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Alberta Geothermal Policy and Regulatory Frameworks

Canadian Geothermal Energy Association (CanGEA)

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About CanGEA

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 Alberta and Canadian 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 Canada's 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 participates in engagements with all levels of government, including federal departments and committees, provincial/territorial governments and utility commissions, municipal governments, and First Nations. 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.

1.0 - Introduction

CanGEA wants to thank the Government of Alberta for the inclusion of our association at the geothermal press release on October 7, 2020 and the Geothermal Policy consultation that took place October 22, 2020. Advancing the geothermal energy industry in Alberta is a much-needed step towards the diversification of the economy and the energy sector. CanGEA is positioned to be a key resource for the Provincial government during this legislative implementation and to continue to be one afterwards.

This submission is a response to the Government of Alberta's recently announced Bill 36: *Geothermal Resource Development Act Engagement*. This Act is the right step towards providing Alberta with a baseload renewable energy resource. However, CanGEA has identified a few recommendations that we believe will make this Act a stronger piece of legislation.

As the collective voice of Canada's geothermal energy industry, CanGEA believes that our knowledge and experience can inform the Alberta Government on geothermal heat, cooling or electricity projects.

2.0 - Bill 36: Geothermal Resource Development Act

CanGEA had the opportunity to read the *Geothermal Resource Development Act* in full before writing this submission. Once again, CanGEA thanks the Government of Alberta for creating policy and regulatory frameworks that are specifically aimed at the development of geothermal resources in Alberta.

However, CanGEA is concerned with how liability and the transfer of liability to a geothermal developer, when existing oil and gas infrastructure is leveraged for geothermal projects, will be treated under the *Act.* CanGEA would like to continue a further discussion with the government on this matter.

3.0 - Types of Geothermal Applications

1. **Direct Use of Geothermal Heat (30°C – 150°C)**
2. **Geothermal Electricity (typically > 120°C)**

3.1– Direct Use

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.

Within the category of direct use, there are sub-categories such as: industrial, commercial, and direct heat. Industrial and commercial geothermal heat utilizes the heat from geothermal fluids, typically above 60°C. Applications that fall under this category include ethanol and biofuel production, refrigeration and ice-making, lumber drying, cement and aggregate drying and others.

Direct use geothermal applications are found in a few places throughout Canada, most notably among commercial hot springs.[1] Alberta is home to two of these developed thermal springs, namely Banff Upper and Miette Hot Springs, which have an aggregate capacity of 1,655kWth.[2]

It is expected that future direct use of heat projects in the Province will require drilling. The construction of a local geothermal heat plant can cost more up-front than accessing fossil fuels from a pipeline. This is due to the risks and costs associated with confirming the resource's viability.

3.2 – Geothermal Electricity

In the past, utility-scale geothermal power projects "have been restricted to tectonically active areas where high surface heat flow and extensive subsurface fracture networks allow for relatively easy access to hot fluids."[3] However, other resource types (including Hot Sedimentary Aquifers), can also have the necessary conditions to generate power (see Figure 1[4]). Geothermal power plants have five

[1] Lund, J. W., Freeston, D. H., & Boyd, T. L. (2005). Direct application of geothermal energy: 2005 Worldwide review. *Geothermics*, *34*(6), 691–727.
[2] *Ibid*, 7.
[3] Banks, J (2018). "*Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta,"* University of Alberta, pg. 13.
[4] Canadian Geothermal Energy Association (2019). Alberta Handbook for Community Geothermal Power and Heat Generation. Chapter 1 – Geothermal Resources Overview, pg. 3.

key components: wells, pumps, heat exchangers and piping, turbines, and electrical transmission equipment.[5]

