
[18] BC Hydro, "How Power Is Acquired," http://www.bchydro.com/planning_regulatory/acquiring_power/how_power_is_acquired.html.
[19] New Democrat Official Opposition, "$366 Million Paid To IPPs Owned Outside B.C.," (Victoria: 2010) http://bcndpcaucus.ca/files/Foreign%20IPP%20backgrounder.pdf.

This section will discuss the feasibility of geothermal power in BC. The first part will compare the costs of geothermal power versus the costs of other generating technologies. The second part will show that the technology is readily available but also discuss the risk factors associated with geothermal power. The third part will explore the resource potential of geothermal power. While geothermal power is feasible and competitive with other generating technologies, there is a high amount of uncertainty and risk associated with geothermal power in BC.

2.1 Costs

Table 1: Cost of Electricity Generation by Technology

Technology	Cost Range ($/MWh)		Cost Range ($/kWh)	Reliability	GHG Emissions (tonnes/GWh)
Source	1	2	3		1
Energy Conservation & Efficiency	32-76	0-50		Base	0
Large Hydroelectric	43-62	28-33*	0.020	Base	0
Natural Gas	48-100		0.030-0.050	Base	0-350
Coal	67-82	50-60**	0.030-0.050	Base	0-855
Nuclear			0.050	Base	
Biomass	75-91	40-150	0.058	Base	0-500
Geothermal	44-60	40-100	0.064	Base	0-10
Wind	71-74	50-100	0.070	Intermittent	0
Small Hydroelectric	60-95	40-150		Intermittent	0
Wave and Tidal	100-360	80-190		Future supply option	0
Solar PV	700-1700	200-500	0.120-0.200	Intermittent	0

1. BC Ministry of Energy, Mines and Petroleum Resources, "The BC Energy Plan: A Vision for Clean Energy Leadership."
2. Canada, National Energy Board, *Emerging Technologies in Electricity Generation: An Energy Market Assessment*.
3. David Pimentel et al, "Renewable Energy: Current and Potential Issues"

* Cost range is for heritage hydro
** Cost range is for Integrated Coal Gasification Combined Cycle (IGCC), which is more expensive than conventional coal

BC's reliance on large hydro generation has resulted in one of the lowest electricity rates in the country and low GHG emissions from electricity generation;[20] electricity generation accounted for 3% of all GHG emissions in 2004.[21] As a result, any new generation type hoping to be developed in the province needs to be competitive with the low rates and emissions that

[20] Manitoba Hydro, "Utility Rate Comparisons: Survey of Canadian Electricity Bills — Effective May 1, 2010," http://www.hydro.mb.ca/regulatory_affairs/energy_rates/electricity/utility_rate_comp.shtml#residential_750.
[21] BC Ministry of Energy, Mines and Petroleum Resources, "The BC Energy Plan: A Vision for Clean Energy Leadership."

large hydro allows. Table 1 shows the estimated cost of different generating technologies, their reliability, and their emissions. The three different sources differ in their estimates of the cost range of each technology because the first is for BC, the second for all Canada, and the third from the US for 2002. This table gives us a good estimate though of the cost of geothermal power versus other technologies. In all three cases we see that geothermal offers some of the cheapest prices compared to other renewable technologies. The only case in which is it beat by another non-hydro renewable technology is in the third case in which biomass is cheaper. However, biomass does result in more emissions than geothermal power. The price of geothermal power compared to conventional generating technologies depends on which cost range is used. For the BC Energy Plan, the cost of geothermal is directly competitive with conventional technologies such as large hydroelectric. However, for the other cost ranges geothermal is likely to be relatively more expensive.

Table 2: Estimated Unit and Capital Costs, Lifespan and Land Use for Geothermal Sites in BC

Site	Capacity (MW)	Unit Energy Costs ($/MWh)	Total Capital Costs (2003 $)	Projected Life (Years)	Land Use (hectares)
Meager Creek	100	Unknown	300 million	Unknown	2950
Mount Cayley	20	97	84 million	30	100
Pebble Creek	55	67	179 million	30	8270
Lakelse Hot Springs	10	68	31 million	30	80

Source: BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other."*

Table 2 shows estimated costs for three different geothermal plants that were being explored in 2004. In these cases, all of the unit energy costs are higher than the range given by the BC Energy Plan (but still fall within the range given by the National Energy Board). So the unit energy costs may be higher than estimated in the BC Energy Plan, however, these costs are for illustrative purposes only because more information was needed from the sites.[22] In addition, in a 2005 Resource Options Report from BC Hydro the unit energy costs of the Meager Creek plant is estimated between $47 and $55 per MWh, which does fall within the range from the BC Energy Plan.[23] Therefore, geothermal power may be one of the cheapest forms of renewable energy, but the end price of geothermal power in BC is highly uncertain for all projects listed in Table 2.[24] Price uncertainty is also reinforced by the different ranges that cost estimates fall in to.

