STROKKUR GEYSER, ICELAND

GEOTHERMAL ENERGY

Gaining Steam: A Regulatory and Policy Framework for Geothermal Energy Development in Alberta

Module 1: Geothermal Energy and Alberta's Current Regulatory Landscape

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The Environmental Law Centre (ELC) has been seeking strong and effective environmental laws since it was founded in 1982. The ELC is dedicated to providing credible, comprehensive, and objective legal information regarding natural resources, energy and environmental law, policy, and regulation in the Province of Alberta. The ELC's mission is to educate and champion for strong laws and rights so all Albertans can enjoy clean water, clean air, and a healthy environment. Our vision is a society where laws secure an environment that sustains current and future generations.

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1. Geothermal Energy Uses

Geothermal energy – the heat energy generated and stored in the earth - can be used in geo-exchange systems and directly as heat, as well as for electrical production.

1.1 Geo-exchange

Geo-exchange – sometimes referred to as low-temperature or shallow geothermal systems – uses the constant temperature below the earth to heat and cool buildings, and for water heating. The scale of geo-exchange projects is typically small; it can be used for residential, commercial and institutional buildings, and for manufacturing facilities.[1] A geo-exchange system consists of three components: a heating/cooling distribution system; an electric ground source heat pump; and a ground loop (subsurface pipes).[2] A geo-exchange system may use an open-loop or a closed-loop (either vertical or horizontal) configuration. An open-loop system uses groundwater from a water well to extract or release heat using a liquid source heat pump. A closed-loop system

[1] Pembina Institute, "Geoexchange: Energy under foot: Making Renewable Energy a Priority Fact Sheet" available at https://www.pembina.org/reports/geoexchangefactsheet.pdf.

[2] *Ibid*.

has a continuous, sealed, underground or submerged heat exchanger through which a heat-transfer fluid is continuously recirculated to and from a heat pump.

Unlike geothermal direct heat or power production applications, a geo-exchange system does not require special geological conditions.[3] Rather, geo-exchange is based on the constant and stable underground temperatures that result from solar radiation (there is no positive thermal source) which means that geo-exchange can be applied in most locations.[4]

1.2 Geothermal Direct Heat Systems

Direct heat systems involve using hot geothermal water for a variety of purposes including heating pools (hot springs), district heating, and agricultural applications.[5] Direct use of geothermal heat can be used on an industrial scale.[6] Because of lower temperature requirements, geothermal resources that are not suitable for power production may still be useful for direct heat systems.[7]

1.3 Geothermal Power Plant Developments

The hottest geothermal resources are suitable for power plant developments. There are three primary types of geothermal resources that may be used for development of geothermal power plants: [8]

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[3] See https://www.geoexchange.com.au/technology/faq/.

[4] *Ibid*. See also https://www.cangea.ca/intro.html.

[5] See https://www.cangea.ca/intro.html.

[6] *Ibid*.

[7] *Ibid*.

[8] Justin Crewson and Alison Thompson, International Geothermal Policy Mechanisms Best Practices: Identifying the Canadian Gap (June 2015, CanGEA) [Crewson and Thompson].

- Hot Dry Rock (HDR) which can be developed using Enhanced Geothermal Systems (EGS). EGS technology uses hydro-shearing, a form of hydraulic fracturing, to create artificial reservoirs in hot dry rock. EGS is currently a developing and relatively expensive technology. The International Energy Agency has developed a protocol for EGS development especially focused on associated seismicity.[9]

- Hot Sedimentary Aquifers (HSA) which have significant amounts of hot water although tend to be lower temperature. These can be used to reliably produce power, in addition to or separate from the production of large amounts of hot water for spa facilities, greenhouses, district heating and other activities that need clean, plentiful hot water. Since HSAs are typically found in areas where oil and gas activity is common, there is often plentiful exploration data.[10]

- Volcanic Geothermal Systems (Hydrothermal) are the conventional setting for geothermal power plants. Naturally occurring pools of hot water are heated by volcanic activity relatively close to the surface. These tend to have much higher temperatures of water but are more difficult to target via drilling compared to HSA resources.

Geothermal power plants may be designed as: [11]

[9] International Energy Agency, Technology Roadmap: Geothermal Heat and Power (2011).

[10] Crewson and Thompson, *supra* note 8.

[11] S.E. Grasby et al., Geothermal Energy Resource Potential of Canada, Geological Survey of Canada, Open File 6914 (revised) (2012) Natural Resources Canada doi: 10.4095/291488 [Grasby et al.].

- Binary cycle plants where moderately hot geothermal water is passed by a secondary fluid with a lower boiling point than water which causes a secondary fluid flash to vapour which drives the turbines.

- Flash steam plants which pull deep, high-pressure hot water into lower-pressure tanks and use the resulting flashed steam to drive turbines.

- Dry steam plants directly use geothermal steam to drive turbines.