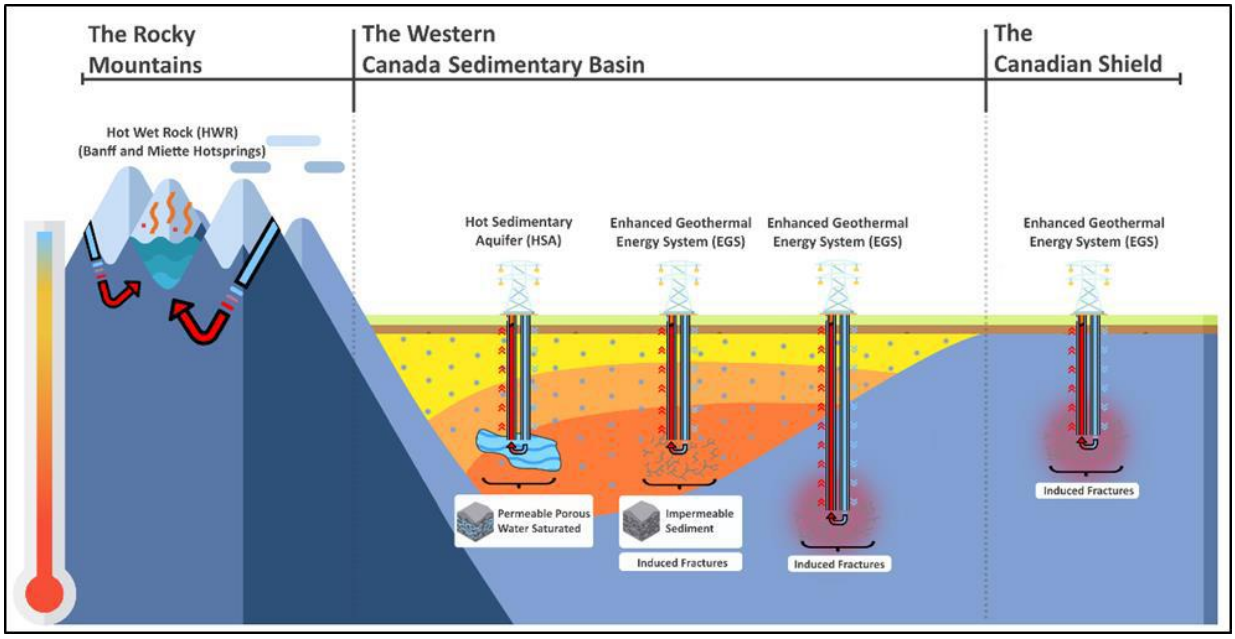

Figure 1. Simplified cross-section of Alberta depicting the types of geothermal systems that could potentially exist within each geological region of Alberta. (source: CanGEA, 2020).

Like direct use of heat projects, geothermal power plants cost more up-front than fossil fuel-powered plants due to the risks and costs associated with confirming the geothermal resource's viability. In comparison to larger geothermal power 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 is per kWe produced.[26] Though smaller projects cost more, it is important to note that a 250 kWe geothermal power plant could be profitable if the power plant is accompanied by a direct use application such as aquaculture, a greenhouse, or another type of direct use application.[27]

Due to the higher up-front cost of developing geothermal projects, CanGEA recommends that the Provincial government assist these types of projects through government funding during their development stage.

4.0- Addition of Directive G-060

For the last decade, CanGEA has been uniquely advocating for the adoption of a Directive 060 that is tailored for geothermal power or heat projects. This section of our submission will provide the

[5] *Ibid*, 55.

government with an overview of the importance that this proposed directive could have on geothermal development in Alberta.

4.1 - Geothermal Heat is a Valuable By-Product

Geothermal resources offer a renewable source of energy that can be utilized for direct-use heating and cooling, or the generation of electricity. Geothermal energy can be used for nearly any commercial or industrial process requiring heat. Such resources are used in 86 countries[6] around the world to spur economic growth and are especially suited to rural areas, Indigenous and other communities seeking low-impact energy, and entrepreneurs.

