Submission to the British Columbia Utilities Commission Indigenous Utilities Regulation Inquiry

CanGEA
CANADIAN GEOTHERMAL ENERGY ASSOCIATION

Canadian Geothermal Energy Association (CanGEA)

Submitted July 15, 2019

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About CanGEA

CanGEA's mission is to accelerate Canadian exploration and development of geothermal resources in order to provide secure, clean, and sustainable energy to Canada's heat and electricity markets.

The Canadian Geothermal Energy Association (CanGEA) is the collective voice of Canada's geothermal energy industry. As a non-profit industry association, it represents the interests of its member companies with the primary goal of unlocking Canada's tremendous geothermal energy potential. Geothermal energy can provide competitively priced, renewable, around-the-clock energy to the Canadian and U.S. markets and is part of the solution to growing concerns about securing sustainable and cost-effective energy sources. CanGEA promotes the industry and the potential of geothermal energy in Canada through outreach events, research, policy work and representing Canadian interests internationally. Conducting research and providing valuable reports is an important method for CanGEA to promote the industry and the potential of geothermal energy.

CanGEA acts as the conduit between industry and government to ensure that there is a supportive ecosystem for development across Canada. CanGEA participates in engagements with all levels of government, including federal departments and committees, provincial/territorial governments and utility commissions, municipal governments, and First Nations. Our advocacy efforts have proven fruitful in that we have enabled geothermal energy projects to be eligible for federal tax incentives and funding programs and led several provincial and local feasibility studies. Being a membership-based association, all of our efforts are geared towards bringing value to our members and the markets they operate in. CanGEA's membership is composed of geothermal developers, service providers, academic institutions, government entities, and students.

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1.0 - Introduction

CanGEA is registered as an intervener in the British Columbia Utilities Commission (BCUC) Indigenous Utilities Regulation Inquiry. CanGEA is participating in the Indigenous Utilities Regulation Inquiry to present the case for how geothermal energy utilities can provide a socio-economic stimulus to Indigenous communities as well as act as a vehicle for self-determination. Currently, geothermal resources, at or above the temperature of 80°C, are exempt from the BCUC Utilities Commission Act, meaning they are exempt from BCUC oversight. Considering that the Inquiry is investigating whether Indigenous-owned utilities should be regulated, regardless of utility type, CanGEA believes that our knowledge and experience can inform the Commission about geothermal energy for the purpose of delivering recommendation(s) to the British Columbia (BC) government on whether Indigenous geothermal utilities below 80°C should be regulated.

The purpose of this submission is to provide the Commission with an understanding of geothermal energy, its applications, and how it is regulated in Canada and abroad. The submission will also analyze various global case studies of Indigenous ownership and participation in geothermal energy utilities. The submission will then utilize a recent federal government study regarding best practices for Indigenous engagement in major energy projects to provide the federal view of Indigenous involvement in energy projects. The last part of the submission will focus on how the different regulatory contexts, ownership models, and federal considerations can be applied to the Inquiry's questions.

To begin, it is first necessary to gain a basic understanding of geothermal energy, how it works and the different types of applications that can utilize geothermal heat. With an understanding of the basics of geothermal energy, this submission will then analyze the BC geothermal energy regulatory context in comparison to other jurisdictions in Alberta and the United States.

1.1- The Basics of Geothermal Energy

Takeaway: geothermal energy is a mature technology capable of producing heat and electricity and is widely used globally.

Geothermal energy, or heat from the subsurface, is a clean and renewable form of energy that is being developed and utilized in 86 countries around the world.[1] The United States (US) currently leads global geothermal electricity production with approximately 3,639 MW of installed capacity,

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[1] Yousefi, Hossein, Abbasapour, Atefeh, and Seraj, Hamid Reza, "The Role Geothermal Energy Development on CO_2 Emission by 2030," *44th Workshop on Geothermal Reservoir Engineering Proceedings*, Stanford University, 2019, https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2019/Yousefi1.pdf.

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where most of the projects are located within the Western half of the US, as can be seen in Figure 1 and 2 below.[2] In comparison, global electrical capacity sits at 14,600 MWe.[3]

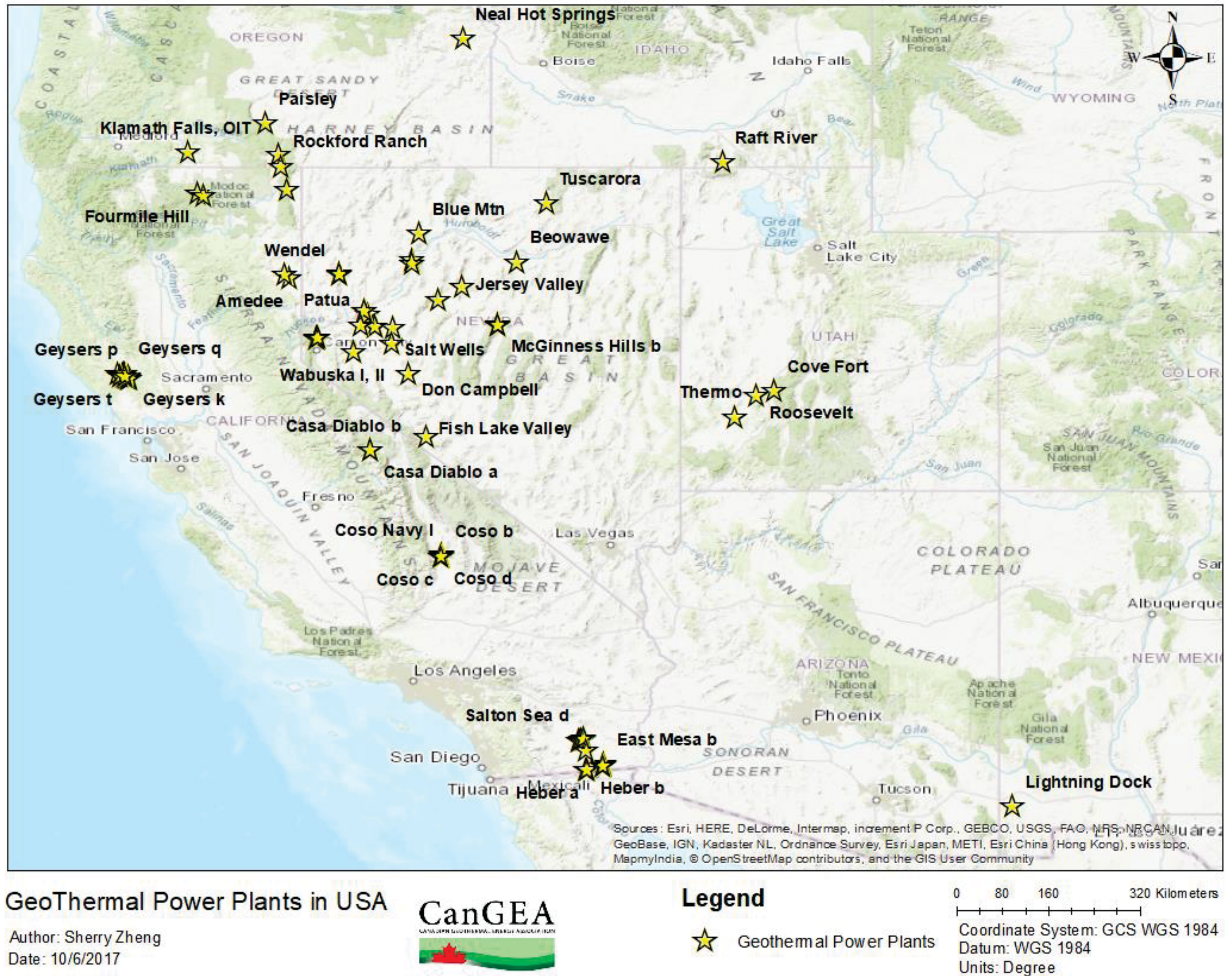

Figure 1: Geothermal Power Plants in the Mainland USA

[2] ThinkGeoEnergy, "The Top 10 Geothermal Countries 2018 – based on installed generation capacity (MWe)," 2018, http://www.thinkgeoenergy.com/the-top-10-geothermal-countries-2018-based-on-installed-generation-capacity-mwe/.
[3] *Ibid*.

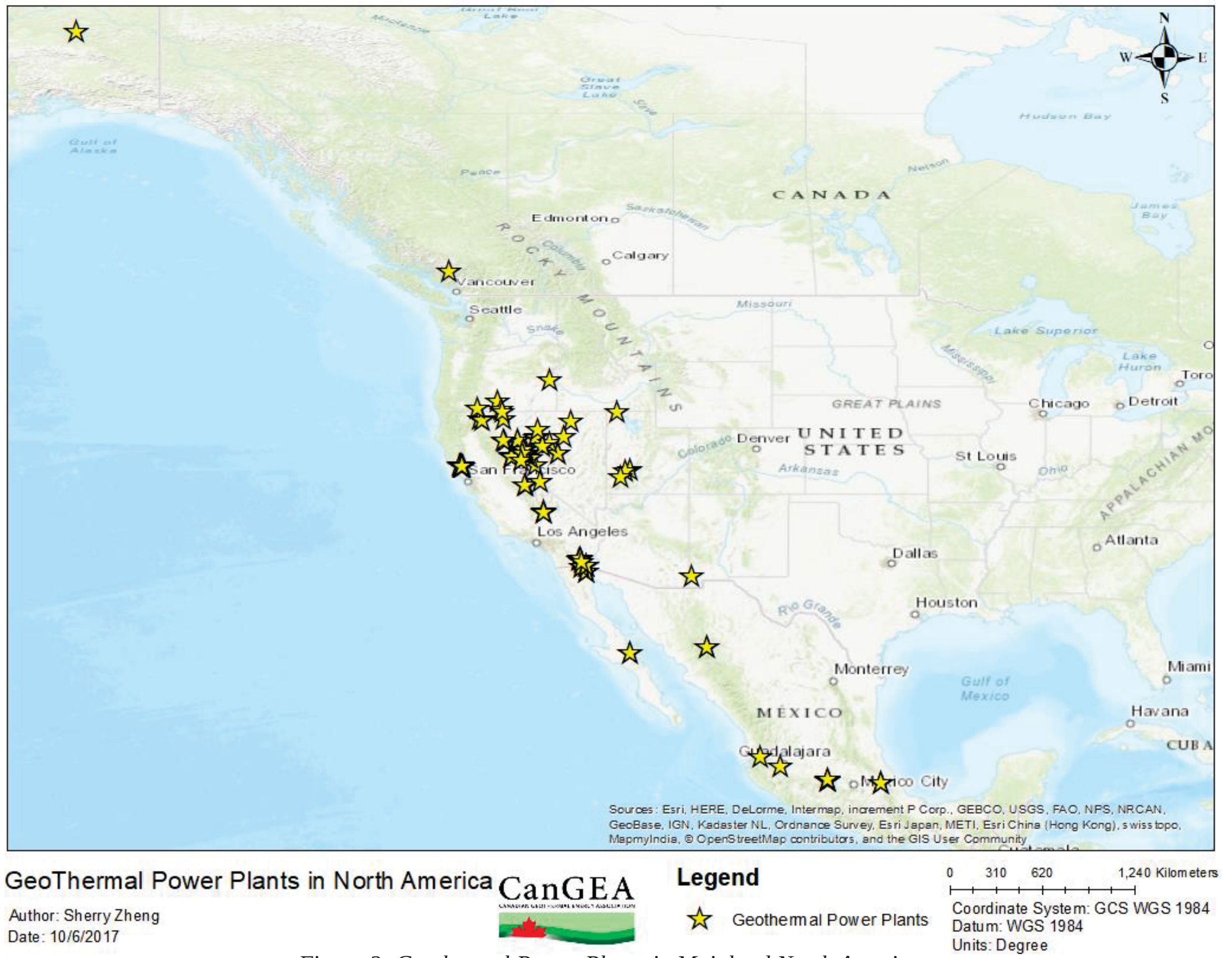

Figure 2: Geothermal Power Plants in Mainland North America

Geothermal energy is a renewable resource, with one of its most significant advantages being that it is a baseload and dispatchable form of energy.[4] Unlike other renewables that depend on external factors like weather to produce electricity, the Earth constantly produces heat, thereby allowing for the continuous production of electricity and/or heat.

The temperature of the Earth's crust increases according to depth, at a rate referred to as the geothermal gradient. The average geothermal gradient ranges from 20 °C to 30 °C per kilometre. However, there are many factors that can influence the geothermal gradient resulting in areas with higher or lower temperatures at depth. The geothermal gradient is generally the steepest near tectonic plate boundaries (i.e. the Earth's crust is warmer than average as a function of depth).[5]

Indigenous peoples who inhabited these areas were historically among the first to use geothermal energy. Proof of the early use of geothermal energy is present in areas where geothermal fluid

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[4] NRCan, *About Renewable Energy – Geothermal*, https://www.nrcan.gc.ca/energy/renewable-electricity/7295#geo, accessed June 19, 2018.
[5] Burke, K., & Kidd, W. S. F. (1978), Were Archean continental geothermal gradients much steeper than those of today? Nature, 272.

reaches the surface of the Earth and creates hot springs.[6] These manifestations of geothermal energy were used for bathing and washing clothes for more than 7,000 years. Industrial use of geothermal energy began in the early twentieth century. One of the first industrially used geothermal reservoirs was Larderello in Italy, where electricity was produced from the underlying geothermal resource starting in 1818.[7]

At the core of geothermal energy production is the basic operation of a liquid being converted to vapour, which then spins a turbine, thereby producing electricity. Traditional geothermal plants make use of volcanic heat, which is capable of flashing water to steam upon contact; these are considered high-grade resources and can be found in locations such as Iceland and Hawaii. Figure 3 below, illustrates the types of geothermal resources that can be found in Canada.

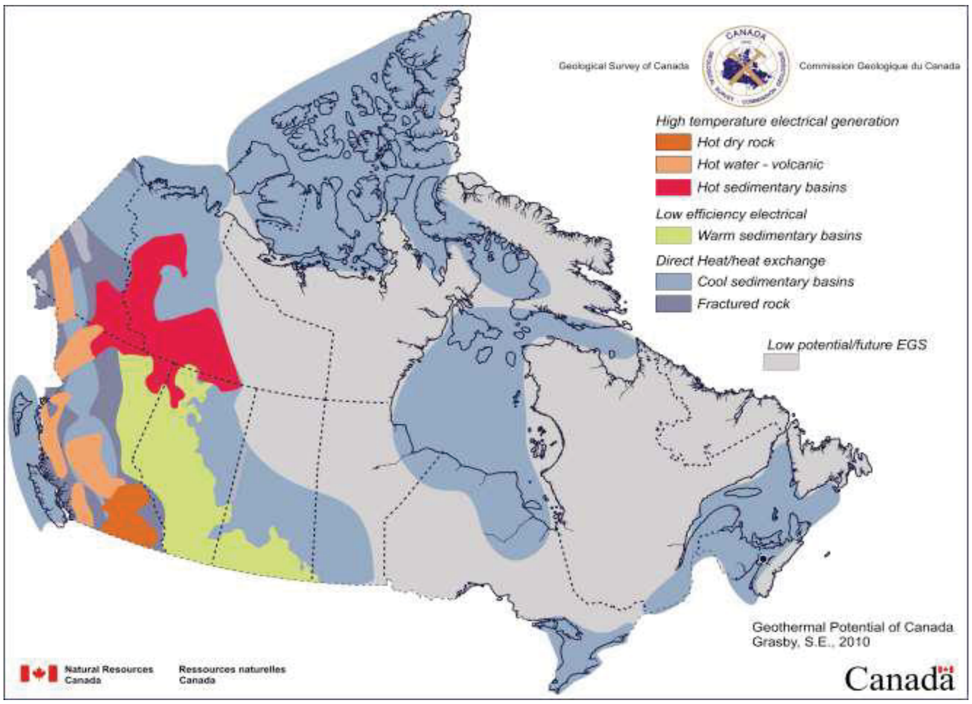

Figure 3: Geothermal Resource Types in Canada

As seen in Figure 3, above, BC has three main types of geothermal resources Hot Sedimentary Aquifers (HSA – also referred to as Warm/Hot Sedimentary Basins), Volcanic, Hot Wet Rock (HWR), and Hot Dry Rock (HDR).