In terms of development costs, direct use operations are significantly cheaper than geothermal electrical power plants. [12]

2. Geothermal Potential in Alberta

In its 2012 assessment of geothermal resources across Canada, the Geological Survey of Canada looked at provincial inventories of past mining sites (abandoned mine sites). In Alberta, this consisted of open pit and underground mines for coal extraction. These sites contained total geothermal resources of 4,835 TJ with an average of 1.24 TJ for underground mines and 16.5 TJ for open pit mines.[13] There are regions in northern Alberta that have potential for electrical generation.[14] Northwestern and central Alberta have high potential for EGS development (high heat flow but a lack of water or low permeability/porosity of host rocks).[15]

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[12] Jonathon Banks, Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development In Alberta: Final Report (2016) Earth and Atmospheric Sciences, Faculty of Science, University of Alberta [Banks].

[13] Grasby et al, *supra* note 11.

[14] *Ibid*.

[15] *Ibid.*

Some of this potential may coincide with existing infrastructure whereas some areas will be greenfield projects. Of existing wells, the Canadian Geothermal Energy Association has estimated that Alberta has the potential of roughly 500 wells for power generation, 7,202 wells for industrial heat and over 53,000 wells for direct heat.[16]

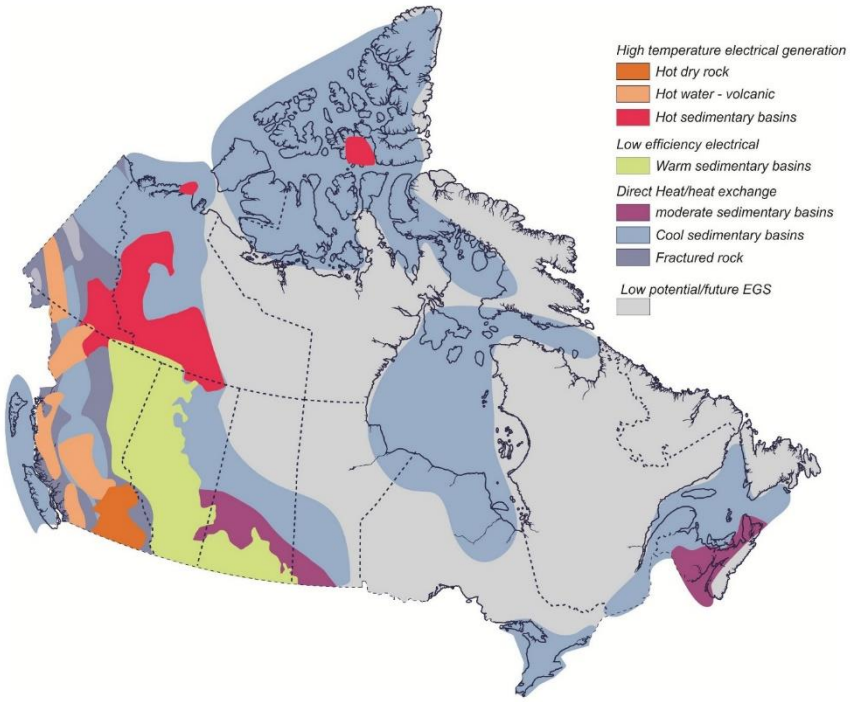

Figure 2. Map showing distribution of geothermal potential in Canada based on end use.

Figure 2. Reproduced from Grasby et al., infra. note 11. For Alberta specific maps, see CanGEA website at https://www.cangea.ca/albertageothermal.html.

[16] See Canadian Geothermal Energy Association, *Alberta Well Filtering Study Overview,* Wellhead Analysis, Methodology and Dashboards, online: https://www.cangea.ca/reportanddashboards.html.

A more recent study – published by Banks at the University of Alberta in 2016 - found over 6,100 MWt of thermal power production available to domestic, commercial and industrial users for 30-year production period (in a study area covering Alberta's Leduc, Swan Hills, Gilwood, and Granite Walsh formations).[17] However, this finding is "tempered with practical concerns". [18] This includes the quality of the resource - some reservoirs are not hot enough for reliable electrical production with existing binary cycle technology and the required flow rates would require an uneconomical number of wells.[19] Another major concern is the hydrogeologic properties of the reservoirs; for instance, there is "little information regarding the reservoirs' abilities to sustain required flow rates for electrical production". [20] Further study is required to determine the hydrodynamic properties of the brine which is required for calculation of net power production (and commercial viability). [21]

The hottest and deepest reservoirs in the study area looked at by Banks were found in the area around Hinton making it the best target for large-scale geothermal electricity production in Alberta.[22] Another study identified an area around the hamlet of Winfield (100 km southwest of Edmonton) as being suitable for geothermal electricity production.[23]

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[17] Banks, *supra* note 12.

[18] *Ibid*. at 40.

[19] *Ibid*.

[20] *Ibid*. at 40.

[21] *Ibid*.

[22] *Ibid*.