[22] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* (2004): D-2, http://www.bchydro.com/etc/medialib/internet/documents/info/pdf/info_appendix_d_alternative_and_clean_energy_other.Par.0001.File.info_appendix_d_alternative_and_clean_energy_other.pdf.
[23] BC Hydro, *2005 Resource Options Report*, 7-27, http://www.bchydro.com/etc/medialib/internet/documents/info/pdf/info_iep_2005_resource_options_report.Par.0001.File.info_iep_2005_resource_options_report.pdf.
[24] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* 113, 115, 117 & 119.

The capital costs for a geothermal plant are typically between $3000 to $3500 per KW of installed capacity plus the cost of drilling the wells which ranges from $2 to $3 million each.[25] A 100MW facility, such as the one proposed at Meager Creek, has an estimated cost of $400 million.[26] Table 2 shows estimated capital costs for four geothermal sites being explored in BC from 2004. At that time the plant at Meager Creek was estimated at $300 million. Why that plant now has an estimated cost of $400 million may be because costs have increased or original estimates were too low.

2.2 Technical Feasibility and Risks

Geothermal electricity generation is not new. It already provides over 9000MW of electricity worldwide, but none in BC.[28] The estimated potential generating capacity from geothermal sources range from 1000MW for the most likely prospects to more than 3000MW province-wide by some estimates.[29]

The technology is already developed and readily accessible. The type of turbine in a geothermal power plant depends on the temperature of the reservoir.[30] If the source is greater than 150°C, then it can be driven directly by the steam from the reservoir.[31] If the source is between 90 and 150°C, then the turbine is driven by water that is flashed to steam.[32] Finally, for a source less that 90°C, the turbine is driven by vapour from a secondary fluid that is heated by the groundwater through a heat exchange.[33] BC's geothermal sources are found in all three ranges (see Figure 9).

Risks and factors that need consideration for geothermal power projects in BC include:

1. Size of the reservoir must be determined.
2. Depth of the reservoir; must be close enough to the surface to be economically feasible.
3. Temperature of the source must be determined. The higher the temperature, the more potential a reservoir has to be commercially exploited because it lowers the costs.
4. Insufficient permeability of the rock which leaves water or vapour trapped. This can be addressed using technology from the oil and gas industry which fractures the rock to increase permeability.[34]
5. Terrain may also be a problem. For example, the Mount Cayley project is located on very steep terrain.[35]

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[25] Canada, National Energy Board, *Emerging Technologies in Electricity Generation: An Energy Market Assessment*, (Calgary: 2006): 28, http://www.neb.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/lctrcty/mrgngtchnlglctcty2006/mrgngtchnlglctcty2006-eng.pdf.
[26] Independent Power Producers Association of British Columbia, *Fact Sheet: Geothermal*, (Port Moody, BC: 2008) 2, http://www.ippbc.com/media/Geothermal%20Fact%20Sheet.pdf.
[28] Canada, National Energy Board, *Emerging Technologies in Electricity Generation*, 27.
[29] Independent Power Producers Association of British Columbia, *Fact Sheet: Geothermal*, 2.
[30] Canada, National Energy Board, *Emerging Technologies in Electricity Generation*, 27.
[31] Ibid., 27.
[32] Ibid., 27.
[33] Ibid., 27.
[34] Ibid., 28-29.
[35] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* 114.

6. Land use could be an issue. For example, half of the prospective geothermal site at the Pebble Creek project is covered by a Provincial Park.[36]
7. Land ownership. For example, the Lakelse Hot Springs project covers private land and the owners of a nearby resort are opposed to the project.[37]
8. Competing interests over the reservoir. For example, in all four cases discussed in Table 2 there are concerns that the geothermal project will affect the hot springs in the area.[38]
9. Access to grid may require new transmission lines, the costs of which can be reduced by sharing new transmission lines with other projects. For example, the Meager Creek project could share transmission line costs with the Pebble Creek project.[39]

All of these factors need to be investigated before going ahead with a project to determine technical feasibility, and will no doubt affect financial feasibility through the final unit energy costs for the power plant.