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[6] Lund, J. W. (2001), Balneological use of thermal waters, *International Geothermal Days, Bad Urach, Germany*.
[7] Quick, H., Michael, J., Huber, H., & Arslan, U. (2010). History of international geothermal power plants and geothermal projects in Germany. In the Proceedings of the World Geothermal Congress.

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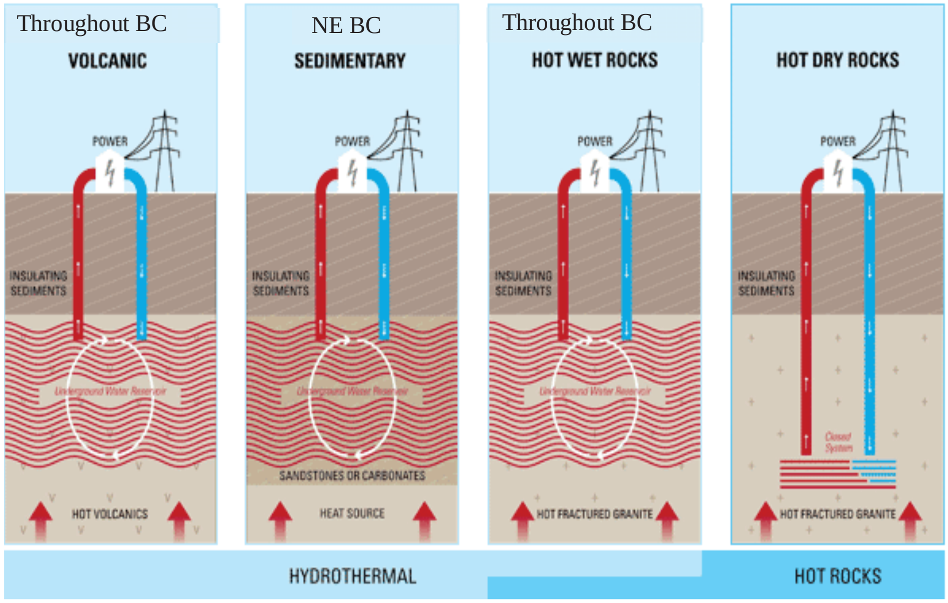

Figure 4: Types of Geothermal Energy Systems

Hot Wet Rock and Volcanic Systems (Combined for Simplicity)

Hot Wet Rock (HWR) geothermal systems occur in areas where convection of subsurface waters results from tectonic (crustal movement) or volcanic activity. Meteoric waters (rain waters) descend through fractures and permeable pathways to depths where they become heated, and in cases mixed with fluids from deep in the Earth, to then travel back up naturally via fractured pathways to the Earth's surface and occasionally form thermal springs.

Hot Sedimentary Aquifer (HSA)

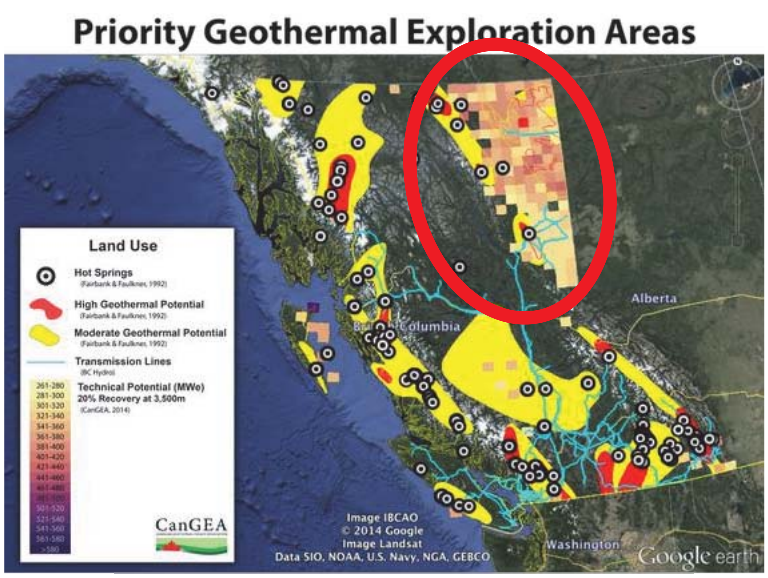

Figure 5: Priority Geothermal Exploration Ares in BC

Hot Sedimentary Aquifers (HSA) are deep, porous, and highly permeable layers of rock saturated with fluids (aquifers) that are heated naturally. For this type of geothermal systems, a well is used

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to bring the heated fluid to the Earth's surface where it can be used for electricity generation or heating. The cooled water is then pumped back into the subsurface.

Though HSA resources are considered lower grade in comparison to volcanic/HWR resources, they still have large potential and there are many possible applications for electricity generation and heating. The Western Canada Sedimentary Basin in the northeast portion of BC, highlighted in Figure 5 on the previous page, is the most prospective region for the development of HSA geothermal resources, due to its geological characteristics and knowledge from historic oil and gas exploration. However, the geothermal potential of HSAs within other sedimentary basins in BC, such as the Bowser and Nechako basins, remains uncertain.

For reference, some of Germany's geothermal resources are located in sedimentary basins, which are similar to the Western Canada Sedimentary Basin. Germany has increased their annual electricity production from 0 GWh to 36 GWh between 2003 and 2013.[8] Moreover, at the same time, Germany managed to increase the annual production of their geothermal district heating stations from 60 GWh to 530 GWh.[9]

Figure 1 and 2 on page 2 and 3, is notable as most of the geothermal electricity installations in the US are located in the western states, which are located along the ring of fire and have similar resources to BC. The map is important as geothermal resources do not stop at borders; with supportive regulations and policies for development, BC could start to see the development of its own geothermal resources.

1.1 - Types of Geothermal Applications

The applications of geothermal energy fall into two classes:

1. **Direct Use of Geothermal Heat (30°C – 150°C)**
2. **Geothermal Electricity**

Direct use of geothermal heat implies that geothermal energy is used for heating and other industrial or commercial processes. Direct use operations often involve drilling to a certain depth and bringing geothermal fluids to the surface to extract the heat. After the heat is extracted, the lower temperature liquid is returned to the earth via an injection well so that it can be reheated and utilized again. Industrial uses include heating greenhouses, aquaculture, pulp and paper manufacturing, and many other applications that require moderate heating. In some areas, hot springs will reach the surface naturally and the hot waters can be put to use without drilling.

Within the category of direct use, there are two sub-categories: industrial heat and direct heat. Industrial geothermal heat utilizes the heat from geothermal fluids, typically above 60°C.

[8] Agemar, Thorsten *et al.*, "Deep Geothermal Energy Production in Germany," *Leibniz Institute for Applied Geophysics*, (July 2014), pg 1, http://www.mdpi.com/1996-1073/7/7/4397/pdf.
[9] *Ibid*.

Applications that fall under this category include ethanol and biofuel production, refrigeration and ice making, lumber drying, cement and aggregate drying and other industrial processes.

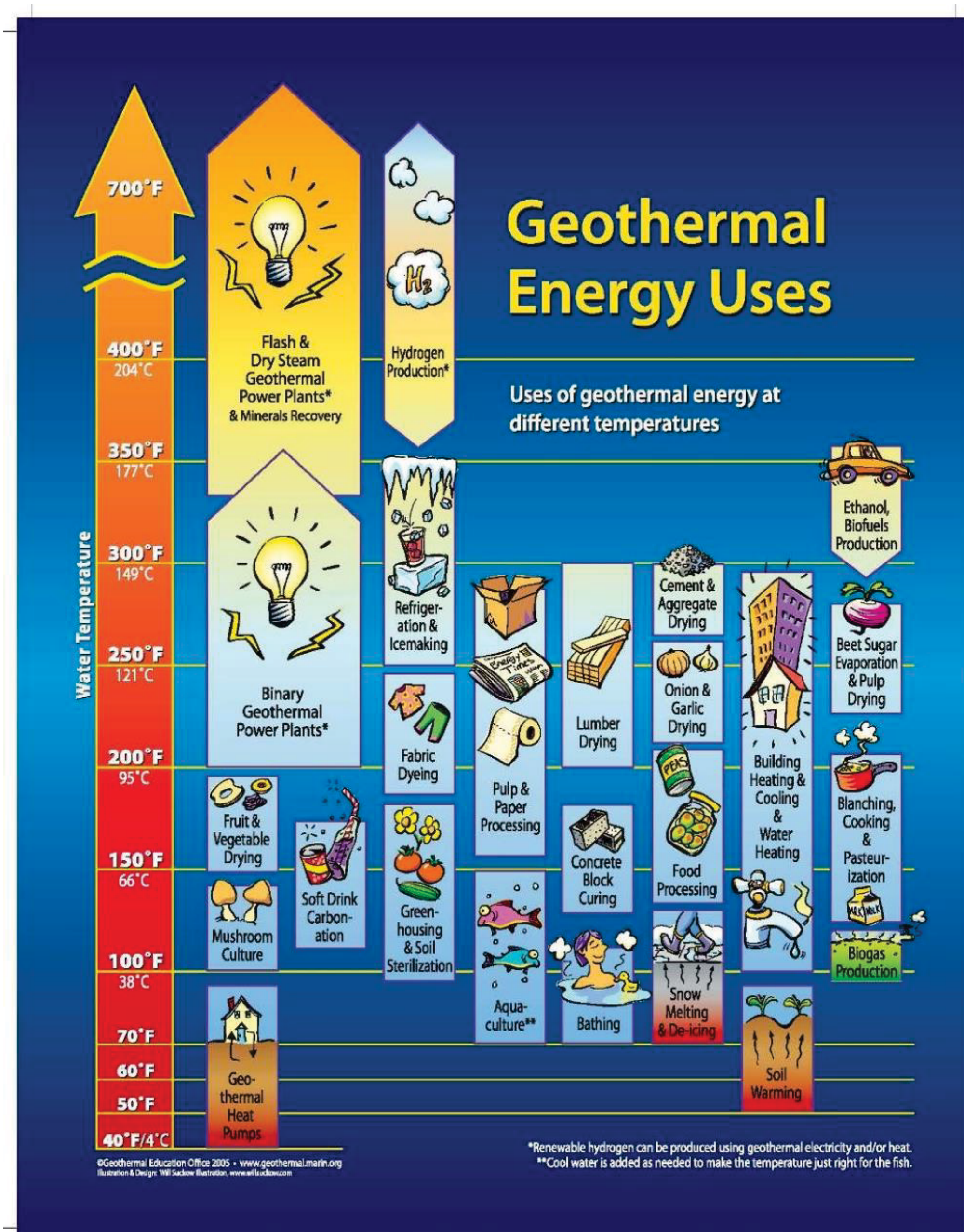

Figure 6: Geothermal Energy Uses

There are many possible applications of direct heat including water (pre) heating, aquaculture, bathing, and snow melting and de-icing as can be seen in Figure 6[10] above. An important note is that the heat from geothermal fluids can be cascaded (as illustrated in Figure 7 on the next page),

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[10] Ground Zero Energy, "Geothermal Energy Uses," accessed July 15, 2019, http://www.groundzerosoftware.net/Geo-energy-uses.

meaning that a resource can be used multiple times for different purposes until the temperature has been lowered to a point where it is no longer useful, thereby utilizing as much heat from the geothermal resource as possible.

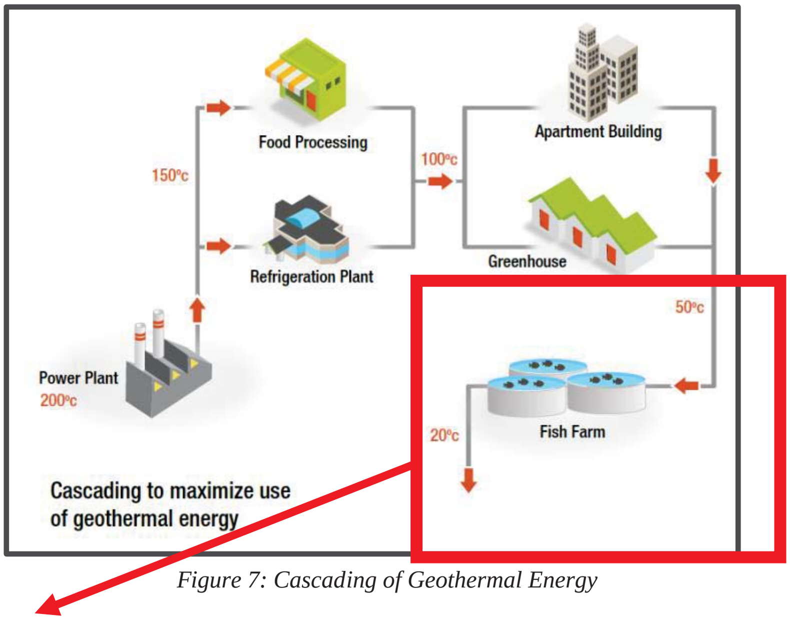

Figure 7: Cascading of Geothermal Energy

CanGEA believes that the highlighted portion of the cascaded system in Figure 7 above should be exempt from regulation if it is coming from a higher temperature source (i.e. 80°C or above exemption). In the case of a cascaded geothermal energy project, excessive regulation could hinder the development of lower temperature applications, such as a fish farm, which in turn reduces project profitability and a portion of the environmental benefits.

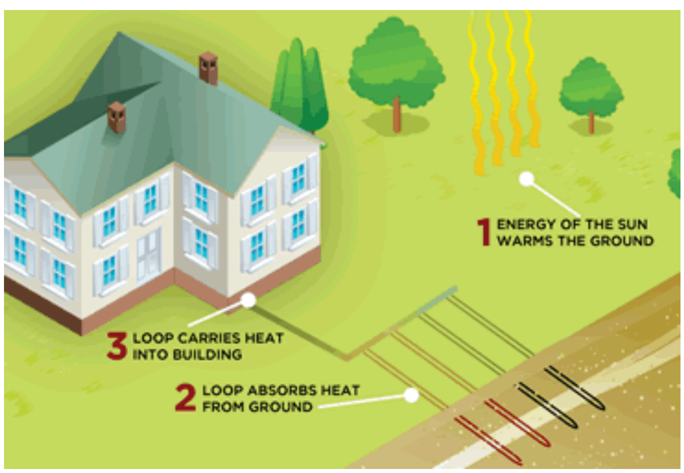

Figure 8: Geo-Exchange System Diagram

It is important to distinguish between Geo-Exchange or ground-source heat pumps (seen in Figure 8 above), which is commonly used in residential purposes, and geothermal direct use. At low temperatures, the difference between Geo-Exchange and direct use geothermal can become blurry. The primary difference is that Geo-Exchange uses the ambient soil temperature (that is primarily heated by the sun) and a working fluid in a closed loop, whereas direct use geothermal often utilizes geothermal fluid (that is heated by conduction and convection from Earth's core) directly in the system, before re-injecting it back underground.[11] At high temperatures, direct use implies using the heat from the geothermal fluid for anything but electrical generation. Direct use geothermal applications are found in a few places throughout Canada, most notably, areas with commercial hot springs.[12]

A large portion of the Geo-Exchange systems that exist in Canada are systems that have been installed in houses, which does not require any regulatory body oversight as they make use of the house's existing electrical tie-in to run the system.[13] One of the problems associated with single-home installations is the high upfront cost for installation, this can be mitigated through the development of larger scale ground-source heat pump district heating systems.