[23] Simon Weides, Exploration of geothermal resources in the Alberta Basin, Canada (2014) PhD Dissertation Thesis, University of Berlin. Results of additional studies are also available, see for instance: Jacek Majorowicz et al., High Temperatures Predicted In the Granitic Basement of Northwest Alberta - As Assessment of the EGS Energy Potential (2014) Proceedings, Thirty-Ninth Workshop on Geothermal Resevoir Engineering, Stanford University, Stanford, California, February

Although less suitable for large-scale geothermal electricity production, there is likely ample thermal energy for direct heating and other residential, commercial and industrial purposes in other parts of the study area looked at by Banks.[24] These purposes include domestic and commercial space heating, industrial process heat, greenhouse and nursery heating, timber and grain drying, snow melting, and spas and public baths.[25]

Although very much in the early stages, there are some geothermal developments underway in Alberta. In November, 2019, Terrapin Geothermics was granted permission to conduct testing operations for a large-scale geothermal plant in the Municipal District of Greenview.[26] In support of these operations a geothermal testing subsurface reservoir lease was issued via an Order-in-Council (Cabinet Order)[27] pursuant to sections 9 and 57(5) of the *Mines and Minerals Act*. This project is financially supported by the Natural Resources Canada's Emerging Renewables Power Program.[28]

Another pilot project (by Razor Energy with the University of Alberta) to produce geothermal heat and power with co-produced fluids in Swan Hills has received funding from Alberta Innovates[29] and Natural Resources Canada's Clean

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24-26, 2014; and Jacek Majorowicz et al., Implications of Post-Glacial Warming for Northern Alberta Heat Flow - Correcting for the Understimate of the Geothermal Potential (2012) 36 GRC Transactions 693.

[24] Banks, *supra*. Note 12.

[25] *Ibid*.

[26] https://www.cangea.ca/uploads/3/0/9/7/30973335/media_release_-_alberta_government_signs_crown_agreement_for_terrapin's_geothermal_project.pdf and https://www.alberta.ca/release.cfm?xID=647402D85A063-0F6F-19C4-D8A0400865124BA3.

[27] O.C. 222/2019.

[28] See https://www.terrapingeo.com/press.

[29] See Awardee Summary at https://albertainnovates.ca/wp-content/uploads/2019/01/CCITF-Awardee-Summary-CTD-2018-027.pdf.

Growth Program.[30] As part of Razor Energy's normal operations, there is a large amount of heat in produced water. The project will repurpose an oil and gas battery to capture geothermal heat thereby reducing overall emissions of its oil and gas operations, and add power revenues to Razor Energy (up to 5 MWe).[31] Razor Energy has indicated that it has collaborated with "the various governing regulatory bodies to use the current exemplary regulatory framework, and to work on long term policy to enhance the development of a geothermal industry and renewable energy".[32]

A demonstration project – using Eavor-Loop technology – is underway in Rocky Mountain House.[33] This technology uses two connected vertical wells to capture heat using a circulating working fluid (in a closed loop system).[34] This technology can use low temperature geothermal resources to generate small-scale energy production.[35] It is also an attractive technology as it can be developed at brownfield sites such as abandoned oil wells.[36] Drilling at the Rocky Mountain House site was completed in September 2019.[37]

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[30] See Razor Energy press release (June 27, 2019) at https://static1.squarespace.com/static/5ba9071b9d41490a35a48592/t/5d14d2461d6147000120a106/1561645638862/Razor+Press+Release+Geothermal+Funding.pdf.

[31] See project description at https://www.nrcan.gc.ca/science-and-data/funding-partnerships/funding-opportunities/current-investments/geothermal-energy-co-production-active-oil-and-gas-operation/22151.

[32] *Supra* note 30.

[33] https://www.cbc.ca/news/canada/calgary/eavor-loop-geothermal-1.5255420. See also CWF, Hot Commodity which uses the Eavor-Loop project as a test case for analyzing Alberta's geothermal regulatory approach.

[34] See Eavor website at https://eavor.com/technology/.

[35] CWF, Hot Commodity.

[36] *Ibid*.

[37] See Eavor press release September 16, 2019 at https://eavor.com/press/#press10.

The Town of Hinton, in partnership with the University of Alberta and Alberta Innovates, has also been exploring geothermal development for several years. In 2018, a cross governmental partnership, including investment of $1.2 million, was announced to determine the viability of a geothermal district energy system in Hinton.[38]

3. The Geothermal - Oil and Gas Interface

It has been noted that there are several similarities between oil and gas activities and geothermal energy development, making Alberta a natural fit for the geothermal industry.[39] Both oil and gas activities and geothermal activities use similar technical and non-technical skills, both use wells to extract fluids from the sub-surface, both collect and use sub-surface data, and both are subject to high financial risk.[40] In addition, there is potential synergy between the two industries since existing and abandoned oil and gas wells may be used to explore for and/or develop geothermal resources.[41] It has also been suggested that CO_2 could be used as geothermal fluid (rather than water) to increase the efficiency of geothermal heat production from the low temperature and

[38] See Town of Hinton website at https://www.hinton.ca/hintongeothermal.