Alberta, especially, can benefit from the utilization of geothermal heat, where lower-temperature geothermal resources capable of producing useable heat are much more abundant than high-temperature geothermal resources capable of producing power. The Province's Central East and South East regions have significant shallow geothermal resources, accessible for the supply of low-cost heat. Specifically, the opportunity exists in the South and North Saskatchewan, as well as the Red Deer land use regions. This heat can be used for a multitude of purposes, including space heating for homes, fish farming, greenhouses, crop drying, milk pasteurization, livestock heating, and as process heat for various oil, gas and mining activities.

4.2 - Directive 060

AER Directive 060 has encouraged industry to harness flare gas, and we believe that a similar route could be taken to encourage geothermal energy co-production. Many oil and gas wells produce less than 10% hydrocarbons and greater than 90% water (co-produced).

Co-produced water should be mandated to be used for economic and environmental benefit in much the same way that the *AER Directive 060* has mandated flare-gas to be conserved, using volumetric, temperature, and economic thresholds.

A co-produced water analogue to *AER Directive 060* would result in the maximization of the utility of the drilled well and the associated land disturbance.

Co-produced wastewater from oil and gas operations is sometimes hot enough to be used for power generation in binary geothermal power plants. If able to be produced, this electricity can be used to decarbonize the oil and gas operation and/or provide clean energy to the Provincial grid.

More significantly, co-produced wastewater from oil and gas operations is nearly always hot enough for direct-use heating. In theory, co-produced water with temperatures as low as 20°C could be used to economically heat a greenhouse. District energy systems used for space heating and commercial activities are viable options for communities and entrepreneurs in the areas surrounding oil and gas operations. Most likely, fossil fuels are currently deployed or contemplated to meet these needs. Using co-produced water for geothermal heat could reduce greenhouse gas emissions in these areas and lower heating costs by a significant margin.

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

Furthermore, the implementation of a co-produced water analogue to *AER Directive 060* will reduce the costs and risks associated with geothermal energy development by using already existing infrastructure, thereby encouraging the growth of Alberta's nascent geothermal industry.

CanGEA recommends that The Alberta government should follow *Alberta Energy Regulator Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting* for geothermal power or heat projects by creating an additional Directive called G-060.

5.0 – Environmental Assessment (Mandatory and Exempted Activities) Regulation Exemption

As a result of the introduction of Bill 36 there will be several consequential amendments taking place on existing Alberta Acts. One of these amendments being a portion of the *Environmental Protection and Enhancement Act*. The change according to the Alberta Government would be the following:

- "Establishes the legislative authority to regulate recovery and use of geothermal resources and appropriate environmental and regulatory oversight."[7]

However, CanGEA believes that the Provincial government missed an important consequential amendment.

Grant Van Hal whose firm Peterson & Purvis LLP is a member of CanGEA, wrote a paper titled *Legal Obstacles to the Development of Geothermal Energy in Alberta*. The following recommendations are from sections 3.7.1 and 3.7.2 of his paper and are relevant to the consequential amendment stated above.

According to the Canadian Society for Unconventional Resources (CSUR):

> A standard single well lease site for conventional oil or gas will typically affect a surface area measuring 100 meters by 100 meters. The lease site will typically hold the drilling rig and additional equipment along with supervisory accommodation and material storage. If multiple wells from a single pad are planned, the surface area of the lease site would be larger; in some cases, as much as double the size. (100 meters by 200 meters).[8]

Depending on how many oil wells are drilled on a given lease, the dimensions given above can be converted to between 2.47 acres and 4.942 acres.[9] A geothermal project in Nevada estimated the size of each of its proposed geothermal well pads to be 2.8 acres[10]. Thus, it is notable that fossil fuel wells and geothermal wells have a nearly identical footprint.

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[7] Government of Alberta. "Bill 36: Geothermal Resource Development Act Engagement." Teleconference Roundtable Department of Energy. October 22, 2020.