1.2 - Geothermal Greenhouses: Direct Use Case Study

Numerous commercially marketable crops have been raised in geothermal heated greenhouses in the Netherlands, New Zealand, Germany, Japan, Iceland, China, Tunisia, Kenya, and the United States.[14] These include vegetables, such as cucumbers and tomatoes, flowers, houseplants, tree seedlings and cacti. Using geothermal energy for heating reduces operating costs and allows for operation in colder climates where a commercial greenhouse would generally depend on fossil fuels for heating would not normally be economical.[15]

Worldwide there is approximately 1,333 ha of greenhouses heated with geothermal energy with an installed capacity of 1,830 MWt utilizing 26,662 TJ/yr in 31 countries.[16] The average energy use is 20 TJ/yr/ha.[17] The leading countries for annual energy use are the Netherlands, Turkey, Russia, Hungary, China and Italy; however, most do not distinguish between covered greenhouses versus uncovered ground heating. There are is one active geothermal-heated commercial greenhouse in Canada, located in Springhill, Nova Scotia. There is also a geothermal-heated aquaponics project located in the Yukon, which will be discussed later. By comparison, the conventional greenhouse industry is prominent in Canada and British Columbia (BC). Considering BC's high geothermal potential, there exist many opportunities to develop geothermal-heated greenhouses.

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[11] Canadian Geo-Exchange Coalition (2015). How Geo-Exchange Systems Work. Available online at: http://www.geo-exchange.ca/en/geoexchange_how_it_works_p49.php
[12] Lund, J. W., Freeston, D. H., & Boyd, T. L. (2005). Direct application of geothermal energy: 2005 Worldwide review. *Geothermics*, *34*(6), 691–727.
[13] Community Energy Association, "Heating our Communities," March 2011, http://communityenergy.bc.ca/wp-content/uploads/dlm_uploads/2014/06/HeatingGuide_Mar2011.pdf.
[14] Lund, J. W., Freeston, D. H., and Boyd, T. L. (2011). Direct Utilization of Geothermal Energy 2010 Worldwide Review, *Geothermics, 40*, Elsevier, Oxford, United Kingdom, pp. 159-180.
[15] Boyd, T. L. (2008). Geothermal Greenhouse Information Package, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon, 287 p.
[16] *Ibid*, 4-7.
[17] *Ibid*, 4-7.

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Figure 9: Geothermal well being drilled outside of a greenhouse in the Netherlands

The Netherlands *Geothermal Acceleration Plan for Horticulture* (the Plan) has led the Netherlands from producing 20 MW_{th} of geothermal heat in 2009 to more than 130 MW_{th} in 2015.[18] At the core of the Plan are feed-in tariffs and a drilling risk reduction program, which had an end goal of increasing the number of geothermal wells drilled per year.[19] As is evident by the increase in MW_{th} of geothermal capacity, the Plan has spurred the development of 11 geothermal greenhouse projects, which has contributed to the Netherlands becoming a global leader in food production per square mile and the number two exporter of food measured by value, second only to the United States.[20] An important takeaway is that the Netherlands is not home to world-class geothermal resources, yet through effective government regulations and programs, they have managed to become a global leader in clean, sustainable food production.

1.3 - Geothermal Electricity Explained

The most likely application for geothermal electricity in BC is through a binary geothermal plant. A binary geothermal plant utilizes the heat of geothermal water, which is transferred via a heat exchanger to a second (binary) liquid in an adjacent loop.[21] The binary fluid then boils to vapour, which in turn spins the turbine, thereby creating electricity.[22] Binary plants generally use lower temperature resources (38°C -149°C) as they make use of a binary liquid with a lower boiling

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[18] Bakema, Guido, Schoof, Frank *et al.*, "Geothermal Energy Use, Country Update for The Netherlands," *European Geothermal Congress* 2016, https://geothermie.nl/images/Handboeken/EGC_2016_country _update_Netherlands.pdf
[19] Dutch Association of Geothermal Operators, "Geothermal Energy in Netherlands," *dago.eu*, accessed November 15, 2018.
[20] Viviano, Frank, "This Tiny Country Feeds the World," *National Geographic* 2017, accessed November 14, 2018.
[21] Battocletti, Liz, "Geothermal Small Business Workbook," *Bob Lawrence & Associates, Inc.*, (May 2003): pg. 37, Produced for the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Geothermal Technologies Program under Contract No. DE-FG03-01SF22365.
[22] *Ibid*.

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point, such as butane.[23] A common application with binary plants is small modular units with a 0.25-3 MWe capacity range that can be stacked in sequence to create larger scale projects.

A geothermal plant costs more up-front than a fossil fuel-based electricity generation plant due to the risks and costs associated with confirming the resource's viability. In comparison to larger geothermal plants, small plants cost more per kilowatt of electricity (kWe).[24] It is also important to consider the operations and maintenance costs associated with running a geothermal plant, costs can vary depending on the price of electricity in the jurisdiction.[25] In general, the cooler the resource and the smaller installed capacity of a plant, the more expensive the project per kWe produced.[26] Though smaller projects cost more, it is important to note that a 250 kWe geothermal plant could be profitable if the plant is accompanied by a direct use application such as aquaculture, a greenhouse, or another type of direct use application.[27] A smaller project could be

1.4 – Conclusion

The purpose of this section was to provide an understanding of the basics of geothermal energy: how it works, the types of geothermal applications, what types of resources exist in Canada, where they are located, and what the benefits are to development. Further information regarding the ancillary benefits of geothermal energy projects can be found within Appendix A of this document. With this baseline information, it is now possible to discuss the Canadian Geothermal Energy Association's (CanGEA) role in Canada and the geothermal projects and studies being conducted by our members.

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[23] *Ibid*.
[24] *Ibid*, 38.
[25] *Ibid*.
[26] *Ibid*.
[27] Battocletti, "Geothermal Small Business Workbook," 39.

2.0 - CanGEA Member Active Projects and Studies

The following section will briefly highlight all active CanGEA member projects as of July 2019, studies and geothermal-related efforts in Canada with the goal of providing an overview of Canada's geothermal energy landscape.

2.1.1 - Nunavut

Qulliq Energy Corporation (QEC)

The QEC is the 100% government-owned arm's length electricity authority for the territory of Nunavut. All electricity needs in Nunavut are met by imported fossil fuel supplies. Each community in Nunavut has its own independent electricity generation and distribution system; there is no back-up grid. QEC is the only energy corporation in Canada without developed local energy resources or regional electricity transmission capability, creating a situation of high dependency on fossil fuel.

In an attempt to explore alternative energy options, CanGEA worked with the QEC to develop a request for proposals for a desktop geothermal energy feasibility study. In the summer of 2018, QEC completed Phase 1 of their feasibility study at a cost of $98,685.00 (self-funded). QEC is currently planning a Phase 2 study, which will allow them to better understand their geothermal resources by collecting site-specific subsurface data.

2.1.2 - British Columbia

Borealis GeoPower Inc. (BGP) – www.borealisgeopower.com

BGP is a private Canadian corporation focused on developing geothermal projects throughout Western and Northern Canada. BGP's portfolio includes projects with exploration permits, mining permits, as well as a diverse collection of geothermal consulting assignments.

BGP's vision is to work closely with their host communities and First Nations partners to build energy projects that provide local jobs, zero-emission electricity and heat production, support a diversified economy and allow for participation in the international mining sector.

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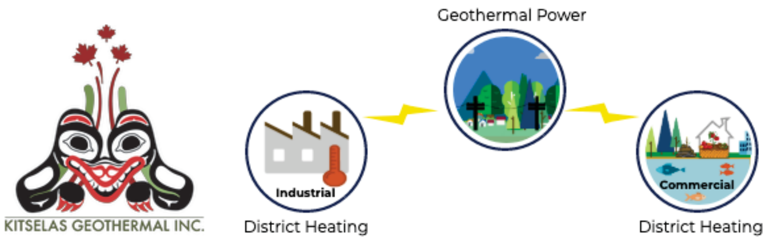
BGP - Lakelse Geothermal Project, BC – Geothermal Heat and Electricity



BGP's Lakelse Geothermal project is a joint venture between BGP and Kitselas Development Corporation, formulated as Kitselas Geothermal Inc (KGI). BGP's Lakelse geothermal project is located near Terrace, BC. The Terrace area is near the end of an ~800 km long 287 kV transmission lines, and as a result, it experiences frequent electricity outages, placing it among the top 10 brownout areas of the Province, as seen in Figure 10[28] below. BC Hydro transmission and high voltage distribution lines run above many parts of the project area and it is currently assumed that the project's interconnection will be within 300 meters of BC Hydro facilities.

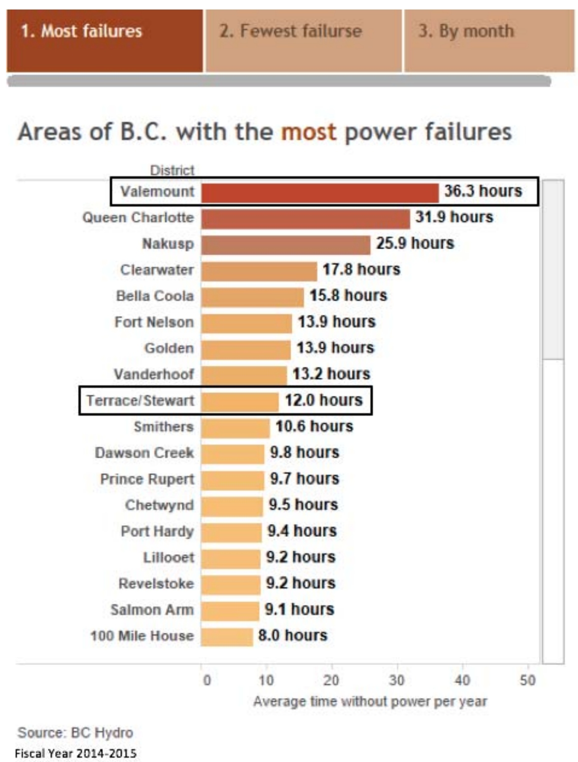


Figure 10: Areas of BC with the Most Power Failures

[28] Vancouver Sun, "Power failures far more common in remote parts of BC," accessed July 15, 2019, http://www.vancouversun.com/technology/Power+failures+more+common+remote+parts/11311997/story.html.

The project is set to be executed in three Phases. The first Phase will involve the development of a small geothermal-heated business park (geoheat park), then Phase 2 will involve ramping up the geoheat park with up to 20 times the amount of heat produced in Phase 1, although depending on the customer base in the area, which is rapidly growing due to the emerging LNG industry in the area, Phase 2 may be larger. Finally, Phase 3 aims to produce electricity that can be fed into the grid or provided directly to a nearby LNG project. A byproduct of the produced geothermal brines may be valuable metals and minerals currently dissolved in the fluid. They envision some form of mining as a separate but parallel Phase of the project.

BGP - Canoe Reach Geothermal Project, BC – Geothermal Heat and Electricity

BGP's Canoe Reach geothermal project is located near Valemount. The Valemount area is at the end of a 300 km long 138 kV radial transmission line, and as a result, it experiences frequent electricity outages, see Figure 9 on the previous page for reference. The Canoe Reach project is following a similar Phased approach to the Lakelse project in Terrace. Phase 1 is aiming to build a small-scale electricity project, followed by a geoheat park in Phase 2. Phase 3 would expand the heat and electricity projects to match the resource potential with local energy market demand. Metal and mineral extraction may also be a part of the project. BGP is working closely with the Village of Valemount and local businesses on the project.

BGP looks forward to dialogue with the BC government on the potential for renewable heat and electricity from this project site due to its strategic location within the Provincial grid, proximity to the large, new load developing from the TransMountain pipeline expansion project, and the negative emissions impact that current wood burning for heat is having on the region.

A timely article in the local newspaper, The Rocky Mountain Goat[29], appeared on July 4, 2019, and discussed the choices the region's residents are making to burn additional wood in light of rising electricity prices due to the termination of the BC Hydro E-plus program (article attached in Appendix C). The termination of the E-plus program and coinciding response to burn more wood is notable considering the recent release by the BC Ministry of Environment and Climate Change

[29] Andru McCracken, "BC Hydro scraps E-Plus program, forces more wood burning" (July 4, 2019), *The Rocky Mountain Goat*, pg 3, online: <https://www.therockymountaingoat.com/2019/07/bc-hydro-scraps-e-plus-program-forces-more-wood-burning/>.

Strategy's Central Interior Air Zone Report (2015-2017).[30] The report found that on an annual and daily concentration basis, Valemount had the highest concentration of $PM_{2.5}$ pollution in the Central Interior Air Zone (CIAZ).[31] $PM_{2.5}$ are particles up to 2.5 micrometres in diameter that are harmful to human health and can lead to shortness of breath, cardiovascular and respiratory diseases as well as birth defects.[32] The reduction of $PM_{2.}$ has been a top air quality priority across the Central Interior Air Zone over the past several years.[33] It is worth noting that the numbers in the report were affected by wildfire smoke.[34]

CanGEA member, the Village of Valemount, is already starting to see consequences from the cancelled E-plus program (i.e. wood burining for heat), despite having the worst $PM_{2.5}$ levels in the CIAZ. CanGEA recognizes that the BC government is working with communities with poor air quality to help reduce emissions and improve air quality. With Valemount being home to an active geothermal project, there is a prime opportunity for the community to utilize local, clean and renewable heat and electricity to help mitigate its air quality situation.

VALEMOUNT GEOTHERMAL SOCIETY

Valemount Geothermal Society (VGS) – www.valemountgeothermal.org

The VGS was officially incorporated as a non-profit in May of 2016 with the purpose of developing geothermal resources for the enhancement of Valemount and surrounding areas. The VGS is composed of 40 local members and has held vision planning sessions and local stakeholder engagement sessions. VGS aims to harness and/or assist in harnessing their local geothermal resource potential.

2.1.3 – Yukon

NORTH STAR AGRICULTURE FEEDING THE NORTH

North Star Agriculture (NSA) – www.northstaragriculture.ca

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[30] BC Ministry of Environment and Climate Change Strategy, *Central Interior Air Zone Report (2015-2017)*, accessed July 15, 2019, https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/air-zone-reports/2015-2017/central_interior_air_zone_report_2015-2017.pdf.
[31] *Ibid*, pg. 3.
[32] *Ibid.*
[33] *Ibid.*
[34] *Ibid.*

NSA's vision is to ensure that Northern families have access to beautiful, local, fresh, and sustainably-farmed food every day of the year, including the cold winter months, without any need for herbicides, pesticides, or chemical fertilizers. NSA is planning to build a small-scale aquaponics facility, located just North of Whitehorse. The facility will be used to showcase a vertical aquaponics system and also to educate the benefits and positive impacts that the facility can bring to the North. This facility will be heated and cooled by geothermal waters, which will also be showcased for visitors. The NSA project is an excellent example of one of the many potential applications for geothermal heat that could be implemented in BC.

Takhini Hot Pools – www.takhinihotpools.com

The Takhini Hot Pools is a hot spring located in Whitehorse, Yukon. The natural mineral water is 47°C, which is used to heat the pool year-round. The Takhini Hot Pools attract thousands of tourists year-round and serve as an excellent model for how geothermal heat can be utilized for tourism purposes.

2.1.4 - Alberta

Co-production project - University of Alberta, Alberta Innovates and Industry Partner – www.geothermics.ca

The co-production project will produce a comprehensive assessment of geothermal co-production opportunities throughout Alberta. The project is an example of a public-private partnership, where the University of Alberta and Alberta Innovates will work directly with an industry partner to design and install a pilot well-head waste heat recovery system in their South Swan Hills asset. **The project and related activities have received $2,950,000 CAD from Alberta Innovates as well as $5,000,000 Natural Resources Canada.**[35]

[35] Alberta Innovates, "Awardee Summary," accessed July 15, 2019, (1) https://albertainnovates.ca/wp-content/uploads/2019/01/CCITF-Awardee-Summary-CTD-2018-004.pdf, (2) https://albertainnovates.ca/wp-content/uploads/2019/01/CCITF-Awardee-Summary-CTD-2018-027.pdf.; Global Newswire, "Razor Energy Receives Funding for Geothermal Power Project, " accessed July 15, 2019, https://www.globenewswire.com/news-release/2019/06/27/1875064/0/en/Razor-Energy-Receives-Funding-for-Geothermal-Power-Project.html.