[39] Aletta Leitch, Sara Hastings-Simon and Brendan Haley, Heat Seeking: Alberta's geothermal industry potential and barriers (December 2017) Pembina Institute) [Leitch et al. 2017]. See also Aletta Leitch, Brendan Haley and Sara Hastings-Simon, Can the oil and gas sector enable geothermal technologies? Socio-technical opportunities and complementary failures in Alberta, Canada (2019) 125 Energy Policy 384 [Leitch et al. 2019].

[40] Leitch et al. 2017, *supra* note 39 and Leitch et al. 2019, *supra* note 39. See also Aletta Leitch and Jason Switzer, The Missing Pieces in Alberta's geothermal puzzle: Alberta's strengths in oil and gas make geothermal a strong possibility, but it needs a push to get going (December 18, 2017) Pembina Institute Blog.

[41] Leitch et al. 2019, *supra* note 39.

relatively low permeability reservoirs found in Alberta.[42] This means that Alberta's geothermal reservoirs could be used for heat production and CO_2 sequestration. Another potential use identified for geothermal energy is a hybridization with wind energy using compressed air energy storage (powered by geothermal) to address the variability of wind energy.[43] Using modelling, it was determined that the best locations to hybridize geothermal and wind energy sources in Alberta are in the Lethbridge area, the Medicine Hat area, the Lloydminster area, and the Grand Prairie area.[44]

Geothermal electrical power production is potentially possible from three types of oil and gas wells: producing wells with a water cut, wells which were abandoned due to a high water cut, and geopressured brine wells with dissolved gas.[45] The power capacity of producing wells is determined primarily by the production rate and the temperature of produced water, ambient temperature, and the conversion efficiency of the geothermal power plant.[46] For wells abandoned due to a high water cut, additional factors affect the power capacity including water salinity, gas content in the produced water, heating value of the gas, and the characteristics of the equipment used to generate power from the produced gas.[47] All these foregoing factors, along

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[42] Simon Weides, Exploration of geothermal resources in the Alberta Basin, Canada (2014) PhD Dissertation Thesis, University of Berlin.

[43] Hamid Rahmanifard and Tatyana Plaksina, Hybrid compressed air energy storage, wind and geothermal energy systems in Alberta: Feasibility simulation and economic assessment (2019) 143 Renewable Energy 453.

[44] *Ibid*.

[45] Subir K. Sanyal and Steven J. Butler, Geothermal Power Capacity from Petroleum Wells - Some Case Histories of Assessment (2010) Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010.

[46] *Ibid*.

[47] *Ibid*.

with the amount of over-pressure in the formation, affect power capacity of geopressured wells.[48]

Geothermal resources have also been proposed as a potential alternative to burning natural gas in oil sands extraction.[49] Given the geological features in the oil sands region, EGS would be required to capture geothermal energy in this region.[50] Those same resources could also be used to provide heat for the communities in the area.[51]

Geothermal power plants consist of five major pieces of infrastructure: wells, pumps, heat exchangers and piping, turbines, and electrical transmission equipment. [52] The riskiest investment is in the wells (the only way to directly confirm a reservoir's viability). [53] Prior to proceeding to full scale geothermal well drilling, it is common practice to drill a "slim hole" to prove a resource. [54] In many cases, an oil or gas well could be retrofitted to serve as a geothermal "slim hole" which is significantly less expensive than drilling a new "slim hole" or repurposing an oil or gas well for full-time brine circulation as a geothermal producer or an injector. [55]

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[48] *Ibid*.

[49] Jacek Majorowicz et al., Implications of Post-Glacial Warming for Northern Alberta Heat Flow - Correcting for the Underestimate of the Geothermal Potential (2012) 36 GRC Transactions 693 [Majorowicz et al.]. See also Leitch et al. 2019, *supra* note 39.

[50] Leitch et al. 2019, *supra* note 39.

[51] Majorowicz et al., *supra* note 49.

[52] Banks, *supra* note 12.

[53] *Ibid*.

[54] *Ibid*.

[55] *Ibid*. In this report, states that any gas well in the study area could be retrofitted to serve as a geothermal slim hole (page 55). Estimates of retrofitting costs are provided in the report.

Other commentators have pointed out that - aside from technological, knowledge and skill overlaps - there is potential for institutional overlap in terms of regulatory frameworks, risk reduction policies and political circles.[56] In light of some technological similarities, a regulatory framework for geothermal development could be drawn from oil and gas institutions. [57] In other jurisdictions, policies to reduce investment risk have been necessary to establish geothermal development.[58] Alberta has similar experience with providing support to establish the oil sands industry and this experience could be built on to reduce private sector risk for geothermal projects. [59] While there is a network of connections between the oil and gas sector and the geothermal sector, there is still a need for stronger geothermal advocacy to create political will needed for a regulatory regime and supportive policies to be put into place. [60]

Aside from potential synergies, the interface of geothermal operations and oil and gas operations also raise potential barriers. There is potential for sub-surface conflicts between the two industries (not to mention potential conflicts with water resources or other subsurface interests). As well, the reworking of existing oil and gas wells into geothermal wells raises legal challenges such as the appropriate allocation of environmental liabilities.