[8] Canadian Society for Unconventional Resources (CSUR), "Well Construction", online: CSUR <http://www.csur.com/sites/default/files/Well_Construction_v2_wBleed.pdf>.

[9] Van Hal Grant, "Legal Obstacles to the Development of Geothermal Energy in Alberta," *Canadian Institute of Resources Law*, Occasional Paper #42 (2013).

[10] US Department of the Interior, Bureau of Land Management, Silver Peak Area Geothermal Exploration Project: Environmental Assessment (Tonopah, NV: US Dept of the Interior, Bureau of Land Management, October 2012) at 6.

Schedule 2 under the *Environmental Assessment (Mandatory and Exempted Activities) Regulation* exempts "the drilling, construction, operation or reclamation of an oil or gas well" from the need for an environmental assessment.[11] CanGEA submits that said Regulation should also provide a similar exemption for geothermal wells from environmental assessments due to the similar land-use footprints associated with each well type, by explicitly adding geothermal wells to Schedule 2 of the Regulation. CanGEA further reasons that geothermal wells are, relatively speaking, environmentally benign. Since the 1980's academics recognized that, "although high environmental quality must be maintained, it does not seem that the level of regulation necessary for other forms of generation is mandatory with regard to geothermal energy."[12]

CanGEA recommends that the Environmental Assessment (Mandatory and Exempted Activities) Regulation, which is a Regulation under the *Environmental Protection and Enhancement Act*, exempt geothermal wells by adding it to the Schedule 2 exempted activities list in the regulation.

6.0 - Alberta Heat and Electricity Market Dynamics

6.1 – Alberta Heat Market Dynamics

The Alberta residential sector relies on natural gas for the majority of its heating needs. In 2016, the Province consumed 175.4 petajoules (PJ) of energy for space heating, where natural gas comprised 138.5 PJ or 79%.[13] Due to the vast supply of natural gas and its convenience, natural gas dominates the heating market. Alberta has accessible geothermal resources suitable for district heating and other space heating opportunities spread throughout the Province. However, given the current market situation, it is unlikely that geothermal heating will play a major role within the short- to medium-term. Although the cost of geothermal heating projects is low when compared to electricity projects, scale must be incorporated in order to make projects more economical. Thus, until there are sufficient pressures politically and socially to utilize carbon-free heating in housing developments, industry growth is likely incremental.

CanGEA believes that geothermal heating is currently the most viable option for the use of geothermal resources in Alberta. The Government of Alberta should take the initiative to promote geothermal heating projects due to how quickly and easily they can be adopted into to Alberta's energy market.

6.2 – Alberta Electricity Market Dynamics

The same can be said about geothermal electricity projects. There is a great benefit to the integration of energy sources that either have a baseload capacity or are dispatchable, like geothermal, into

[11] Alta Reg 111/1993.
[12] MJ Pasqualetti, "Geothermal Energy and the Environment: The Global Experience" (1980) 5 Energy 111-165 at 160
[13] Natural Resources Canada, "Residential Sector Alberta – Table 1: Secondary Energy Use and GHG Emissions by Energy Source," accessed July 15, 2019, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ab&rn=1&page=0.

existing electricity grids. In Alberta, ~ 89% of electricity is produced from fossil fuels, with coal making up approximately 50%, and natural gas the remaining 39%. The previous government endorsed the Alberta Electric System Operator's (AESO) recommendation to transition to a capacity electricity market in order to attract new investment, by providing capacity generators with a payment for the capacity they provide and a payment for the energy they produce and sell to the grid.

The phasing-out of coal and Alberta's possible transition to a capacity market created what seemed to be a window for geothermal electricity generators to enter the market. This was a situation where approximately half of Alberta's capacity was set to be phased-out and a new market that rewarded capacity generators was possible. However, the AESO concluded that a procurement round for dispatchable renewables (i.e. geothermal energy) was not needed to meet coal phase out targets.[14] As a result, the expected uptake of geothermal electricity projects in the Province is expected to be incremental and slow.