Another issue with geothermal power is the lifespan of the geothermal reservoir. Table 2 shows that the projected lifespan of the three projects in BC where this figure could be determined to be thirty years. However, through the reinjection of groundwater, the production of the geothermal source can be extended and through careful monitoring could actually be produced indefinitely.[40] However, taking water out of the natural environment and injecting it in to a geothermal source has its own environmental considerations that would need to be evaluated, such as the depletion of ground water.

Another concern with geothermal is potential pollution. Geothermal power may result in some emissions, depending on the geothermal source itself. Sources may contain gases such as hydrogen sulphide (H2S) or carbon dioxide (CO2).[41] With the use of currently available technology most of the H2S is either returned to the reservoir or recovered as elemental sulphur.[42] The amount of CO2 released is less that from the cleanest fossil fuel generation.[43] In addition, heavy metals found in the source steam or water can be recovered and used commercially.[44] All four potential projects in Table 2 meet BC Hydro's Clean Criteria with regards to GHG emissions, so this should not be a concern for geothermal power in BC.[45]

2.3 Location

Figure 9 shows the potential geothermal sources that could be tapped for electricity generation in BC. As we can see, the sources are spread throughout the province. There is

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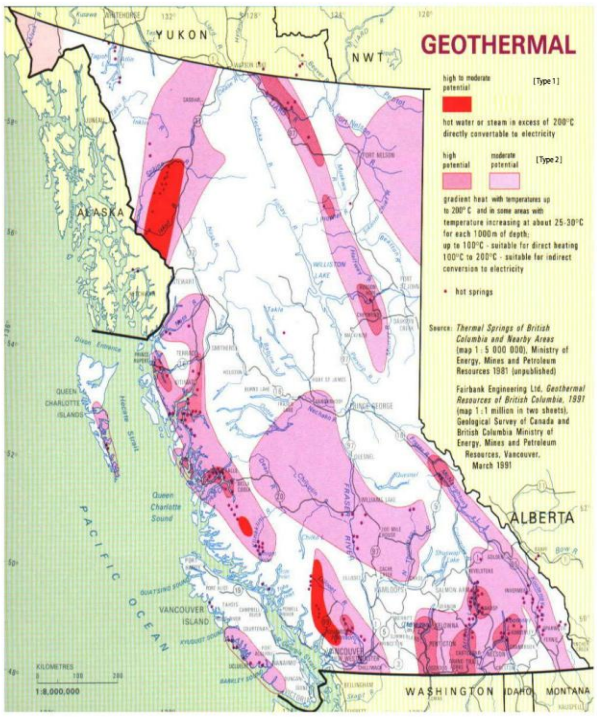
[36] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* 116.
[37] Ibid., 118.
[38] Ibid., 113, 115, 117 & 119.
[39] Ibid., 113.
[40] Canada, National Energy Board, *Emerging Technologies in Electricity Generation*, 28.
[41] Ibid., 28.
[42] Ibid., 28.
[43] Ibid., 28.
[44] Ibid., 28.
[45] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* 113, 115, 117 & 119.

potential located very closely to Vancouver, BC's largest city. In addition, most of the other sources located throughout BC are accessible to pre-existing transmission lines. Figure 10 shows BC's bulk transmission system. Through this transmission system, the geothermal sources in the Lower Mainland, Thompson, Okanagan, Kooteney, Cariboo, southern Skeena and southern Peace are accessible. This leaves only the geothermal sources in the far north of BC out of reach of existing transmission lines. Building transmission lines to connect the power plant to bulk transmission lines could be expensive if required.

Figure 9



Source: BC Ministry of Energy, Mines and Petroleum Resources, "Geothermal Resources Map."

Figure 10

Source: BC Ministry of Energy, Mines and Petroleum Resources, "Transmission and Distribution System."