Regulation of Geothermal Resources in Alberta

Alberta currently lacks a comprehensive regulatory regime governing the exploration for and development of geothermal energy resources. There is currently no legal definition of **geothermal resources**, there is no clear statement

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[56] Leitch et al. 2019, *supra* note 39

[57] *Ibid*.

[58] *Ibid*.

[59] *Ibid*.

[60] *Ibid*.

as to ownership, and there is no established process to obtain exploration and development rights for geothermal resources. A legal definition and clarification of ownership would provide certainty to investors in and developers of geothermal resources, removing some of the risk associated with unresolved legal issues. Issues around potential conflicts and liability associated with the overlap between new geothermal developments and Alberta's existing oil and gas infrastructure must also be clarified. Investment in and development of geothermal resources is facilitated by an established regulatory process and supporting policy. In order to realize the potential of geothermal resources as a relatively clean energy source, an effective legislative and policy framework is essential.

4. Laws of General Application

Despite the lack of comprehensive regulatory regime, various aspects of geothermal development may currently be captured under different pieces of provincial environmental law. As such, it is useful to provide some background on the major relevant pieces of legislation in Alberta: the *Environmental Protection and Enhancement Act* (EPEA),[61] the *Water Act*, and the *Municipal Government Act* (MGA).[62] The application of this legislation, and any relevant references to geothermal resources, will be highlighted below as they relate to geo-exchange, direct heat or power plant developments.

4.1 Environmental Protection and Enhancement Act

The EPEA is comprehensive environmental legislation that:

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[61] *Environmental Protection and Enhancement Act*, R.S.A. 2000, c. E-12 [EPEA].

[62] *Municipal Government Act*, R.S.A. 2000, ch. M-26 [MGA].

- establishes a system of approvals, registrations and notice for **activities** (i.e. those listed in EPEA's Schedule of Activities);

- establishes the provincial environmental assessment process; and

- prohibits the release of substances that may cause a significant adverse effect or that are in contravention of an approval, a code of practice or regulation.

The EPEA does not expressly mention geothermal resource activities; however, it does reference thermal electric power. The EPEA's Schedule of Activities includes the construction, operation or reclamation of a plant, structure, or thing for the generation of **thermal electric power or steam** (s. 2(n)). Further, the *Activities Designation Regulation*, Alta. Reg. 276/2003 defines a power plant as a plant that produces steam or thermal electrical power with a rated production output greater than one megawatt (s.2(2)(vv)). Under the regulation, a power plant is an activity for which an approval is required (s. 5 and Schedule 1). Based on this, it appears that a geothermal power plant would fall into EPEA's Schedule of Activities. However, it is less clear that using geothermal resources for direct heat applications falls into the EPEA's Schedule of Activities.

Depending upon its size, it is conceivable that an approval and even a provincial environmental assessment may be required for a geothermal power plant.[63] The *Environmental Assessment (Mandatory and Exempted Activities) Regulation*, Alta. Reg. 111/93 requires an environmental assessment for any "thermal electrical power generating plant that uses non-gaseous fuel and has a capacity of 100 megawatts or greater".[64] Since there is no exemption in the regulation related to thermal electrical power plants, a power plant smaller than

[63] EPEA, Schedule of Activities, s.2(n) includes thermal electric and steam plants.

[64] *Environmental Assessment (Mandatory and Exempted Activities) Regulation*, Alta. Reg. 111/93, Schedule 1 (k).

100 megawatts may be subject to an environmental assessment at the discretion of the director. It is noteworthy that the *Environmental Assessment (Mandatory and Exempted Activities) Regulation*, Alta. Reg. 111/93 specifically exempts wind and solar electric plants less than 1 megawatt from the environmental assessment process (Schedule 2, (h)). This may set the precedent for creating a similar exemption for geothermal power plants less than 1 megawatt.

In addition to provisions pertaining to approvals and environmental assessments, EPEA requires conservation and reclamation of **specified land**.[65] **Conservation** of specified land is defined as the "planning, management and implementation of an activity with the objective of protecting the essential physical, chemical and biological characteristics of the environment against degradation".[66] **Reclamation** requires removal of equipment, buildings and structures; the decontamination of buildings, structures, land and water; the stabilization, contouring, maintenance, construction and reconstruction of the land surface; and other operations as may be required by regulation.[67]

Under EPEA, an operator has a duty to conserve specified land, to reclaim specified land, and, unless exempted by regulation, to obtain a reclamation certificate.[68] It is important to note that these requirements only apply on **specified land** which is defined in the *Conservation and Reclamation Regulation*[69] and includes land on which there was construction, operation or reclamation of a renewable energy operation (which includes "heat from the

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[65] EPEA, Part 6.

[66] EPEA, s. 1(l).

[67] EPEA, s. 1(ddd).

[68] EPEA, s. 137.