CanGEA believes that the current market conditions for both geothermal heat and electricity will make the integration of geothermal projects incremental and slow, thus, not allowing geothermal energy's full potential to be used in the market. The Provincial government can support both geothermal electricity and heat projects through the recommendations made in this submission, such as:

- **Creating tax incentives;**
- **Providing provincial funding for early stage geothermal energy projects;**
- **Implementing Directive G-060;**
- **Promotion of geothermal energy options in rural areas.**

CanGEA welcomes a further discussion with the government on ways to encourage geothermal development.

7.0 - Distributed Energy Resources and Distribution-Connected Generation

CanGEA, over several years, has championed for the release of important data of congested electric grid areas in Alberta. **CanGEA requests that the Alberta Electric System Operator (AESO) release data of congested areas within Alberta's electrical grid, in order for geothermal projects to develop in these areas.**

Geothermal electricity projects have the opportunity to reduce grid congestion as a Distributed Energy Resource (DER). Some of Alberta's best geothermal resources for electricity generation are located in the central portion of the Province where there is significant opportunity to develop baseload and dispatchable geothermal resources. The Alberta Electric System Operator (AESO) should identify congested areas within Alberta's electrical grid and work with DER developers to map out locations where geothermal projects could be developed to reduce congestion. Figure 2 below illustrates the heat availability in Alberta based on oil and gas wells with varying bottom hole temperature.[15]

[14] Alberta Electric System Operator, "Dispatchable Renewables and Energy Storage," May 31, 2018,
[15] Matek, Benjamin, Gawell, Karl, "The Benefits of Baseload Renewables: A Misunderstood Energy Technology."

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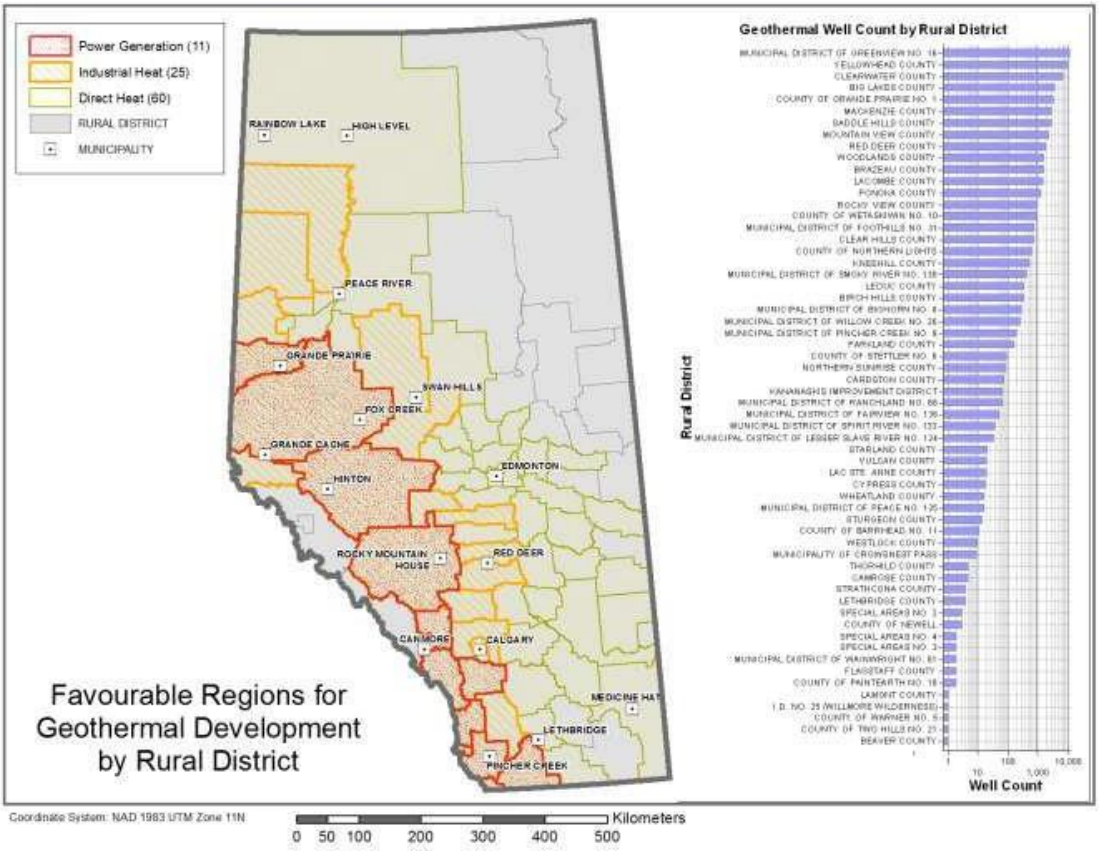