2.4 Conclusions

There is promising potential for the development of geothermal power in BC. Geothermal has some of the lowest costs energy production relative to other forms of renewable energy; however, estimates for the unit energy price for geothermal power shows uncertainty. In addition, the technology is developed and available but there are many risk factors associated with geothermal. These include size, depth and temperature of the reservoir, permeability, terrain, land use, land ownership, competing interests and accessibility to the grid. All these factors must be resolved when developing geothermal power in BC. Another issue is lifespan of the reservoir, which can be extended through the reinjection of groundwater. Emissions are also a concern but the emissions from geothermal power plants can be controlled and are small enough to be considered green. Finally, the location of the use and its proximity to bulk transmission lines is important to be able to access the geothermal sources that are far from population centres. Province-wide, it is projected that the most promising sites could provide

1000MW generating capacity. This would provide an excellent addition to the diversity of BC's generating sources. However, it should also be noted that it was expected in 2004 that if the Meager Creek project were to proceed then it would be online by 2007.[46] Given that the Meager Creek site has not been developed yet, this raises doubts about the feasibility of geothermal power in BC, so our results are inconclusive.

3.0 Options and Recommendations

This section will explore the different options open to the province of BC for meeting future electricity demand by evaluating whether or not geothermal power should be developed to help meet BC's electricity needs. The first section will summarize the problems with the status quo. Then the different factors and resulting options open to the province for meeting their projected electricity shortfall will be discussed, as well as make recommendations and outline how the recommendations should be implemented. Given BC's current supply needs and openness to investment from IPPs, and the advantages of geothermal power but high uncertainty and risk associated with its development in BC, the development of Meager creek should first be pursued to determine the feasibility of geothermal power in BC before other sites are developed.

3.1 Problems with the Status Quo

The problem with the status quo is that BC is facing future electricity supply insecurity. This is because BC has a supply shortfall as well as transmission constraints that limits its ability to import the electricity it needs in the future. Therefore, BC will need to either expand generating capacity or expand transmission capacity. Even if BC decides to expand transmission capacity for imports the members of the Western Interconnect will need to come up with additional generating capacity to maintain the reliability of the whole system.

Furthermore, BC's future supply options are limited. Unless the law is changed, Site C is probably the last large hydro dam that will be built, and the province prohibits nuclear power and GHG emitting power plants such as coal. Therefore, the province's options essentially consist of renewable such as small run-of-river hydro, wind, biomass, and geothermal, as well as upgrading current dams, at least until other technologies such as tidal, solar, and carbon capture and storage become further developed and cheaper. Geothermal power has advantages over other renewable in that it can provide a relatively cheap source of energy, is green, and is reliable enough to be used for base supply. Therefore, geothermal power could provide a valuable part of BC's renewable energy mix, but does not as of now.

3.2 Factors Affecting Policy Options

The recommended course of action via geothermal power depends on the following conditions:

1. Government policy on self sufficiency and IPPs
2. Expected supply shortfall

[46] BC Hydro, *2004 Integrated Electricity Plan: Part 3. Resource Options, "Appendix D – Alternative and Clean Energy – Other,"* 112.

3. Preferred choice of generating technology (for example: geothermal, wind, biomass or small run-of-river hydro)
4. Feasibility of geothermal site

Obviously feasibility of the site is absolutely essential to the development of geothermal power. This will need to be done on a site-by-site basis. As it stands right now, the government of BC desires electricity self sufficiency over importing electricity and accepts the use of IPPs to help meet its growing electricity demand. There is no reason why BC Hydro could not potentially develop its own expertise on geothermal power and develop it itself, but the government prefers to rely on private companies that already have this expertise. In addition, a supply shortfall is expected. However, future projections need to constantly be evaluated to see if expected supply will catch up to demand before geothermal can be developed. Other key factors that could potentially change are the desire for electricity self sufficiency and the desire to continue using IPPs.

3.3 Options

Table 3: Options for Developing Geothermal Power in BC

Course of Action	Benefits	Costs/Risks
Develop	• Have a clean, reliably source of energy	• Some emissions present, but still considered clean • High price uncertainty and many risks associated with geothermal sites (see section 2.2)
Do Not Develop	• No risks	• Will have to develop other sources of generation which may not be as cheap or reliable as geothermal.
Develop Under Conditions	• Minimize risks and uncertainty	• Sufficient supply may be achieved before more sites can be developed

When it comes to geothermal power, BC can either choose to develop the site, not develop it, or develop it based on certain conditions. These options and their benefits, costs and risks are summarized in Table 3. Conditions under which development of geothermal power in BC would occur include:

1. Extensive exploration at site to minimize uncertainty.
2. Waiting for the Meager Creek site to be developed in order to ensure geothermal power is both technically and financially feasible.