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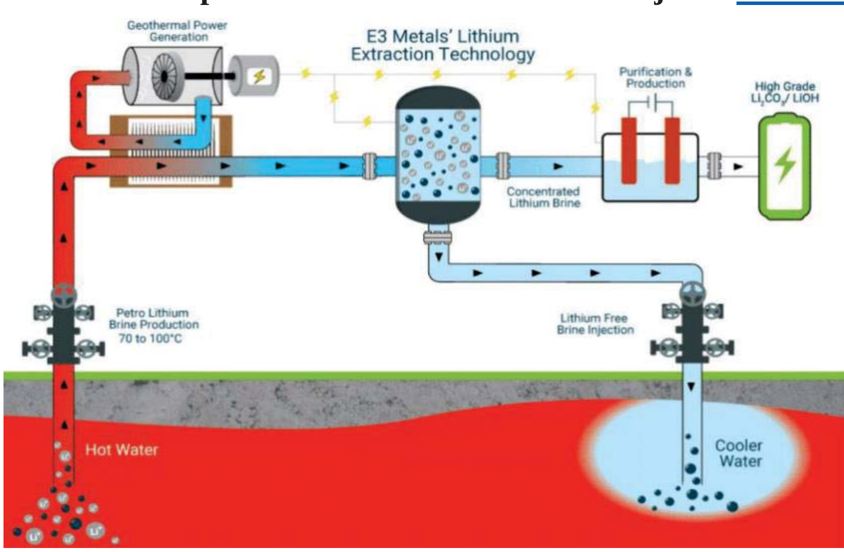
The project will test the heat exchange efficiency of a three-phase (brine, oil and gas) flow and develop mitigation strategies for geochemical and geomechanical risks associated with geothermal co-production in an active hydrocarbon field. Results from this field pilot will be used to help the industry partner plan a 10+ MWe scale-up and will be a key element in evaluating and validating models of the province-wide scope of this unique opportunity. This project represents an innovative step forward for the extractive resource industry, something that could be applied in the BC context.

Geothermal Technology Demonstration Project – Alberta Innovates and Industry Partner

Alberta Innovates is working with an industry partner on the demonstration of a new geothermal technological application. **The project received $6,700,000 CAD from Natural Resources Canada and Sustainable Development Technology Canada, along with approximately $100,000 in support from Alberta Innovates.**[36] Further information regarding the project can be found in citation 35.

E3 Metals Corp. – Petro-lithium Extraction Project – www.e3metalscorp.com



[36] Natural Resources Canada, "Eavor-Loop Demonstration Project," accessed July 15, 2019

E3 Metals is targeting the development of Petro-Lithium – a new source of lithium from reservoirs associated with oil and gas production. E3's permit area is blanketed with a vast network of pipelines, wells and roads that are available for E3 to repurpose for the production and processing of lithium brine. Another advantage is the high temperature (70°C to 100°C brine) and high flow rates (up to 10,000 m^3/day of brine per well) allowing for the potential of geothermal electricity generation or heat recovery. The E3 Metals project is an excellent example of potential collaboration between the geothermal energy industry and the extractive industry sector. **It is worth noting that the project received $100,000 CAD in support from Alberta Innovates in 2018**.[37]

2.1.5 – Nova Scotia

The Cumberland Energy Authority (CEA) was formed in 2012 through an Inter-Municipal Agreement between the Municipality of the County of Cumberland, the former Town of Parrsboro, and the former Town of Springhill to promote regional energy development. The CEA's mission is to support the standard of leadership in local government for the development of renewable energy, support of the progressive energy industry and the encouragement of a sustainable future for our communities.[38]

The CEA oversees the Springhill geothermal mine water project ("the Project"), which began operating in the early 1990's.[39] Ropak Can Am Limited, a manufacturer of plastic packaging products is using the geothermal energy from floodwater in abandoned mines to provide heating and cooling for the company's facility in Springhill, NS; The heat is also used by other operations such as a greenhouse.[40] Mine water at a temperature of 18°C is pumped at a rate of 4L/s from a flooded mine and passed through a heat pump system before reinjection into another separate, but

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[37] Cision Newswire, "E3 Metals granted $100,000 in funding from Alberta Innovates for the continued development of its lithium extraction technology," August 28, 2019, https://www.newswire.ca/news-releases/e3-metals-granted-100000-in-funding-from-alberta-innovates-for-the-continued-development-of-its-lithium-extraction-technology-691865241.html.
[38] Cumberland Energy Authority, "About us," accessed July 15, 2019, https://cumberland-energy-authority.ca/about.html.
[39] CADDET, "Geothermal mine water as an energy source for heat pumps," accessed July 15, 2019, pg 1, https://www.nrcan.gc.ca/sites/oee.nrcan.gc.ca/files/pdf/publications/infosource/pub/ici/caddet/english/pdf/R122.pdf
[40] *Ibid.*

linked mine.[41] Annual energy savings, compared to conventional systems, is around $45,000 CAD or approximately 600,000 kWh.[42] The technology deployed in this project is a heat pump.

2.2 – Conclusion

The purpose of this section was to provide the reader with the general context for CanGEA member projects and studies being conducted throughout Canada. A notable feature is that there are projects being developed in jurisdictions that do not have formal regulatory frameworks, such as Alberta and Yukon. The next section will delve into the existing geothermal regulatory frameworks in Canada and in the United States, with the goal of understanding the different possible approaches to regulating geothermal energy.

3.0 - The Regulation of Geothermal Energy Resources in Canada and the United States

The development of geothermal energy resources has lagged behind other renewable energy types in Canada. As such, there are only three provinces with established geothermal regulatory frameworks - British Columbia, Saskatchewan and Nova Scotia. The following section will briefly highlight the regulatory frameworks in British Columbia, Saskatchewan and Nova Scotia to provide the context for geothermal energy regulation in Canada. This section will also analyze the frameworks in Washington, Idaho and Oregon in an effort to provide a more complete picture of how geothermal energy is regulated in Canada and the US. The last part of the section will provide comments as to the difficulties that can be encountered with the different types of regulatory frameworks that exist, with a specific focus on BC's framework.

3.1 - BC's Geothermal Energy Regulatory Framework

The BC *Geothermal Resources Act* (*GRA*) defines a geothermal resource as "the natural heat of the earth and all substances that derive an added value from it". [43] This includes steam, water, water vapour and all substances dissolved in the steam, water or water vapour obtained from a well.[44] A notable feature is that the Act specifically excludes water that at the surface has a temperature less than 80°C and hydrocarbons.[45] Through the *GRA*, the Province owns all geothermal resources in British Columbia. When geothermal fluids are greater than 80°C at the wellhead, the project is not subject to regulation by the BCUC, but instead is regulated by the BC Oil and Gas Commission. When geothermal fluids are less than 80°C at the wellhead, then the project is treated as a *Thermal Energy System* and is therefore subject to regulation by the BCUC.

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[41] *Ibid.*
[42] *Ibid.*

[43] RSBC 1996, c 171, s 1(1).
[44] *Ibid.*
[45] *Ibid.*

3.1.1 – BC Geothermal Energy Royalty Framework

There is currently no royalty framework for geothermal energy resources in BC. It is worth noting that royalty payments are written into the *GRA*. The *GRA* specifies that a lessee who produces a geothermal resource for purposes other than testing must pay a royalty that has either been previously agreed upon or at the prescribed royalty rate.[46] Geothermal fluids with a wellhead temperature of less than 80°C are not regulated by the *GRA*, but instead by the BCUC and are treated as a *Thermal Energy System*.

In 2018, the BC government conducted a review on geothermal energy royalties, in which CanGEA made a submission.[47] Within our submission, CanGEA acknowledged and supported the BC *GRA*'s requirement to have a royalty on all geothermal energy sold in the Province. However, CanGEA recommended that geothermal projects producing both heat and electricity for distribution, should pay royalties for either heat or electricity; geothermal projects should not be taxed twice for a single project (Tax on tax). CanGEA also agreed with the Ministry of Energy, Mines and Petroleum Resource's (MEMPR) suggestion that projects should be subject to a 10-year royalty holiday. CanGEA's last recommendation was that the suggested 3% royalty rate should be reduced to 1% to achieve parity with wind energy royalties in BC (rent) on both a $/MWh basis, and because 1% is the rate used for lower quality energy resources. For context, the BC MEMPR had suggested 3% as a royalty for geothermal resources. It is worth noting that CanGEA's submission was co-signed by the Canada West Foundation and the Petroleum Services Association of Canada. CanGEA's submission is attached in Appendix B.

3.2 - Saskatchewan's Geothermal Energy Regulatory Framework

In Saskatchewan (SK), geothermal systems are separated into two categories, open-loop and closed-loop.[48] An open-loop system withdraws formation water from a water source well for the purpose of extracting geothermal energy as part of an industrial process and disposing the cooling fluids into a waste disposal well following the extraction of the heat content.[49] In a closed-loop system, the source fluids are circulated in a sealed wellbore/heat exchange loop and there are no formation fluids to be withdrawn or fluids to be disposed of.[50]

In terms of regulating geothermal energy projects, the Government of SK has taken an approach of fitting geothermal energy development into existing oil and gas regulations and directives due to their resources being exclusively HSA systems; the same systems that are utilized to extract oil

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[46] *Ibid*, s 17.
[47] Submission made July 16, 2018 to the Electricity Policy and Regulatory Branch of the Ministry of Energy, Mines and Petroleum Resources; submission attached in Appendix B.
[48] Government of Saskatchewan, "Geothermal Project (Subsurface) Application Form Instructions," accessed July 5, 2019, https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/oil-and-gas/oil-and-gas-licensing-operations-and-requirements/oil-and-gas-drilling-and-operations/gas-storage-and-cavern-storage-disposal.
[49] *Ibid*.
[50] *Ibid*.

and gas. This analysis will briefly look at the applicable regulations and directives.

The following table provides a summary of the active SK project:

Saskatchewan Geothermal Project Case Study:	
Gross Capacity	10 MWe
Net Capacity	5 MWe
Federal Funding (NRCan[51] - ERPP)	$25,600,000
Total Project Value	$51,300,300

3.2.1 - Water Rights

Exploration and production of groundwater is governed by the *Ground Water Regulations*[52] and is administered by the Saskatchewan Water Security Agency (SWSA).[53] Prior to submitting an application for a geothermal project, developers are required to obtain a permit or licence from the SWSA.[54]

3.2.2 - SK Geothermal Energy Production Regulation

Due to the similarities between oil and gas extraction and geothermal energy production, geothermal energy projects are regulated under *The Oil and Gas Conservation Act*[55] (*OGCA*) and coincidingly, the *Oil and Gas Conservation Regulations, 2012* (*OGCR*).[56] Within the *OGCR*, "the geothermal industry" has been included as a "non-oil-and-gas substance" that is governed by the *OGCA*.[57] The geothermal energy industry is required to adhere to the oil and gas regulatory regime to ensure that geothermal resource extraction is done in a responsible and sustainable manner. Geothermal energy developers are required to apply and report to the Ministry of Energy and Resources, who acts as the primary regulatory authority for the oil and gas industry (and non-oil-

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[51] ThinkGeoEnergy, "Canadian government provides $25.6m in funds to Saskatchewan geothermal project," published January 11, 2019, http://www.thinkgeoenergy.com/canadian-government-provides-25-6m-in-funds-to-saskatchewan-geothermal-project/.
[52] Sask Reg 172/66.
[53] Government of Saskatchewan, "Geothermal Project (Subsurface) Application Form Instructions," accessed July 5, 2019, https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/oil-and-gas/oil-and-gas-licensing-operations-and-requirements/oil-and-gas-drilling-and-operations/gas-storage-and-cavern-storage-disposal.
[54] *Ibid*.
[55] RSS 1978, c O-2.
[56] RRS c O-2 Reg 6.
[57] *Ibid*, s 4(1).

and-gas substances), ensuring competitive royalty systems, regulations and policies for all natural resource sectors.[58]

3.2.3 - SK Geothermal Energy Royalties

Though there have not been any official government announcements, it does not appear that geothermal energy resources will be subject to a royalty due to "the geothermal industry" and "non-oil-and-gas substance" being absent from *The Crown Oil and Gas Royalty Regulations, 2012*. It is likely that royalties will be reviewed at a later date when geothermal electricity development is near completion or shortly after it is first produced in the Province.

3.2.4 - Regulating Utilities in SK

There are four regulated energy providers in the province of Saskatchewan.[59] Though there are a few municipalities with their own energy grids, they still procure their electricity from a provincially regulated energy provider such as SaskPower or Saskatoon Light & Power.[60] Power generation developers are required to work with one of the four regulated energy providers to secure a Power Purchase Arrangement in order to sell their electricity to the provincial grid.

3.3 - Nova Scotia's Geothermal Energy Regulatory Framework

In Nova Scotia, the *Mineral Resources Act* (*MRA*) defines geothermal resources as, "a substance, including steam, water and water vapour, that is found anywhere below the earth and that derives an added value from the natural heat present in, resulting from, or created by the earth."[61] Though there is a broad definition as to what defines geothermal resources, geothermal development is limited to areas deemed by the Governor in Council as "geothermal resource areas."[62] There are currently two designated geothermal resource areas in Nova Scotia, the Springhill Geothermal Resource Area[63] and the Pictou County Geothermal Resource Area.[64]

3.3.1 - Royalties on Geothermal Energy in Nova Scotia

Per the *Schedule "C" to O.I.C. 92-1025 - Inapplicable Sections of Act - Designation of Springhill Geothermal Resource Area Regulations*, geothermal resources in the Springhill Geothermal Resource Area are not subject to royalties within the province of Nova Scotia.[65] In the case of the Pictou County Geothermal Resource Area Designation, it is assumed that it is subject to the same

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[58] Government of Saskatchewan, "Energy and Resources," accessed July 5, 2019, https://www.saskatchewan.ca/government/government-structure/ministries/energy-and-resources.
[59] Energy Rates Canada, "Saskatchewan Regulated Energy Providers," accessed July 8, 2019, https://energyrates.ca/saskatchewan-regulated-energy-providers/.
[60] *Ibid*.
[61] SNS 1990, c 18, s 2(ha).
[62] SNS 1990, c 18, ss 2(hb), 8A.
[63] Springhill Geothermal Resource Area Designation, NS Reg 195/92
[64] Pictou County Geothermal Resource Area Designation, NS Reg 123/93
[65] Springhill Geothermal Resource Area Designation, NS Reg 195/92.

exemption due to the fact that the Schedule "C" portion of the regulation is absent. The regulation states that "Schedules B and C may be viewed at the Department of Natural Resources."[66] CanGEA has reached out to the appropriate authority within the Nova Scotia government but has yet to receive a response.[67]

3.3.2 - Regulation of Utilities in Nova Scotia

Pursuant to the *Public Utilities Act*,[68] the Nova Scotia Utility and Review Board (NSUARB) exercises supervision over all electric utilities operating as public utilities within the Province.[69] The NSUARB asserts jurisdiction over rate setting, tolls and charges, regulations for the provision of service, and approvals of large capital expenditures.[70] It is worth noting that there is limited information relating to the regulation of heat utilities; something that can likely be attributed to heating oil, electrical heating and ground source heat pumps being the main players in the heating market.[71]

3.3.3 – Conclusion

A key takeaway from our regulatory analyses is that each of the provinces have their own unique geological scenarios. The majority of Saskatchewan falls within the Western Canada Sedimentary Basin (WCSB), which means there is only one type of geothermal resource present, HSA. The WCSB is also the area in Canada where the majority of oil and gas is extracted, which provides justification as to why the Government of Saskatchewan chose to regulate geothermal energy projects in a similar manner to oil and gas projects.