Figure 2: Favourable rural districts and well counts for all geothermal wells by rural district

Geothermal as a baseload electricity source uses existing transmission capacity efficiently because of its high capacity factor. By comparison, a 50 MW intermittent generator consumes 50 MW of transmission, even though they may rarely use the full capacity of the line.[16] In the case of congested transmission lines, the integration of intermittent generators can raise costs as more transmission infrastructure must be constructed to accommodate the same amount of electricity.[17]

If geothermal energy developers are informed of congested areas on Alberta's grid, projects can be built there to reduce congestion.

Distributed geothermal electricity projects also have the opportunity to act as non-wire solutions in that they can be constructed close to areas of growing demand, reducing the need to transport the electricity over long distances. Distributed geothermal electricity projects could be provided an incentive through various price signals, such as a feed-in tariff for geothermal electricity projects in areas of high congestion. There are many other mid-tier resources located throughout the Province, which can provide the necessary temperatures for electricity generation (at greater depths).

[16] Matek, Benjamin, Gawell, Karl, "The Benefits of Baseload Renewables: A Misunderstood Energy Technology." March 2015, *The Electricity Journal*, https://www.sciencedirect.com/science/article/pii/S104061901500024X.
[17] *Ibid.*

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8.0 - Levelized Cost of Electricity

As mentioned, the AESO's analysis concluded that dispatchable renewables and storage were not needed at this time. It also concluded that dispatchable renewables and storage were not as cost-effective as wind-generated renewable energy. However, the levelized cost of electricity (LCOE) method is a useful way to compare projects with different fuel sources, lifespans and electrical capacity. This method shows that geothermal projects are competitive with all forms of generation.

The LCOE method evaluates the cost of electricity projects. The LCOE measures the lifetime costs of a project, divided by the amount of energy produced.[18] By calculating the present value of the total cost of building and operating an electricity plant over an assumed lifetime, the LCOE enables for the comparison of different technologies with different lifespans, size, capital cost, risk, return and capacities.[19]

Also, worth noting is the Levelized Avoided Cost of Electricity (LACE) approach. Economic competitiveness can be evaluated through avoided cost, a measure of what it would cost the grid to generate the electricity that would otherwise be displaced by a new generation project, as well as its levelized cost. Avoided cost can be summed over its financial life and converted to a level annualized value that is divided by average annual output of the project to develop its LACE.[20] The LACE value can be compared with the LCOE value to provide an indication of whether or not the project's value exceeds its cost.

The LCOE considerations are absent in a simple $/MW cost analysis, which in the case of geothermal electricity projects is detrimental as they have long lifespans and a high capacity. On an LCOE basis, geothermal electricity projects are among the most competitive in comparison to all other forms of generation and the fuel is free.[21] The US Department of Energy calculates the LCOE for hydrothermal geothermal electricity projects to be between $0.04 CAD and $0.10 CAD per kWh.[22]

CanGEA submits that the LCOE or LACE method should be adopted in Alberta as evaluating projects on a $/MW basis does not consider all the costs associated with a project's lifetime, especially in the case of intermittent renewables that use up a disproportionate amount of grid capacity compared to their delivered energy.