[69] *Conservation and Reclamation Regulation*, A.R. 115/1993, s. 1(t).

earth when used for electrical power generation"),[70] as well as numerous oil and gas operations. The term **operator** is broadly defined and includes the person who conducted the activity, the statutory authorization holder, a working interest participant in certain oil and gas operations, the surface lease holder, the successor/ assignee/ executor/ administrator/ receiver/ receiver-manager/ trustee of the foregoing, or the principal or agent of the foregoing. [71]

An operator of a renewable energy operation reclaimed prior to July 1, 2018 or smaller renewable energy operations[72] is not required to obtain a reclamation certificate.[73] Further, where in the opinion of the Director, a reclamation certificate is not required if a second activity is being carried out on that same specified land.[74] There are no timelines for conducting reclamation activities and obtaining a reclamation certificate. The standard for reclamation is achieving an **equivalent land capacity** which means that "the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the land individual land uses will not necessarily be identical".[75] Once a reclamation certificate is obtained, the operator remains liable for environmental protection orders issued in relation to the specified land for 25 years.[76]

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[70] *Conservation and Reclamation Regulation*, A.R. 115/1993, s. 1(q.3).

[71] EPEA, s. 134.

[72] *Conservation and Reclamation Regulation*, A.R. 115/93, s. 15.1(1)(a)(vi). Renewable energy operations that generated or produced an amount of electricity equal to or less than that which is defined for large micro-generation in the *Micro-generation* Regulation (i.e. not more than 150 MW) and has a total footprint no greater than 1 hectare in size.

[73] *Ibid.*, s. 15.1(1)(a)(vi).

[74] *Ibid.,* s. 15.1(1)(b).

[75] *Ibid*., ss. 1(e) and 2.

[76] *Ibid.*, s. 15.

Conservation and reclamation obligations pertain only to the surface of specified land. In the case of release of a substance that has caused, is causing, or has the potential to cause an adverse effect, remediation requirements are triggered (and are not limited to only specified lands).[77] **Remediation** means "reducing, removing or destroying substances in soil, water or groundwater through the application of physical, chemical or biological processes".[78] Remediation procedures and standards are set by prescribed guidelines issued by Alberta Environment and Parks.[79] Upon completion of remediation, a remediation certificate may be issued. A remediation certificate provides some protection from liability for environmental protection orders (for the substance and zones specified in the remediation certificate); however, liability continues for other substances, for other zones, and for exceedances of applicable guidelines.[80] The issuance of a remediation certificate does not affect a person's obligation to obtain a reclamation certificate.[81]

4.2 *Water Act*

The purpose of the *Water Act* is to "support and promote the conservation and management of water, including the wise allocation and use of water".[82] Accordingly, it sets out the licensing and priority regime which enables the allocation of water, its diversion, and its use throughout the province.

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[77] EPEA, s. 112.

[78] *Remediation Regulation*, A.R. 154/2009, s. 1(l).

[79] *Ibid.*, s. 2.

[80] EPEA, s. 118 and *Remediation Regulation*, A.R. 154/2009, s. 8.

[81] EPEA, s. 119.

[82] *Water Act*, R.S.A. 2000, ch. W-3, s.2 [Water Act].

A licence[83] is required for any **diversion of water** which is defined as "the impoundment, storage, consumption, taking or removal of water for any purpose".[84] Certain diversions of water are exempt from the need for a licence (either pursuant to the Act or to regulations). Particularly relevant to geothermal resources is the licence exemption for diversion of saline groundwater under the *Water (Ministerial) Regulation.* As well, under the *Water Act*, a temporary diversion licence (TDL) may be issued.[85] A TDL authorizes a diversion of water for a period of one year of less (although TDL may be re-issued after its expiration).

In addition to these licensing requirements, an approval is needed to conduct **activities** as defined in the Act.[86] This includes:[87]

- drilling or reclaiming a water well or borehole;
- undertakings that alter, may alter, or may become capable of altering the flow or level of water;
- undertakings that change, may change, or may become capable of changing the location of water or the direction of the flow of water; and
- undertakings that cause, may cause, or may become capable of causing an effect on the aquatic environment

[83] *Ibid.*, Part 4, Division 2 (ss. 46-61).

[84] *Ibid.*, s. 1(1)(m).

[85] *Ibid.*, Part 4, Division 2 (ss. 62-65).

[86] *Ibid.*, Part 4, Division 1 (ss. 36-45).

[87] *Ibid.*, s.1.

Under the *Water (Ministerial) Regulation*,[88] some activities are exempt from the requirement to obtain an approval.

Although there is no express reference to geothermal resources or activities, it is likely that the *Water Act* will apply. Given the definition of activity under the *Water Act* and the lack of exemptions in the *Water (Ministerial) Regulation*, it is likely that geothermal developments will require an approval under the *Water Act*. In addition, depending on the design of the direct heat or power plant, there is a good chance that a water licence will also be required. Given that water is often used as the medium to capture geothermal (it may be water existing in a reservoir or added as in an EGS application), a licence is required for associated diversions of water.