Nova Scotia's accessible geothermal resources are located within small HSA resource areas spread throughout the Province. As such, the Government of Nova Scotia has designated two geothermal resource areas that are regulated on an individual basis. It is worth noting that in both cases, geothermal resources are treated as minerals, which for Nova Scotia's limited resources, is logical. Thus, it was most efficient to fit geothermal resources into existing legislation.

In comparison to the Nova Scotia and Saskatchewan regulatory frameworks, the BC geothermal resource and regulatory context is unique. The majority of resources within the Province are non-HSA resources, yet the majority of the active geothermal projects (and the materiality of the size of the projects) in BC are targeting geothermal resources greater than or equal to 80°C, which means that they are subject to regulation by the BC Oil and Gas Commission (BCOGC).

CanGEA believes that the BCOGC does not currently possess the relevant technical competence

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66 Pictou County Geothermal Resource Area Designation, NS Reg 123/93.
67 Attempted to contact the Manager of Mineral Development and Policy on July 11, 2019.
68 RSNS 1989, c 380
69 Nova Scotia Utility and Review Board, "Electricity," accessed July 8, 2019, https://nsuarb.novascotia.ca/mandates/electricity/#renewable-energy-community-based-feed-in-tariffs-48.
70 *Ibid.*
71 Natural Resources Canada, "Residential Sector: Nova Scotia – Table 21: Heating System Stock by Building Type and Heating System Type."

or interpretive flexibility for the early stages of development of the vast proportion of BC's geothermal energy resources. It is believed that relatively deep, large diameter, high volume flowing wells, i.e. production and injection wells, are the specialty of the BCOGC, as well as all aspects of the HSA geothermal resources. Note: HSA projects do not require the early development stages of Hot Wet Rock/volcanic resources, as the HSA resources have already been largely delineated by the oil and gas industry.

Considering that the majority of geothermal energy projects in BC are located in areas with Hot Wet Rock or volcanic geothermal resources, it seems illogical that the early phases of exploration/development would be regulated by the BCOGC and assessed as being as hazardous as oil and gas wells. The administrative costs and time for approvals, reviews and permits are currently costly and burdensome, open to the interpretation of inexperienced regulators for the activities performed, and can lead to, or has led to, project delays or potential project failure.

A later section of this submission will analyze various New Zealand (NZ) Indigenous-owned (Māori) geothermal utilities, however, there are two salient points regarding issues with NZ's current regulatory framework, a framework that was largely adopted by BC in it's *Geothermal Resources Act*, that is worth discussing here:

(1) "Some of the powers do not rest with the appropriate authority."[72]
(2) "The problem with wholesale adoption of the petroleum regulations to the less hazardous geothermal industry is that the costs of implementing the framework applied to petroleum operations will be higher in relation to the benefits. The geothermal industry drilling regime is similar to the petroleum industries, as emphasized by the many [American Petroleum Institute] API standards that are used in practice and referenced in NZS2403:1991 [New Zealand code of practice for deep geothermal wells] but is less hazardous."[73]

The first point is salient in that the author recognizes that the development of NZ's geothermal resources have been slow due to regulatory powers not being assigned to the right authority; something that CanGEA believes is the case with the BC Oil and Gas Commission regulating the early stages of development of the vast proportion of BC's geothermal energy resources.

The second point is important as it speaks to the difficulty of adopting petroleum regulations for geothermal energy, which according to the author, the costs outweigh the benefits. The second sentence of the quote speaks to the similarities of the drilling of deep, large diameter, high volume flowing wells, i.e. production and injection wells and petroleum industry wells. What is absent from this quote is the early stage reconnaissance and exploratory drilling that is required to assess the viability of geothermal resources; in this case, the activities are not similar, which CanGEA believes should require a different regulatory body capable of providing user-friendly, flexible,

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[72] Ellis, Donna, Vernon, Wayne and Lord, Sam, "Challenges of New Zealand Geothermal Legislation," *Proceedings World Geothermal Congress 2015*, April 2015, middle of pg. 6, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/03005.pdf.
[73] *Ibid*, bottom of page 6.

and cost-effective services to geothermal developers in the feasibility and exploratory phases of their projects.

With an understanding of the different regulatory frameworks in Canada, this submission will now analyze three US geothermal regulatory frameworks. The three different US geothermal regulatory case studies will provide more context as to how geothermal resources are regulated in North America.

4.0 - US Geothermal Energy Regulatory Framework Case Studies

Federally, the *Geothermal Steam Act* defines geothermal as "all products of geothermal processes, embracing Indigenous steam, hot water and hot brines…heat or other associated energy found in geothermal formations; and any other by-products derived from them."[74] Despite the all-encompassing federal definition of geothermal resources, it is up to each state to determine how to define their geothermal resources.

It is worth noting that the federal *Energy Policy Act* requires developers to pay royalties, which are split between federal, state and county governments (25%, 50%, and 25%, respectively).[75] For electricity production, royalties are 1.75% of gross proceeds for the first 10 years and 3.5% after 10 years.[76] For direct-use projects, royalties are in the form of an annual fee that is between $100-$1,000.[77] The following section will briefly highlight the frameworks in various US states to illustrate the variation that exists.

4.1 - Oregon's Geothermal Energy Regulatory Framework

Installed Electrical Capacity[78]	33 MWe	90 MWe *Planned*
Installed Heat Capacity[79]	65.68 MWth	N/A

[74] Lund, John and Bloomquist, Gordon, "Development of Geothermal Policy in the United States – What Works and What Doesn't Work," *Thirty-seventh Workshop on Geothermal Reservoir Engineering*, February 2012, https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2012/Lund.pdf
[75] Doris, Elizabeth, Kreycik, Claire, and Young, Katherine, "Policy Overview and Options for Maximizing the Role of Policy in Geothermal Electricity Development," *National Renewable Energy Laboratory Technical Report*, https://www.energy.gov/sites/prod/files/2014/05/f15/policy_overview.pdf.
[76] Lund, John and Bloomquist, Gordon, "Development of Geothermal Policy in the United States."
[77] *Ibid.*
[78] Government of Oregon, "Geothermal Energy in Oregon," accessed July 15, 2019, https://www.oregon.gov/energy/energy-oregon/Pages/Geothermal.aspx.
[79] Geothermal Data Repository, "Update on Geothermal Direct-Use Installations in the United States," accessed July 15, 2019, https://gdr.openei.org/submissions/911.

The legislation in a few US states acknowledges that water resources that exceed a certain temperature are unlikely to be utilized in most applications, therefore in these states, hot water is exempt from certain permitting regimes.[80] Oregon utilizes 120°C as the threshold, where resources less than the threshold are regulated by the Oregon Department of Water Resources and is classified as "Water".[81] If the geothermal resource is greater than 120°C then the use is regulated by the Oregon Department of Geology and Mineral Industries and is classified as a "mineral".[82] Additionally, ownership of the resources belongs to the owner of the surface estate.

4.2 - Idaho's Geothermal Energy Regulatory Framework

Installed Electrical Capacity[83]	18 MWe
Installed Heat Capacity[84]	98.25 MWth

In Idaho, geothermal resources are considered to be *sui generis*, which means it is treated as neither a mineral nor a water resource, but instead is treated as a unique kind of groundwater.[85] Geothermal resources of a temperature less than 100°C, are treated as regular groundwater. By state law, Idaho retains ownership of all groundwater, including geothermal resources.[86] Additionally, the State holds the authority to regulate all groundwater and surface water by issuing water rights, drilling permits, and injection permits. This applies to all geothermal resources, including high (>100°C) temperature water, and low temperature or cold-water resource.[87] The single regulatory authority in Idaho simplifies the licencing in the permitting process as developers can obtain permits for high and low-temperature geothermal projects from the same agency.

4.3 - Washington's Geothermal Energy Regulatory Framework

Installed Electrical Capacity[88]	Research Stage
Installed Heat Capacity[89]	1.5 MWth

[80] Van Hal, Grant, "Legal Obstacles to the Development of Geothermal Energy in Alberta," *Canadian Institute of Resource Law*, December 2013, pg. 31.
[81] Lund, John and Bloomquist, Gordon, "Development of Geothermal Policy in the United States."
[82] *Ibid*.
[83] US Energy Information Agency, "Idaho -Profile Analysis," accessed July 15, 2019, https://www.eia.gov/state/analysis.php?sid=ID.
[84] Geothermal Data Repository, "Update on Geothermal Direct-Use Installations in the United States."
[85] Gillerman, Virginia, "Geothermal Permitting in Idaho," March 2012, http://geology.isu.edu/Geothermal/PermittingInfo/ID%20Geothermal%20Permitting3312012.docx.
[86] *Ibid*.
[87] *Ibid*.
[88] Morey, Mark, "Geothermal Technology Picking up Steam in Washington State," *Tri-City Herald*, published June 2017, https://www.tri-cityherald.com/news/local/article154740384.html.
[89] Geothermal Data Repository, "Update on Geothermal Direct-Use Installations in the United States."

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Prior to 2013, the state of Washington defined geothermal resources based on the technical feasibility of producing electricity with the resource.[90] This restricted definition led to several issues pertaining to how a geothermal resource should be regulated if it is not being used for electricity production, and was identified as a significant barrier to development. In 2013, the Washington government modified the definition to include all:

> the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or that may be extracted from, the natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases and steam, in whatever form, found below the surface of the earth.

This modernized definition was a response to a lack of industry developments and has had a positive impact overall. It has streamlined the development process by centralizing the geothermal permitting authority and including all resources, regardless of temperature, geothermal resource type or application, under the same regulatory framework.[91] The majority of the higher ground and water temperatures in Washington are associated with the state's five major stratovolcanoes.[92] There is also a large warm water sedimentary basin in eastern Washington, however, there is little research that has been conducted in the area.[93] Washington's approach for a single definition for all their resources, regardless of temperature, is likely due to most of their resources being from a single type of resource- volcanic. Another recent update was the passing of a bill that streamlined the process for reconnaissance and experimental drilling from geothermal sources.[94]

4.4 – Conclusion

Despite a broad and all-encompassing federal definition of geothermal resources, many states have adopted their own definition as states are responsible for regulating their own resources. The changes to Washington state's definition of geothermal resources were modified to be more "user-friendly"; a positive change to previous regulations that were narrow and restrictive by nature.[95]

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[90] Callison, Kathleen, "Making Sense of Definitions and Ownership of Geothermal Resources & Recent Developments in Washington State," *GRC Annual Meeting – Pre-meeting Workshop*, September 2014, https://geothermal.org/Annual_Meeting/PDFs/1p%202.00%20%20GeothDefinitionsOwnership%20&%20WA%20State%20Legis,%20CALLISON.pdf.
[91] *Ibid.*
[92] Washington State Department of Natural Resources, "Geothermal Resources," accessed July 11, 2019, https://www.dnr.wa.gov/programs-and-services/geology/energy-mining-and-minerals/geothermal-resources.
[93] *Ibid.*
[94] Morey, Mark, "Geothermal Technology Picking up Steam in Washington State," *Tri-City Herald*, published June 2017, https://www.tri-cityherald.com/news/local/article154740384.html.
[95] *Ibid.*

The principles of simplicity and user-friendliness also apply in the case of utility regulations and should be key considerations in the Indigenous Utilities Regulation Inquiry. If an Indigenous community wants to develop a utility for their community but they are subject to the same regulations and market entry fees as the larger industry players like BC Hydro, there is a clear disadvantage in terms of capacity and industry experience. If Indigenous utilities are to be regulated, then they should be regulated in a way that recognizes socio-economic benefits as well as the aspects of self-sufficiency for the community.

With an understanding of how geothermal resources are regulated in Canada and various states throughout the US, it is now possible to examine global case studies regarding Indigenous ownership and participation in geothermal energy utilities. The section will also briefly analyze the regulatory context that the case studies are subject to in an effort to reveal the circumstances by which Indigenous peoples are actively participating in ownership and/or operation of geothermal utilities.

5.0 - Māori Geothermal Energy Case Studies: History

In New Zealand (NZ), the number of Māori trusts involved in geothermal energy production is increasing. As a result, the versatility of geothermal energy is being demonstrated and the Māori are bringing value to their communities. Despite the current success of the Māori trusts in participating in geothermal energy projects, the situation was quite different prior to 1993.

Prior to 1993, the NZ Crown and the Māori people had a difficult relationship, where the Crown passed a series of legislative items and policies designed to divest the Māori of their economic and political control of their land and resources.[96] Māori ownership of land persisted even though the Crown sought to acquire more of their land at every possible opportunity.[97] In 1993, the Māori Land Act (MLA) was passed, which created a new mandate to support the retention and development of Māori lands.[98] The MLA defined the governance structures and options for the ownership and maintenance of Māori lands, of which the Ahu Whenua Trusts and Incorporations are the most common.[99]

A notable feature of the MLA and other legislation related to natural resources and land management is that Māori values have been incorporated into the legislation. For example, the concept of *Kaitiakitanga*, or the idea that humans must act as stewards for their surrounding natural environment has been incorporated into the Resource Management Act.[100] Thus, from a legal viewpoint, the development of renewable resources, like geothermal energy, is encouraged as renewable energies diverts the need for fossil fuels, which in turn reduces the overall environmental impacts of energy projects.

5.0.1 - Ahu Whenua Trusts and Incorporations

The most common type of Māori trust is the Ahu Whenua Trust, which is designed to promote the use and administration of Māori-owned land in the interests of its trustees.[101] The Ahu Whenua Trusts and Incorporations are typically used for pursuing commercial ventures such as geothermal energy projects. Within the trusts, there are 3 types of trustees: responsible trustees, custodian trustees, and advisory trustees.[102] Responsible trustees are responsible for carrying out the terms of the trust order, managing the business(es) of the trust and distributing the trust's income.[103]

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[96] Bargh, Maria, "Rethinking and re-shaping Indigenous economies: Māori geothermal energy enterprises," *Journal of Enterprising Communities: People and Places in the Global Economy* Vol. 6, No. 3 2012, 272.
[97] *Ibid*.
[98] *Ibid*.
[99] *Ibid*.
[100] *Ibid*, 277.
[101] Government of New Zealand, "Māori Land Trusts – Māori Land Court/ Te Kooti Whenua Māori," *Summary Document*, accessed July 2, 2019, https://www.maorilandcourt.govt.nz/assets/Documents/Publications/MOJ0217.1E-Maori-Land-Trusts.pdf
[102] *Ibid*.
[103] *Ibid*.

Custodian trustees are responsible for investing funds, disposing of assets, and gathering and holding the assets of the trust.[104] Advisory trustees are responsible for giving advice to the responsible trustees and not administering the trust.[105]

The trustees are bound by the MLA and the Trustee Act 1956, where their core functions are to "to maximize the assets and minimize the liabilities of the trust."[106] Each of the trustee's powers, rights, and obligations are set out in the trust order.[107] Trustees are appointed by landowners within their trust region, therefore are required to regularly update them on the state of the trust's assets.[108] Overall, the goal of trusts is to bring as many benefits to the community as possible, these benefits can come in the form of:

- Income distribution
- Charitable actions
- Health grants
- Educational grants, including scholarships
- Sports, arts and Māori cultural grants

The NZ Māori asset base represents 6.1% of the total NZ economy, with an estimated value of $42.6 billion in 2013.[109] The Māori asset base is made up of $12.5 billion in Māori trusts, incorporations, and other entities, $23.4 billion in assets of Māori employers, and $6.6 billion in assets of self-employed Māori individuals. With a basic understanding of the history and roles of the NZ Māori trusts and their trustees, and the value it brings to the Māori people and NZ, it is now possible to examine some of the most notable trusts that are involved in geothermal energy production.