[18] US Department of Energy, "Levelized Cost of Energy," Office of Indian Energy, accessed July 15, 2019, https://www.energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf.
[19] *Ibid.*
[20] U.S. Energy Information Administration, "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016," (2016), 2.
[21] OpenEI, "Transparent Cost Database - LCOE," https://openei.org/apps/TCDB/.
[22] *Ibid.*

9.0 – Pembina Institute and ACTia

The Pembina Institute put forth several arguments in regards to how the geothermal industry in Alberta can succeed[23]. The following are some of the core solutions to help accelerate geothermal development in Alberta. These arguments are also voiced by ACTia in their submission to the Alberta Government's geothermal policy consultation. CanGEA both agrees and supports these points, which are summarized below.

9.1 Preferential Pricing for Geothermal

There is a need for there to be a pricing system for geothermal electricity in Alberta. Alberta's natural gas and electricity prices mean there is limited motivation to develop geothermal resources. The low costs and fast accessibility to natural gas, results in a near-monopoly over the base-load market that is developing as coal generation is retired. These low natural gas prices make it difficult to achieve a reasonable payback on high-cost projects like geothermal electricity. The AESO's Renewable Electricity Program could address this issue. However, geothermal projects are unlikely to be able to compete with more mature wind and solar technologies.

There can be an improved return on investment for geothermal projects by establishing a guaranteed long-term price for geothermal electricity. A logical approach in Alberta may be to design a Renewable Electricity Program or the capacity market to enable geothermal electricity to successfully compete for government support. For example, the U.K. uses a contracts-for-difference program to encourage renewable electricity generation, but it was designed with separate competitions between groups or more and less established technologies.

CanGEA recommends that the government create a Renewable Electricity Program that integrates geothermal to compete with other renewables that are already established or create the capacity market to enable geothermal electricity to successfully compete for government support.

9.2 – Extend Exploration and Production Tax Credits to Geothermal

Alberta must also implement risk reduction policies for geothermal projects, capitalizing on experience managing risk for the oil and gas sector. Such policies, ranging from government-led exploration to financial support and tax exemptions for exploration drilling, have been integral to the successful development of geothermal industries worldwide.

CanGEA recommends that the government provide both financial support and tax credits to the geothermal industry. This will result in faster geothermal development in the Province, as well as wider interest from investors.

[23] Pembina Institute. "The Missing Pieces in Alberta's Geothermal Puzzle." Pembina Institute, December 18, 2017. https://www.pembina.org/blog/missing-pieces-albertas-geothermal-puzzle.

9.3 – Project Funding

The lack of project experience is the most significant issue that will arise in geothermal development in Alberta. Without more completed geothermal projects, the synergies between oil and gas and geothermal energy are untested. Just as government support was required to successfully develop the first oilsands projects and the associated technologies, the Provincial government should support a series of early projects to explore Alberta's true geothermal opportunity.

CanGEA recommends that the Alberta government should support early projects through appropriate funding programs.

10.0 - Conclusion

CanGEA applauds the Government of Alberta for introducing a geothermal policy and regulatory framework through Bill 36: *Geothermal Resources Development Act.* The government has recognized the ability presented by geothermal resources to further diversify Alberta's economy and energy sector. CanGEA hopes that the Provincial government will use the insights and recommendations from this submission to make the proposed geothermal *Act* stronger.

CanGEA once again thanks the Government of Alberta for moving towards the development of geothermal energy. This opportunity will stimulate the economy and bring investment into Alberta.

Sincerely,
Manjot Klair, Policy Manager &
Alison Thompson, Chair of CanGEA