4.3 *Municipal Government Act*

The MGA sets out the powers, duties and functions of municipalities in Alberta. For Calgary and Edmonton, this is augmented by city charters,[89] which among other things, provide expanded bylaw powers. All municipalities in Alberta have authority to make bylaws, and to regulate planning and development within their boundaries. As well, all Alberta municipalities have the direction, control, and management of bodies of water within their boundaries.[90]

A municipality may pass bylaws for municipal purposes including "the safety, health and welfare of people and the protection of people and property".[91] Such "general welfare" bylaw powers have been interpreted to enable bylaws

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[88] *Water (Ministerial) Regulation*, A.R. 205/1998.

[89] *City of Calgary Charter, 2018 Regulation*, A.R. 40/2018 and *City of Edmonton Charter, 2018 Regulation*, A.R. 39/2018.

[90] MGA, s. 60.

[91] I*bid.*, s. 7.

for environmental matters.[92] As charter cities, Calgary and Edmonton also have express authority to make bylaws for the "well-being of the environment".[93] As such, it is possible that a municipality could make bylaws which impact on geothermal development (as a matter of planning, water management or environment).

The planning and development authority of municipalities could also potentially impact geothermal development. In terms of planning, a municipality may (and in some cases must) make a variety of statutory plans. These include intermunicipal development plans, municipal development plans, area structure plans, and area redevelopment plans. A municipality may also make non-statutory plans dealing with matters of planning and development. In terms of development, each municipality passes a Land Use Bylaw which addresses matters such as zoning and development permits.

Depending upon the municipality, there may be requirements to obtain municipal development permits for direct heat projects or power plants.

It should be noted that section 619 of the MGA provides that an approval issued by the Natural Resources Conservation Board, the Alberta Energy Regulator, or the Alberta Utilities Commission prevails over any statutory plan, land use bylaw, subdivision decision or development decision made by a municipality.[94] This means that if a municipality receives a municipal development permit application for a project approved by one of these regulatory bodies, then the

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[92] See, for example, 114957 Canada Ltée (Spray-Tech, Société d'arrosage) v Hudson (City of) [2001] 2 S.C.R. 241.

[93] *City of Calgary Charter, 2018 Regulation*, s. 4 and *City of Edmonton Charter, 2018 Regulation*, s. 4.

[94] Section 619 also applies to decisions made by subdivision authority, development authority, subdivision and development appeal board, the Municipal Government Board or anything other authorization under Part 17 of the MGA.

municipality must grant the permit to the extent that is consistent with that approval. While the regulatory body's approval takes priority over the municipal development permit, it is possible the approval may be conditioned to address municipal concerns. Further, the municipality may be able to place additional requirements on the project (as long as the regulatory approval is not contradicted or frustrated).

5. Laws addressing Geothermal Operations

There is not a comprehensive regime for the regulation of geothermal operations in Alberta. For the purposes of reviewing the scant applicable regulation in Alberta, this section looks separately at shallow geothermal (geo-exchange) and deep geothermal (direct heat and power production) operations.

5.1 Shallow Geothermal (Geo-exchange)

Unlike geothermal direct heat or power production applications, a geo-exchange system does not require special geological conditions.[95] Rather, geo-exchange is based on the constant and stable underground temperatures that result from solar radiation (there is no positive thermal source) which means that geo-exchange can be applied in most locations.[96]

There is some existing regulation around geo-exchange systems. Geo-exchange systems completed above the base of groundwater protection[97] (with the

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[95] See https://www.geoexchange.com.au/technology/faq/.

[96] *Ibid*. See also https://www.cangea.ca/intro.html.

[97] See *Directive* at 1.2(2)(c): **Base of Groundwater Protection** is the depth at which groundwater is estimated to transition from non-saline to saline.

exception of horizontal closed-loop systems) are regulated under the *Water Act*, the *Water Act (Ministerial) Regulation*, and the *Directive for Water Wells and Ground Source Heat Exchange Systems* (the "*Directive*").[98] The *Directive* aligns with the ANSI/CSA C448 Series-2016: Design and Installation Ground Source Heat Pump Systems for Commercial and Residential Buildings standard. As of January 1, 2020, contractors installing vertical closed-loop ground source heat exchange wells above the base of groundwater protection must have an approval to drill.[99] An approval to drill water wells is required for contractors drilling water wells for open-loop systems.[100]

Given the typically small scale and the lack of need to access special geological conditions (i.e. do not require well construction), there is likely existing capacity to regulate these systems via building codes, municipal building requirements, and environmental laws of general application. In the case of dense geo-exchange developments or district heating systems, special consideration should be given to potential environmental impacts in the municipal development permit process. Provincial level guidelines, standards or Codes of Practice may be necessary.

5.2 Deep Geothermal (Direct Heat and Power Plants)

As discussed above, some aspects of the EPEA, the *Water Act* and the MGA may be applicable to deep geothermal operations. In addition, the regulatory requirements overseen by the Alberta Utilities Commission are particularly relevant to geothermal power plants.