5.1 - Tuaropaki Trust

Tuaropaki Trust (TT) is an Ahu Whenua Trust established by the Māori Land Court under the MLA 1993.[110] Starting in 1952, 297 landowners agreed to amalgamate their lands to be managed by their representatives and the Department of Māori Affairs.[111] Then, in 1994, the TT established the Tuaropaki Power Company Ltd. (TPC), which purchased the rights to develop geothermal wells on Tuaropaki lands and is 75% owned by TT and Mercury NZ holds the remaining 25%.[112]

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[104] *Ibid.*
[105] *Ibid.*
[106] *Ibid.*
[107] *Ibid.*
[108] *Ibid.*
[109] Nana, Ganesh, Khan, Masrur and Schulze, Hillmare, "Māori Economy Report 2013," Te Puni Kokiri commissioned BERL to conduct the report, April 2015, https://www.tpk.govt.nz/en/a-matou-mohiotanga/business-and-economics.
[110] Tuaropaki Trust, "Our History," accessed July 4, 2019, http://www.tuaropaki.com/our-story/our-history/.
[111] *Ibid.*
[112] *Ibid.*

Since then, the TT has developed geothermal electricity and several heating projects and offers a variety of services to their people.

5.1.1 - Tuaropaki Geothermal Power Generation – Mokai Power Station

The TPC owns the Mokai power station (100% ownership) and works with Mercury NZ, a Crown utility, who operates the station.[113] The Mokai geothermal field consists of 22 wells, where 11 are production wells (bring steam to the surface), 6 for injection (returning fluid to the reservoir), and 4 others.[114] The TPC employs a strategy of 100% reinjection to ensure the longevity of the geothermal system.[115] The Mokai geothermal station has a total installed capacity of 113 MWe with a 96% average capacity and is made up of three separate plants.[116] The electricity is delivered to the NZ national grid via a 22 km 110 kV connection line and is enough electricity to power the city of Hamilton, New Zealand; a city with a population of 165,000.[117] The TT believes that developing the Mokai geothermal system is a unique opportunity for self-determination for the Māori people.[118]

5.1.2 - Tuaropaki Geothermal Heating Applications – Geothermal-Heated Greenhouse

Figure 11: Tuaropaki Geothermal-Heated Greenhouse

The TT is a 25% shareholder in a 12-hectare state-of-the-art climate-controlled greenhouse, seen in Figure 11[119] above, where they grow capsicum, blueberries, apples, and tomatoes, which are then exported to foreign markets.[120] The greenhouse is heated by the steam from the Mokai

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[113] New Zealand Geothermal Association, "Mokai Geothermal System," accessed July 4, 2019, https://nzgeothermal.org.nz/nz_geo_fields/mokai-geothermal-system/.
[114] *Ibid*.
[115] *Ibid*.
[116] *Ibid*.
[117] *Ibid*.
[118] Waikato Regional Council, "Mokai Geothermal System," accessed July 4, 2019, https://www.waikatoregion.govt.nz/environment/natural-resources/geothermal/energy-and-extraction/mokai-geothermal-system/
[119] Tuaropaki Trust, "Temperature Controlled Horticulture," accessed July 4, 2019, http://www.tuaropaki.com/our-business/temperature-controlled-horticulture/
[120] *Ibid*.

geothermal field and employs over 50 Māori, where most of them were previously unemployed.[121] The geothermal-heated greenhouse has had a significant positive effect on the socio-economic well-being of the surrounding Māori communities. Waste from the greenhouse is used by a nearby worm farm that grows native plants for riparian planting within TT land.[122]

5.1.3 - Miraka Milk Powder Plant

Figure 12: Miraka Milk Powder Processing Plant

Located in Mokai, Miraka is a unique dairy industry operation, seen in Figure 12[123] above, in that it utilizes sustainable and renewable geothermal energy within its state-of-the-art manufacturing processes.[124] Miraka has the capacity to process more than 250,000,000 litres of milk into powders and Ultra High Temperature (UHT) products every year.[125] Miraka's products are exported to more than 23 countries globally.[126] Miraka uses geothermal steam from the Mokai geothermal field to run its manufacturing plant– a world first for the milk powder processing industry. It is worth noting that there are a number of monitoring bores around the property ensure there is no impact on the water table. Waste milk from the plant is utilized within a nearby worm farm that grows native plants for riparian planting within TT land.[127]

5.1.4 - Tuaropaki Energy Services and Engineering

The TT is also the owner of MB Century, which is New Zealand's only world-class, one-stop-shop geothermal and energy solutions service company.[128] Some of the services offered include

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[121] Waikato Regional Council, "Mokai Geothermal System."
[122] *Ibid*.
[123] Miraka Milk Powder Plant source: http://www.tuaropaki.com/our-business/dairy-processing/
[124] Miraka, "Who are we?" accessed July 4, 2019, https://www.miraka.co.nz/who-are-we-.html.
[125] *Ibid*.
[126] *Ibid*.
[127] Waikato Regional Council, "Mokai Geothermal System."
[128] Tuaropaki, "Energy Services and Engineering," accessed July 4, 2019, http://www.tuaropaki.com/our-business/energy-services-and-engineering/.

geothermal and oil/gas drilling, maintenance, reservoir data logging, and steam field design and engineering.[129]

5.1.5 - Benefits to the Tuaropaki Trust

The benefits that the TT members receive are managed by the Owner Services team, whose role is to execute many of the core activities within the Trust. The activities carried out by the Owner services team include:

- Overseeing financial distributions to Trust members
- Tuaropaki Berkeley Scholarship (partnership with the University of California, Berkeley)
- Educational grants and scholarships (secondary education and tertiary grants)
- Kaumātua Grants (elderly support grants)
- Engineering apprenticeships at MB Century (2 per year)

In addition to the grants and opportunities mentioned above, the TT offers employment opportunities for their people throughout their various business ventures. The TT also hosts cultural events, gatherings and supports local arts, sports and other cultural initiatives. The TT has also recently created a telecommunications company called 2degrees Mobile, which is well received in the NZ mobile market and was recently awarded best advertising promotion and best customer service.[130] The TT is also actively involved in pastoral farming through which they produce beef, lamb and milk from its dairy herd.[131] Lastly, the TT owns and operates a wasabi farm in Nanoose Bay, BC, which it plans to expand from 2000 m^2 to 20,000 m^2.[132]

Together, the TT business ventures have given the Trust and its members a means to bring ample economic, employment, health and other benefits to their people. In accordance with their motto, "we will act as a beacon of hope and prosperity for our people," the TT has created a vehicle for self-determination for their people.[133] The TT's model serves as an excellent motto for other Indigenous groups around the world looking to generate economic opportunities and self-determination for their people.

5.2 - Tauhara North No. 2 Trust

The Tauhara North No. 2 Trust (TN2T) is an Ahu Whenua Trust that was established under the MLA in 1993.[134] The TN2T covers an area of 3,265,000 hectares of land and is an amalgamation

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[129] *Ibid*.
[130] Tuaropaki, "Communications – 2degrees Mobile," accessed July 4, 2019, http://www.tuaropaki.com/our-business/communications/.
[131] *Ibid*.
[132] Tuaropaki, "Food and Nutraceutical," accessed July 4, 2019, http://www.tuaropaki.com/our-business/food-and-nutraceutical/.
[133] Tuaropaki Trust, www.tuaropaki.com.
[134] Tauhara North No.2 Trust, "The Trust – History of Tauhara North No.2 Trust," accessed July 4, 2019, https://www.tauharano2.co.nz/the-trust/.

of three blocks of land known as Tauhara North 2A, Tauhara North 2B, and Tauhara North 2C.[135] The current owners of the TN2T are the descendants of the original people to whom the land was given.[136] The TN2T land is primarily occupied by the Ngāti Tahu, and most of the owners, around 800, are members of Ngāti Tahu.[137]

5.2.1 - TN2T Geothermal Power Generation - Nga Awa Purua Power Station

The Nga Awa Purua Power Station (NAP) was commissioned in 2010 and is a joint venture between Mercury NZ, a Crown Utility (65%) and the TN2T (35%).[138] The NAP is a 140 MWe geothermal power station with an investment of $376,615,488.90 CAD and operating costs around $14,335,200 CAD.[139] NAP is currently the largest geothermal plant in NZ and the largest single turbine geothermal plant in the world.[140]

Figure 13: Nga Awa Purua Power Stations

The plant, as seen in Figure 13[141] above, is operated and maintained by the Mercury NZ.[142] The electricity produced can power 140,000 homes and provides 3% of New Zealand's electricity

[135] *Ibid*.
[136] *Ibid*.
[137] *Ibid*.
[138] Aussie Renewables, "Nga Awa Purua Geothermal Power Station," accessed July 4, 2019, https://www.aussierenewables.com.au/directory/nga-awa-purua-geothermal-power-station-173.html.
[139] Malafeh, Sam and Sharp, Basil, "Sustainable Development of Geothermal Resources an Economic Alternative," *University of Auckland*, Thirty-Eighth Workshop on Geothermal Reservoir Engineering 2013, pg. 13, https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2013/Malafeh.pdf
[140] Tauhara North No.2 Trust, "RML – Commercial – Nga Awa Purua Power Station," accessed July 4, 2019, https://www.tauharano2.co.nz/rml-commercial/nga-awa-purua-power-station/.
[141] Nga Awa Purua Power Station photo source: *http://www.thinkgeoenergy.com/successful-maintenance-work-concluded-at-nga-awa-purua-geothermal-plant-nz/*.
[142] Renewable Technology, "Rotokawa II / Nga Awa Purua Geothermal Power Plant," accessed July 4, 2019, https://www.tauharano2.co.nz/rml-commercial/nga-awa-purua-power-station/.

needs.[143] The plant utilizes seven 2,000 m - 2,500 m deep production wells and four 3,000 m injection wells and has a target of 75% reinjection.[144]

5.2.2- TN2T Geothermal Power Generation – Rotokawa Power Station

The Rotokawa Power Station was commissioned in 1997 as a 24 MWe geothermal plant, however, more recently the plant has expanded to a capacity of 34.5 MWe.[145] The TN2T has no equity involvement in the Rotokawa power station, but it does receive ground lease and royalty payment for the supply of the TN2T fuel, or the geothermal fluid.[146] Despite no financial involvement, the TN2T represents two of five Directors for the Rotokawa.[147] Royalty payments to the TN2T are approximately $611,249.56 CAD annually and there is no capital risk.[148]

5.2.3 - TN2T Geothermal Heat Generation

Though the TN2T is not currently utilizing geothermal direct use streams, they have included the desire to partner with businesses that require clean heat for processing or primary production within their business development plan.[149]

5.2.4 - Benefits to the Tauhara North No. 2 Trust

In addition to the geothermal electricity generation assets the TN2T is involved in, the Trust is also involved in the farming industry.[150] The TN2T currently owns and operates 6 dairy farming operations of different size, with a total land size area of 1418 hectares, which hold 2945 dairy cows that produce 1,000,000 kg of milk solids per year.[151] The goal of the Trust's farming operations is to optimize the use of their land, to increase their returns for their people, and to protect their environment.[152]

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143 *Ibid*.
144 *Ibid*.
145 *Ibid*.
146 *Ibid*.
147 Mizuno, Emi Ph.D., "Geothermal Power Development in New Zealand – Lessons for Japan," *Japan Renewable Energy Foundation*, February 2013, pg. 38, https://www.renewable-ei.org/en/images/pdf/20130220/20120912_lessonfromNewZealand.pdf
148 *Ibid*.
149 Tauhara North No. 2 Trust, "RML – Commercial – Business Development," accessed July 4, 2019, https://www.tauharano2.co.nz/rml-commercial/business-development/.
150 Tauhara North No. 2 Trust, "RML – Commercial – Farm Assets," accessed July 4, 2019, https://tauharano2.co.nz/rml-commercial/farm-assets/.
151 *Ibid*.
152 *Ibid*.

The Trust offers a number of benefits to their members, which are primarily distributed through the Charitable Company Limited (CCL), which is a subsidiary of the TN2T.[153] The CCL offers several direct benefits to Trust members, which include:

- Health grants (vision, dental, hearing or orthodontic)
- Education grants (early childhood, tertiary and vocational)
- Scholarships for tertiary level institutes
- Arts, sports and Māori cultural grants
- Further grants are available upon special request
- Youth camps (3 different camps per year)

The TN2T also hosts a variety of cultural events, gatherings and other services designed to bring its membership together and celebrate their Māori culture.

The business ventures of the TN2T enable the Trust to provide many economic, education, and other supports for their people, which in return allows the TN2T to safeguard their culture and traditional practices. Additionally, similarly to the TT, the geothermal and other business ventures that the TN2T either fully owns or receives payments for enable to the trust to determine their own future – for their own people – on their land.

5.3 - Kawerau A8D

The Kawerau A8D (KA8D) is an Ahu Whenua Trust that was established in 1993 under the MLA.[154] The KA8D hold approximately 171.47 hectares of land and there are currently 109 beneficial owners.[155] The KA8D hold their land for the purpose of "common use and benefit of the present owners of the Kawerau A8D and their successors in accordance with Māori custom.[156] Prior to 2009, the Trust had not engaged in any major business ventures, however, the Trust structure was varied to investigate the development of a geothermal project on their land.[157] More recently, the KA8D formed a partnership, the Te Ahi O Maui partnership, with Eastland Generation to develop a geothermal electricity project.[158]

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[153] Tauhara North No. 2 Trust, "Charitable Company Ltd.," accessed July 4, 2019, https://tauharano2.co.nz/ccl/.
[154] Māori Land Court/ Te Kooti Whenua Māori, *Kawerau A8 D Block v. Colleen Skerrett-White and Tomairangi Fox*, Judgement of Judge L R Harvey, 31 August, 2016, https://www.maorilandcourt.govt.nz/assets/Documents/Decisions/hunia-skerrett-white-kawerau-a8d2016146-waiariki-mb-281146-waiariki-mb-281.pdf.
[155] *Ibid.*
[156] *Ibid.*
[157] *Ibid.*
[158] Eastland Group, " Te Ahi O Maui signs construction deal with Ormat," May 19, 2016, http://www.eastland.nz/2016/05/19/te-ahi-o-maui-signs-construction-deal-with-ormat/.

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5.3.1 - Geothermal Power Generation – Te Ahi O Maui Geothermal Project

The Te Ahi O Maui geothermal project was commissioned in September of 2018 and will deliver at least 25MWe of geothermal electricity; enough to power approximately 25,000 homes.[159] At an estimated total cost of $106,089,750 CAD, the project has now begun operations and is expected to have a minimum lifecycle of 35 years.[160] The plant's ownership is primarily held by the Eastland Group (94%), while the landowning partner, KA8D, holds 6%.[161] The project is located near 2.3 km north-east of the Kawerau township, which reduced the costs associated with connecting to the grid.

5.3.2 - Benefits to the Kawerau A8D

Considering the Te Ahi O Maui geothermal project represents the KA8D's first major business venture and that the plant has just been brought online, there have been few benefits comparable to the other Trusts engaged in geothermal development in NZ. Prior to plant construction, Colleen Skerrett-White, KA8D owner and past trustee stated that:

> Te Ahi O Maui will provide the opportunity to develop and create local expertise and employment well into the future. We expect as many as 100 people will be involved in the construction phase and, throughout the life of the power plant, people will be required to operate and maintain it. These activities require businesses to support them, including engineering firms to provide the technical know-how and skills and lunch bars and cafes to feed staff. Much of this support will come from local businesses, which will mean a large part of the money spent on the plant will be spent locally. The employment opportunities for our local people, and particularly youth, are one of the important benefits of this project.[162]

Therefore, it is important to recognize that the development of the project represented a significant opportunity for members of the KA8D to participate directly or indirectly in the project development. Moreover, the project will continue to bring benefits to the Trust through employment, clean electricity and future opportunities relating to project expansion and/or potential geothermal heating projects. It can also be expected that as revenue is generated from the project that the KA8D will begin to be able to offer similar opportunities that the aforementioned Māori trusts offer their people.