3.4 Recommendations

Given BC's current supply needs, their desire for self sufficiency, and their acceptance of IPPs, BC should support the development of geothermal power in BC. Geothermal power is clean, has an advantage over other renewable technology in cost, and is a reliable source of electricity that can be used to provide base supply. In addition, since this would be a private endeavour, private companies would be the ones taking the risks and putting up the financing for it and not BC. However, the prospects for geothermal power are inconclusive due to the

uncertainty over the feasibility of geothermal power in BC and the delay of the Meager Creek project, the cause of which is unknown. Therefore, it is recommended that the development of geothermal power in BC wait to see if Meager Creek is developed and confirms feasibility.

3.5 Implementation of Recommendations

Since Meager Creek is currently the most promising site for the development of geothermal power, this site should be developed first in order to explore the financial and technical feasibility of geothermal power in BC, and perhaps at a smaller scale and cost than the currently planned 100MW facility to reduce risks. If feasibility can be confirmed, then the Meager Creek site should be expanded and other sites should be explored for development. However, if feasibility cannot be confirmed or other sites developed before electricity self sufficiency is obtained, then there is no reason to develop other sites as there will be no demand for it.

3.6 Stakeholders

The stakeholders involved in this decision include BC Hydro and IPPs. BC Hydro has already committed to buying power from IPPs to help meet its growing electricity demand, and private companies are already exploring geothermal sites as well as developing other forms of renewable power in BC. Therefore, the two dominant players in this decision do not constitute obstacles. A third potential stakeholder involves citizens who own property on which the geothermal power facility may require for development and those living in the area or using it for recreational or other purposes. These people will need to be dealt with on an individual basis of a given site to produce support among the community. However, the power of the community to block development would probably be limited if the development did not require the use of private property and had the support of BC Hydro. For example, Western GeoPower Corporation, who is developing the Meager Creek site which is located on crown property in a rural area, already has a geothermal resource lease to develop that site, so it is unlikely that citizens could block this development.[47]

3.7 Conclusion

While BC currently needs to expand generating capacity and geothermal power, which is competitive with other renewable technology and has potential in BC, has not yet been developed in BC, the development of geothermal power should wait for the development of the Meager Creek site in order to confirm financial and technical feasibility. This is because the feasibility of geothermal power in BC is inconclusive.

Conclusion

BC is looking to expand electricity generating capacity to the point of being electricity self sufficient during a time when demand is increasing and imports are about to become insecure. BC's future supply options are limited due to restrictions on large hydro damns (except

[47] BC Hydro, *2005 Resource Options Report*, 7-27.

for Site C), GHG emitting sources and nuclear power. Therefore, biomass, wind, small run-of-river hydro and geothermal remain to be the main options open for new electricity generation in BC apart from expanding existing capacity through upgrades at existing dams until other technologies such as solar, tidal and carbon capture and storage become more developed.

Geothermal power is one of the options open to the province for electricity supply and has much potential for it located throughout the province. The technology is already developed, it is competitive or even cheaper than other renewable technologies, and it is green. However, there are many risks associated with geothermal power in BC including size, depth and temperature of the reservoir, permeability, terrain, land use, land ownership, competing interests and accessibility to the grid. In addition, there seems to be uncertainty over the unit energy price of geothermal power for proposed sites in BC. Varying estimates have been given for the Meager Creek site, and this project has not yet been developed even though it would have been online by 2007 if it were to go ahead. This means that the feasibility of geothermal power in BC is inconclusive.

Due to the above evidence, it is recommended that the development of geothermal power wait for the development of the Meager Creek site in order to confirm financial and technical feasibility. This option would minimize the risks and costs associated with developing geothermal power for the first time in BC and Canada. However, the downside is that feasibility may not be confirmed in time for other sites to be developed before electricity self sufficiency is achieved. If this is the case though, these sites will still be available for future electricity generation options. In the future, costs may come down with more advanced technologies that geothermal power plants can use to make geothermal power more economical, even for deeper geothermal reservoirs for example with new drilling techniques or technologies. Therefore, uncertainty and risk that exist today may be alleviated in the future. In conclusion, geothermal power should remain as an option for electricity generation in BC even if it proves to be financially or technically infeasible today.

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