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[159] Eastland Group, "Te Ahi O Maui," accessed July 5, 2019, http://www.eastland.nz/eastland-generation/projects/te-ahi-o-maui/.
[160] Muir, Jeremy, " Te Ahi O Maui will run for 35 years," *The Gisborne Herald*, http://gisborneherald.co.nz/opinion/4168939-135/te-ahi-o-maui-will-run.
[161] Richter, Alexander, "Construction of 25 MW Te Ahi o Maui geothermal plant in New Zealand nearly completed," *ThinkGeoEnergy*, 26 July, 2019, http://www.thinkgeoenergy.com/construction-of-25-mw-te-ahi-o-maui-geothermal-plant-in-new-zealand-nearly-completed/.
[162] Van Der Boom, Sarah, "Te Ahi O Maui Drilling is Underway," *Electric Energy Online*, June 18, 2018, https://electricenergyonline.com/article/organization/33166/707620/Te-Ahi-O-Maui-drilling-is-underway.htm.

5.4 - Māori Trusts and Geothermal Energy Production in NZ

In 2017, geothermal energy accounted for 22% of NZ's total primary energy supply, which includes 17% of electricity generation.[163] Geothermal electricity is also currently one of NZ's cheapest sources of new electricity generation.[164] It is worth noting that a significant number of geothermal projects in NZ involve a high level of commercial participation by Māori-owned enterprises (trusts).[165]

Total geothermal electrical capacity currently stands at over 900 MW and it has been estimated that another 1,000 MW of geothermal resources could be harnessed for geothermal electricity production.[166] Assuming that the 1,000 MW was realized and replaced existing fossil-fuel-based electricity generation, geothermal electricity could represent approximately 36% of NZ's electricity needs in the future.

In terms of geothermal heat or direct use applications, there is currently about 8 Petajoules per year produced in NZ, where approximately 65% is used in industrial applications, 25% in commercial and the remainder in residential and agricultural applications.[167] The direct use applications currently being utilized in NZ include:

- Pulp and paper mills
- Timber drying
- Aquaculture/tourism (balneology)
- Horticulture
- Milk drying
- Space heating

5.4.1 -NZ Geothermal Energy Regulatory Regime

Despite the significant amount of geothermal resources that NZ has developed, there is an active conversation revolving around the inefficiency of NZ's geothermal regulatory environment. The main issue is tied to the 1991 Resource Management Act (RMA), which is an all-encompassing

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[163] Energy Efficiency and Conservation Authority of New Zealand, "Geothermal," accessed July 5, 2019, https://www.eeca.govt.nz/energy-use-in-new-zealand/renewable-energy-resources/geothermal/.
[164] New Zealand Ministry of Business, Innovation & Employment, "Geothermal energy generation," https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-generation-and-markets/geothermal-energy-generation/.
[165] *Ibid*.
[166] Energy Efficiency and Conservation Authority of New Zealand, "Geothermal."
[167] New Zealand Ministry of Business, Innovation & Employment, "Geothermal energy generation."

environmental act that "attempts to apply reasonable constraints on development," however in its early years, the RMA was both supported and criticized by different interest groups within NZ.[168]

The situation has improved as several amendments have been implemented, with one of the most notable being the encouragement of "positive consideration" for renewable energy projects, including geothermal energy, to be able to make it through the necessary review process.[169] Another feature, which ties into the Māori concept of *Kaitiakitanga,* is that geothermal resources are not "owned" in NZ, but rather regional authorities or Māori trusts are the managers of geothermal resources (stewards of their natural environment) and therefore must give consent, via the RMA, for any geothermal developments.[170] This requirement has led to the high level of Māori involvement in NZ's geothermal energy sector.

5.4.2 - NZ Electricity Sector and Royalties

The NZ electricity sector functions on the basis of open competition between private and (part) state-owned generation companies.[171] The NZ Emissions Trading Scheme does offer the opportunity for renewable energy generators to generate credits, however, the effects on project economics are considered limited.[172] There are currently no royalties for geothermal energy development in NZ, which assists in making geothermal energy competitive on its own compared to other forms of generation.[173]

5.5 - Conclusion

The NZ Māori trust geothermal utility case studies serve as useful examples as to how Indigenous groups and communities can benefit from the ownership or partial ownership of geothermal utilities. The evolution of NZ's RMA is also demonstrative of how prudent government action can resolve regulatory issues that hinder development. The inclusion of Māori values in NZ's resource management laws has led to several successful geothermal utility Māori trust and government partnerships, which in turn has led to increased self-sufficiency, economic stimulus, jobs and other opportunities for the trusts and their members.

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[168] White, Brian, "An Update on Geothermal Energy in New Zealand," NZGA, accessed July 5, 2019, bottom of pg. 3, https://www.eastharbour.co.nz/assets/pdfs/AnUpdateOnGeoEnergyInNZJully2006.pdf; Ellis, Donna, Vernon, Wayne and Lord, Sam, "Challenges of New Zealand Geothermal Legislation," *Proceedings World Geothermal Congress 2015*, April 2015, pg. 6, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/03005.pdf.
[169] *Ibid*.
[170] Van Campen, Bart, "Overview Geothermal Regulation and Licensing," *The Geothermal Institute University of Auckland*, May 2014, https://www.irena.org/-/media/Files/IRENA/Agency/Events/2014/Jun/2/3_vanCampen.pdf?la=en&hash=6047F87E44913E06922CD14E462E41A99B24C63F.
[171] *Ibid*.
[172] *Ibid*.
[173] *Ibid*.

Though the context for the organization of Indigenous groups and land ownership is quite different between NZ and BC, the Māori case studies demonstrate the positive socio-economic impacts and environmental benefits that geothermal energy developments can bring to Indigenous communities. It is also worth noting that the scale of the projects in BC will not likely be the same as the Māori projects (100's of MWs), in the short-to-medium term, due to the difference in resource quality, accessibility, and Indigenous control over resource use. However, the Indigenous Utility Regulation Inquiry represents an opportunity to bring positive change to the conditions for Indigenous utility development in BC.

An important takeaway from the Māori geothermal project case studies is that even though only the Tuaropaki Trust was the only trust to have significant ownership in their geothermal ventures (75%), all of the trusts had benefitted (or were expecting to benefit) significantly from the projects on their land. The benefits varied from employment opportunities to revenues that enabled the trusts to offer various grants to their members, however, in each case it is clear that the trusts benefitted significantly; this is likely due to projects requiring consent from the regional authorities or Māori trusts prior to development.

With an understanding of what case studies exist of Indigenous participation in geothermal utilities globally, this submission will now briefly analyze Canadian federal considerations with regard to reconciliation and Indigenous participation in energy projects.

6.0 - Federal Government Considerations

The current federal Liberal government has made reconciliation one of their utmost priorities, which can be seen through the various initiatives that have been taken since 2015. One of the more recent efforts was led by the Federal Standing Committee on Natural Resources (RNNR) in their study titled, "International Best Practices for Indigenous Engagement in Major Energy Projects: Building Partnerships on the Path to Reconciliation."[174] The purpose of the study was to examine how Canadian governments can best engage with and include Indigenous peoples in the development and operation of energy projects within the country.[175]

The study made 5 recommendations as to how Canadian governments can best work with Indigenous peoples and communities in energy projects in an effort to promote long-term socio-economic benefits to the communities. The most notable recommendation was Recommendation 1, which was to "Create Sustainable Opportunities for Indigenous Peoples," by:

A. Providing educational and professional development opportunities to support a competitive Indigenous workforce, including higher education scholarships and skills training;

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[174] Standing Committee on Natural Resources, "International Best Practices for Indigenous Engagement in Major Energy Projects: Building Partnerships on the Path to Reconciliation," June 17, 2019, https://www.ourcommons.ca/Content/Committee/421/RNNR/Reports/RP10575903/rnnrrp13/rnnrrp13-e.pdf.
[175] *Ibid*.

B. Establishing procurement policies that support Indigenous-led businesses, goods and services, similar to Australia's Indigenous Procurement Policy[176];
C. Supporting the development of community-owned and operated utilities through public-private partnerships and regional cooperatives;
D. Investing in transportation and communication infrastructure in remote and rural areas, where needed, in a manner that balances out environmental and socioeconomic considerations, according to local priorities; and
E. Promoting the development of Indigenous heritage trust funds to ensure that the benefits of non-renewable energy resources extend to future generations.[177]

Recommendation 1 from the RNNR report provides a clear message that Indigenous participation in energy projects represents a significant opportunity for reconciliation as well as an opportunity for Indigenous communities to develop long-term, sustainable socio-economic benefits for their communities. Moreover, *Recommendation 1C* was that governments should partner or work with communities to develop Indigenous-owned or partial-owned utilities in an effort to create sustainable opportunities for Indigenous peoples. Considering the success Māori trust case studies and the recent RNNR report, supporting the development of Indigenous utilities in BC should be a top priority for the BC government. Support could come either through partnerships, increased funding, and/or the development of procurement policies similar to Australia's Indigenous Procurement Policy.

Australia's Indigenous Procurement Policy

The Indigenous Procurement Policy (IPP) was launched July 1, 2015, and had three main priorities (1) a target number of contracts need to be awarded to Indigenous businesses; (2) a mandatory set-aside for remote contracts (valued between $80,000-$200,000 AUD); and (3) minimum Indigenous participation requirements in contracts valued at or above $7,500,000 AUD in certain industries.[178] At the core of the IPP was the goal of leveraging Australia's multi-billion procurement spend to increase opportunities for Indigenous goods and services, as well to stimulate Indigenous economic development.[179] Though the IPP was an open-ended procurement program, the concept of promoting economic development and increased opportunities should be considered when considering if or how Indigenous utilities should be regulated in BC.

Considering the recent federal RNNR committee report, the BC government's own goals for reconciliation, and the Māori case studies for Indigenous geothermal utilities, it is clear that the development of Indigenous-owned or partial-owned utilities is in the best interest of all governments throughout Canada. It is the government's and by extension the BCUC's role to ensure that the regulatory context is designed in a way that maximizes the socio-economic benefits

[176] Australian Government, "Australia's Indigenous Procurement Policy" accessed July 11, 2019, https://www.pmc.gov.au/Indigenous-affairs/economic-development/Indigenous-procurement-policy-ipp.
[177] Standing Committee on Natural Resources, "International Best Practices for Indigenous Engagement in Major Energy Projects."
[178] Australian Government, "Australia's Indigenous Procurement Policy."
[179] *Ibid*.

for Indigenous communities and promotes Indigenous participation in any manner – from full ownership and operation to limited ownership (<50%).

7.0 - Responding to the Indigenous Utilities Regulation Key Questions

1) What are the characteristics of an "Indigenous Utility" with respect to:

a) The ownership and operation of the utility;

CanGEA anticipates that our member, Kitselas Geothermal Inc. will provide a response to this question.

b) What services are provided;

CanGEA submits that Indigenous geothermal utilities should be eligible to develop the resource in the combination that best suits their needs: a geothermal electricity project, a geothermal heating project, or a geothermal heat and electricity project. CanGEA also submits that Indigenous geothermal utilities should be able to retain and sell carbon credits resulting from renewable energy generation as another means to economic stimulus.

As is done in the State of California, baseload electrical capacity should be financially recognized in British Columbia. By providing dependable capacity, geothermal electricity has the potential to shape, firm and help integrate intermittent and other renewable sources such as wind, solar and run of river hydro onto the grid. These positive ancillary services should be available to Indigenous utilities to maximize profits from their geothermal electricity projects.

c) Who the services are provided to; and/or

CanGEA anticipates that our member, Kitselas Geothermal Inc. will provide a response to this question.

d) The location or area served by the utility?

CanGEA anticipates that our member, Kitselas Geothermal Inc. will provide a response to this question.

2) Should Indigenous utilities be regulated or not? And if so, how?

a) If they should be regulated, should they be regulated by the Utilities Commission Act (UCA) or another mechanism?

CanGEA's mission is to accelerate Canadian exploration and development of geothermal resources in order to provide **secure, clean and sustainable energy** to Canada's heat and electricity markets. The concepts of **secure, clean and sustainable energy** were common throughout the Indigenous Utility Regulation Inquiry's Community Input Sessions, alongside the ideas of **socio-economic benefits and self-sufficiency**. As such, CanGEA submits that if Indigenous Utilities are to be regulated, CanGEA believes that **regulations should be designed in a way that promotes the development of Indigenous-owned utilities and facilitates the social, economic, and environmental benefits for their traditional territories and beyond.**

b) If unregulated, how will the interests of Indigenous utility ratepayers be protected?

CanGEA anticipates that our member, Kitselas Geothermal Inc. will provide a response to this question.

Appendix A – Ancillary Benefits of Geothermal Energy Projects

There are several ancillary benefits that geothermal electricity projects, where the majority of these are economic benefits:

1. **Geothermal Heat is a Valuable By-Product.**
2. **More Permanent Jobs are Generated by Geothermal Operations Than Other Alternatives.**
3. **Reduced Emissions Resulting in Better Air Quality.**
4. **The Electricity Grid is Strengthened Through Geothermal Energy's Unique Base Load and Dispatchable Capacity.**
5. **Geothermal Fluids Create Strategically Significant Mineral and Rare Earth Elements Recovery Opportunities.**
6. **Geothermal Offers Increased Food Security, Price Stability and an Opportunity for Self-Sufficiency.**
7. **The Physical and Environmental Footprint of Geothermal is Small.**
8. **Geothermal Offers a Means to "Green" Natural Gas, Liquid Natural Gas, and Mining Operations Through the Use of Geothermal Energy**

1. Geothermal Heat is a Valuable By-Product

Geothermal resources offer a low-cost source of heat that can be utilized in addition to, or independent of, electricity production. Geothermal energy can be used for nearly any commercial or industrial process requiring heat. Such resources are used in 86 countries[180] around the world to spur economic growth and are especially suited to rural areas, municipalities, Indigenous communities, and entrepreneurs. For example, natural gas is not available in the Village of Valemount, instead, propane is trucked into the area and used for heating along with wood. Heating could be instead provided by geothermal energy.

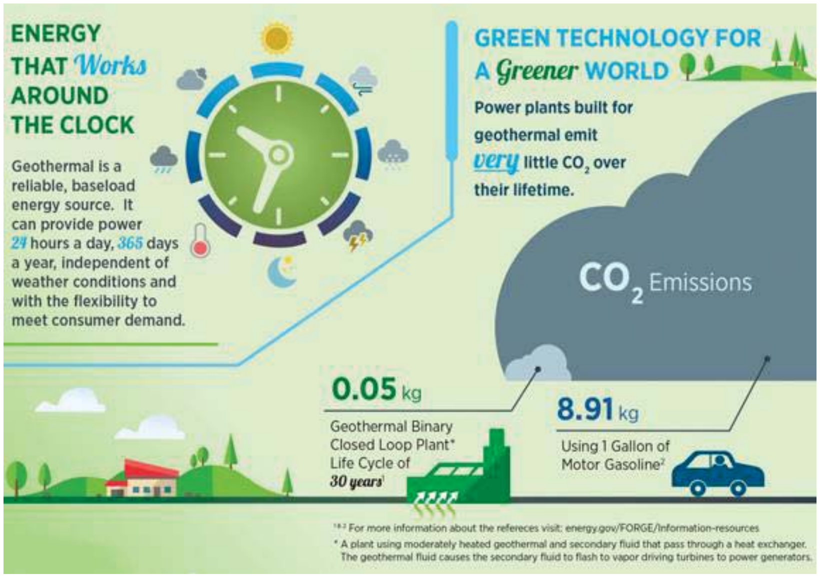
2. More Permanent Jobs are Generated by Geothermal Operations than Other Alternatives

Geothermal electricity projects create the most amount of sustainable employment opportunities for surrounding communities in comparison to other forms of renewable generators. U.S. Department of Energy (DOE) statistics indicate that geothermal electricity projects produce 4 jobs per MW in the construction phase of the project and 1.7 sustainable jobs per MW to maintain the

[180] Yousefi, Hossein, *et al.*"The Role Geothermal Energy Development on CO_2 Emission by 2030."

plant through its lifecycle.[181] This total does not include jobs that result from the direct use of geothermal heat, which are also significant.

3. Reduced Emissions Resulting in Better Air Quality



Geothermal electricity projects that employ closed-loop binary electricity plants emit 0.05 grams of CO_2 over a 30-year period. Communities in BC relying on wood-burning stoves and fossil-fuel based sources of energy could stand to benefit from a geothermal energy project in their community.[182]

4. The Electricity Grid is Strengthened Through Geothermal Energy's Unique Base Load and Dispatchable Capacity

Jurisdictions worldwide recognize the benefit to their electricity grids of incorporating energy sources that either have a baseload capacity or are dispatchable. The advantages accruing from such characteristics are referred to as ancillary services. Neither wind, solar nor run of river hydro possesses both of these characteristics. In contrast, geothermal electricity is baseload and dispatchable.

As is done in the State of California, these characteristics should be financially recognized in British Columbia. By providing dependable capacity, geothermal electricity has the potential to shape, firm and help integrate intermittent and other renewable sources such as wind, solar and

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[181] US DOE, "Buried Treasure: The Environmental, Economic, and Employment Benefits of Geothermal Energy," accessed July 11, 2019, https://www.nrel.gov/docs/fy05osti/35939.pdf.
[182] U.S. Department of Energy, Energy that Works Around the Clock, accessed October 18, 2017, https://www.energy.gov/sites/prod/files/2015/04/f22/EGS%20Infographic_0.pdf.

run of river hydro onto the grid. These positive ancillary services can also be used to maximize profits from electricity exports.

A further benefit of geothermal electricity production is that in colder climates, like Canada, there is the ability to generate more electricity output in the winter months. This matches well with the "winter peaking" electrical grid that exists within BC.

5. Geothermal Fluids Create Strategically Significant Mineral and Rare Earth Elements Recovery Opportunities

Geothermal brine contains various minerals, rare earth elements and near-earth elements, which can be extracted prior to reinjection into the ground. An example of a metal that can be extracted is lithium, which is a valuable material used in the production of electric vehicles (EV). Considering the CleanBC goal to increase the adoption of EVs, having a BC source of lithium could ensure that extraction is done in an ethical and environmentally-responsible manner.

Many more minerals and elements are believed to be able to be extracted, which could support the development of BC's circular economy. These materials are used in the production of a variety of important technologies, including computers, mobile phones, solar panels, and most modern electronics. Therefore, geothermal energy's ability to enable the cost-effective extraction of such minerals and rare earth elements is strategically significant, as it can enable Canada to be self-sufficient with respect to these commodities. It will also serve to enhance the cost-effectiveness of geothermal projects.

Importantly, the recovery of rare earth elements can be accomplished in a manner that does not adversely impact the surrounding environment. For example, binary geothermal electricity plants operate in a closed loop system, so that all withdrawn groundwater is reinjected.

6. Geothermal Offers Increased Food Security, Price Stability and an Opportunity for Self-Sufficiency.

Geothermal energy has the potential to increase food security in rural and Indigenous communities. Heat, which is a by-product of geothermal electricity plants, is utilized around the world as a source of energy for greenhouses and fish farms. These can provide affordable fresh fruits and vegetables, as well as a source of protein, while also providing jobs. In addition to food security and price stability, geothermal projects also offer the opportunity for self-sufficiency for communities in that projects can provide electricity and heat, two crucial services that any community needs. Moreover, the heat can be used in a variety of applications, as described above, and can reduce the need for food to be trucked in.

7. The Physical and Environmental Footprint of Geothermal is Small

Geothermal energy is recognized internationally as a clean and reliable source of electricity with greenhouse gas emissions per unit of energy that are comparable to nuclear, and lower than hydroelectric.

Case in point, the use of binary geothermal plants is considered by most experts to be environmentally benign. They emit no, or nearly no greenhouse gases, and operate in a closed loop system so that all withdrawn groundwater is re-injected. They also utilize a concentrated subterranean resource and thus have a smaller physical footprint than nearly all other sources of energy, conventional and renewable alike.

8. Geothermal Offers a Means to "Green" Natural Gas, Liquid Natural Gas, and Mining Operations Through the Use of Geothermal Energy

Making use of the geothermal potential in northeast BC could help to avoid the emission of millions of tonnes of GHGs into the atmosphere from upstream natural gas and Liquid Natural Gas (LNG) operations. Using distributed geothermal plants to electrify upstream gas fields and the proposed LNG Canada processing operations, near Terrace, BC, represent a significant opportunity to decarbonize the project. This is especially true as distributed geothermal electricity generation plants have a high level of consistency and reliability.

Upstream oil and gas operations produce large quantities of hot water, much of which is hot enough to be used for geothermal electricity production. Currently, much of this hot water is disposed of at great expense to the producer. The co-produced hot water can be used on-site for micro-electricity production, which can act as a means of "greening" the upstream operations. Moreover, this can also increase the profitability of these operations.

A recent white paper by Clean Energy BC analyzed how extensive electrification of BC could lead to significant carbon reductions. One of the areas analyzed was BC's upstream natural gas sector, where the report found that extensive electrification could reduce GHGs by 60%, or 16.2 megatonnes per year in 2030.[183] Another area analyzed was the downstream LNG Canada processing facility, where the report found that extensive electrification could result in a reduction

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[183] Clean Energy BC, "Electrification of BC White Paper," accessed July 15, 2019, pg. 12, https://www.cleanenergybc.org/wp-content/uploads/2018/10/Electrification-of-BC.-CEBC-White-Paper-Oct-2018.pdf.

of 72% of emissions below the business-as-usual level.[184] The report also concluded that if BC stayed on a business-as-usual basis, the added pollution would make it difficult to meet the Province's 2030 goals.[185]

In a similar way, geothermal water can be used in a variety of mining processes, including as a source of heat for the extraction of gold and silver through the heap leaching process. Case-in-point, in Nevada, 10 producing gold, silver or gold/silver mines have geothermal resources on-site or in close proximity to the leaching facilities.[186] A number of them are already using geothermal brine in enhanced leaching.[187]

Another relevant case study is the Lihir Gold Mine in Papua New Guinea (PNG), which uses geothermal brines to generate 56MWe that is used exclusively for the mine and covers approximately 75% of the operation's needs.[188] The geothermal electricity produced saves the mine approximately $40,000,000 USD in savings from offsetting heavy fuel oil consumption and $4,500,000 from sales of carbon credits on the global market.[189]The plant reduces the operation's emissions by 280,000 tonnes of GHGs per year.[190] The project also employs more than 2,200 people and contributes to the broader PNG economy through "taxation and royalties to national, provincial and local governments, salaries and wages, landowner contracts, investments in public infrastructure and services, and support of Lihirian and PNG suppliers, […] including access to health services, the provision of electrical power and water to local villages."[191]

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[184] *Ibid*, 9.
[185] *Ibid.*
[186] Patsa, Eleni, Van Zyl, Pat, Zarrouk, Sadiq and Arianpoo, Nastaran, "Geothermal Energy in Mining Developments: Synergies and Opportunities Throughout a Mine's Operational Life Cycle," *Proceedings World Geothermal Congress 2015*, April 2015, pg. 8 ,https://www.researchgate.net/publication/269395965_Geothermal_Energy_in_Mining_Developments_Synergies_and_Opportunities_Throughout_a_Mine's_Operational_Life_Cycle.
[187] *Ibid.*
[188] *Ibid*, 1.
[189] *Ibid.*
[190] *Ibid.*
[191] *Ibid.*

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Appendix B – CanGEA Submission to BC Royalty Review

Attached on next page

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Electricity and Alternative Energy Division BC Ministry of Energy and Mines
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Victoria, BC, V9W 9N1

July 16, 2018

Re: Support and Comments on the Proposed Geothermal Royalty Policy

Dear Mr. Walsh,

The Canadian Geothermal Energy Association (CanGEA) represents several organizations and a number of individuals. Our members are working to bring geothermal projects on-line throughout Canada, in a variety of geologic settings in both geothermal power and geothermal heat. Thus, our members working on projects in British Columbia will be directly and materially affected by the final decision on geothermal royalties. For this reason, CanGEA is submitting these comments.

Our members recognize that MEMPR has an obligation to create implementing royalty regulations to meet the requirements of the Geothermal Resources Act (1996). In so doing MEMPR must develop a system that will cover both electricity and heat. It is also important to achieve parity with other renewable energy systems that have royalty obligations and to construct a system that does not create an unreasonable financial barrier to development.

It is clear from the "Intentions Paper: Geothermal Royalty Policy Proposal" (IPGRPP) that the goals MEMPR must meet conflict in some ways, and that compromises among those goals are required.

CanGEA has provided the following feedback to the three points at the end of the IPGRPP.

Q1. The proposed royalty rate and impact of the royalty holiday.

CanGEA's members strongly support the 10-year royalty holiday. The royalty holiday would be best implemented following the final day of project construction and day 1 of facility power/heat generation. Geothermal power and heat projects are very capital intensive, have high exploration and development risk, and carry fairly high discount rates for NPV calculations. Thus, the proposed 10-year holiday results in a meaningful improvement to the NPV of a project, and hence to its very chance of being built at all.

CanGEA's members recommend that the royalty rate be reduced from 3% to 1%. There are two reasons for this recommendation.

First, while the discussion in the IPGRPP suggests that this creates parity with BC's wind royalty, it unfortunately results in the government's royalty structure providing a large financial incentive to wind energy over geothermal energy on a $/MWh basis. Wind energy at $40/MWh or less contract prices is common for good wind resources. The corresponding 3% royalty rate produces a $1.20/MWh royalty.

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Since geothermal is more expensive power, due to many factors, it is not uncommon for power prices to be much higher, often in the neighbourhood of $100/MWh. At the proposed 3% royalty rate, this results in a $3.00/MWh royalty, which is 2.5 times larger ($1.80 more than) the royalty of the wind projects, and clearly does not achieve parity between wind and geothermal.

In fact, the majority of resources that will be developed will not be the high quality (high temperature) resources of California, US Federal lands, or Kenya, all of which have very large high-temperature resources. For BC to see significant development of either geothermal power or geothermal heat, many lower quality resources (low and moderate temperature) will have to be developed. Parity with the approach developed for wind resources would suggest that lower quality resources are granted lower royalties of 1%. Since the majority of geothermal resources will be lower-quality (lower temperature), the royalty rate should be 1%.

This royalty review is of great importance, not only to those directly developing geothermal power and heat, but also those outside of the energy sector. The Canada West Foundation, an independent, non-partisan public policy think tank that focuses on the policies that shape the West, and by extension, Canada, has contributed this example for this submission:

The rational for aligning the geothermal royalty rate with the high end of the wind participation rent is also flawed. The wind participation rent operates on a sliding scale based on the wind facility's capacity factor with higher capacity factor facilities being subject to a higher rate. The underlying reason for this sliding scale is that higher capacity factor wind facilities are driven by higher quality wind resources. Therefore, a higher rent is warranted for access to a higher quality resources under the assumption that these facilities will be more capable of paying a higher rent.

While it is true that most geothermal facilities will have capacity factors much greater than wind facilities, it does not follow that these geothermal resources should be considered "high quality." The capacity factor for high-quality and low-quality geothermal resources will be greater than the typical wind facility. The biggest difference between high- and low-quality geothermal resources will be the cost to access those resources. For this reason, it does not make sense to apply the 3% rate to all geothermal facilities in British Columbia since capacity factor does not necessarily correlate with resource quality like it does for wind facilities.

Q2. If the inclined royalty rate is preferable, please indicate why this would be a better option to meet the objectives outlined.

CanGEA's members agree that the flat royalty rate is preferred.

Q3. Are there any additional considerations the Province should consider.

CanGEA's members would prefer a single royalty rate for all geothermal projects, rather than one rate for the limited number of high-temperature resources and another rate for low-temperature resources. This is for multiple reasons, including: The time and effort it will take to make and agree

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on the temperature and resource quality distinctions is considerable; and, parity with wind energy can be achieved by the simple adoption of a 1% royalty. Furthermore, geothermal power and heat projects should be subject to royalties on either heat or electricity generation; not both. Due diligence must be taken to ensure that projects are not being penalized with double royalty payments for both heat and electricity (Tax on tax).

It is also worth noting that higher capital costs for integrated geothermal power and heat plants (that also create jobs and/or provide ancillary services to the grid that lower system costs for all grid-users) may lead to higher power prices, and result in higher royalties to the BC government.

In summary, CanGEA's members:
1) Acknowledge and support that The Geothermal Resources Act (1996) requires a royalty on all geothermal energy sold.
2) Geothermal projects producing both heat and electricity for distribution, should pay royalties for either heat or electricity. Geothermal projects should not be taxed twice for a single project (Tax on tax).
3) Agree with MEMPR's proposal for a 10-year royalty holiday on geothermal energy.
4) Recommend revising the 3% royalty rate to 1% to achieve parity with wind energy on both a $/MWh basis, and because 1% is the rate used for lower quality energy resources.

Thank you for the opportunity to review and comment on this policy.

Sincerely,

Canadian Geothermal Energy Association

Kayla Wilson-Layton
Policy Analyst

Canada West Foundation

Nick Martin
Policy Analyst

Petroleum Services Association of Canada

Tom Whalen
President

Appendix C - Valemount Rocky Mountain Goat Article

Rocky Mountain Goat
Newspaper serving Valemount, McBride & the Robson Valley

BC Hydro scraps E-Plus program, forces more wood burning

By Andru McCracken

Rene Nunweiler would rather not burn wood, but BC Hydro's rate structure is leaving her no other option despite the fact she believes that it is not good for Valemount's air.

Nunweiler used to heat exclusively with electricity. She received a special rate from BC Hydro under a program called E-Plus.

The E-Plus program was started in 1987 and took new customers until 1990. A second separate meter kept track of how much electricity was used on home heating and the household was required to have a backup in case of a power outage.

According to the BC Hydro the 'special low Electric Plus rate was [....] at least one third lower than the firm electric rate.'

"For several years we benefited from heating the house electrically, except during occasional power outages when we switched to the wood stove," she said.

Nunweiler said that BC Hydro ended the program last year. Instead of being offered an incentive to heat with electricity, she and others like her are forced to pay more.

Instead of E-Plus there is now a Residential Conservation Rate.

According to BC Hydro's website: "Customers pay one rate for the first 1,350 kWh they use over an average two-month billing period. Above that amount, customers pay a higher rate per kWh for the balance of the electricity used during the billing period."

This higher rate is called 'Step 2.'

It has made heating with electricity too expensive for Nunweiler.

As a result, she's burning wood. "February was extremely cold and I burned wood night and day for the entire month," she said.

"BC Hydro's rate structure is a problem. It is impossible to heat a home without going into their 'Step 2'

usage at a higher rate. Step 2 is meant for energy conservation, but is punitive in my case."

Nunweiler uses a recently installed high efficiency wood burner.

"It still contributes to the poor air quality," she said. "I don't believe the answer is a wood stove exchange program, but working with BCHydro to reduce heating rates. They could eliminate the 2 step rates for Valemount where we have no affordable alternative except wood heat."

Nunweiler said even good wood stoves give off harmful particulate.

"Once my stove is going you don't see the smoke, it's clear and has a catalytic converter. But you are still putting out something, you can't get around that."

Nunweiler said it makes sense to heat with nonpolluting power… like hydroelectricity.

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