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[98] Government of Alberta, Ground Source Heat Exchange Systems in Alberta: Facts at your fingertips (2018).

[99] *Ibid*.

[100] *Ibid*.

Geothermal power is expressly mentioned in:

- *Small Power Research and Development Act*, R.S.A. 2000, c. S-9 which is designed to enable pilot projects to sell electricity to public utilities under long term contracts (the program under this Act is fully allocated). The Act's definition of **eligible power production facility** includes power generators that are single power production facilities that produce electricity from geothermal resources. However, the Act provides no definition of geothermal resources.

- *Micro-Generation Regulation*, Alta. Reg. 27/2008 which is a regulation under the *Electric Utilities Act*, S.A. 2003, c. E-5.1. This regulation enables generation of electricity from renewable or alternative energy sources on a local, small scale basis. Geothermal is included as renewable or alternative energy source. Again, this regulation provides no definition of geothermal resources.

- *Small Scale Generation Regulation*, A.R. 194/2018 which is a regulation under the *Electric Utilities Act*, S.A. 2003, c. E-5.1. This regulation enables generation of electricity from renewable or alternative energy sources on a small scale (but unlike micro-generation, small scale generation is not primarily for the own use of the producer). Geothermal is included as renewable or alternative energy source. Again, this regulation provides no definition of geothermal resources.

In Alberta, there are two categories of electricity generators: micro-generators and distributed-generation (which includes small scale generation). A micro-generator must:[101]

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[101] *Micro-Generation Regulation*, AR 27/2008. Micro-generators must also meet requirements in AUC Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System

- use renewable or alternative energy sources to produce electricity;
- be intended to meet all or some of their own energy needs (not to earn revenue);
- have a generation capacity is the lesser of 5 MW or the rating of the micro-generator's service (i.e. cannot plan to produce more than historically needed);
- supply energy only to a site that is located on property that they own or lease; and
- the micro-generating unit is located on the site described above or adjacent to that site (which they also must own or lease).

Micro-generation larger than 150 kW but under 5 MW is considered to be "large micro-generation". Those under 150 kW are considered to be "small micro-generation". Both small and large micro-generation requires submission of a micro-generation notice to the wires owner (for example, Trans-Alta). [102] The wires owner then reviews the notice for compliance with all requirements and installs the required meter. Large micro-generators need to follow additional electrical codes and technical interconnection requirements as compared to small micro-generators.

If the electrical production does not meet the requirements for micro-generation, then it is considered distributed-generation. In this case, a power plant application must be made pursuant to section 11 of the *Hydro and Electric Energy Act,* along with necessary connection applications under section 18 of

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Designations and Hydro Developments; Rule 012: Noise Control and Rule 024: Rules Respecting Micro-Generation.

[102] AUC, Micro-generation notice submission guideline, Version 2.0 (May 2019).

the Act. Power plant applications are received, considered and approved by the Alberta Utilities Commission in accordance with *Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments.*[103] However, there are three exceptions to the requirement to obtain a power plant approval in accordance with Rule 007.

Firstly, if a power plant is 10 MW or greater and to be used solely for the owner's use, then a power plant approval **may** not be needed (at the discretion of AUC) as long as it is demonstrated that no person is directly and adversely affected, the power plant complies with *Rule 012: Noise Control*, and there are no adverse environmental effects.[104]

Secondly, if a power plant is less than 10 MW and to be used solely for the owner's use, then a power plant approval is not needed as long as it is demonstrated that no person is directly and adversely affected, the power plant complies with *Rule 012: Noise Control*, and there are no adverse environmental effects.[105]

Thirdly, if a power plant is less than 1 MW and the owner is not planning to generate energy solely for his own use, an application is not required if the conditions in section 18.1(2) of the *Hydro and Electric Energy Regulation* are met (i.e. no person is directly and adversely affected, the power plant complies with *Rule 012: Noise Control*, there is no adverse environmental impact, and there is an operating agreement with the wires owner).

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[103] AUC, Rule 007: Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments (2019) which is currently undergoing review with the goal of incorporating changes to the AUC participant involvement process and reorganization for clarity purposes (see Bulletin 2020-30 at https://www.auc.ab.ca/News/2020/Bulletin%202020-30.pdf).

[104] *Ibid*., s. 1.4.3.

[105] *Ibid*.

One specific type of distributed-generation is small scale generation, which is governed by the *Small Scale Generation Regulation*, A.R. 194/2018. Small scale generation is similar to micro-generation in that it uses only renewable or alternative energy sources, including geothermal.[106] However, a key difference is that micro-generation is produced primarily for the use of the producer, whereas small scale generation is produced for commercial purposes (often, but not always, as community generation or community generation within an isolated community). The nameplate capacity of small scale generation cannot exceed the electric distribution system hosting capacity at the interconnection point.[107] The small scale power producer is responsible for all costs of connecting to the grid and operating the generating unit.[108]

6. Considerations for Moving Forward: A Comprehensive Legal Regime

While Alberta has some limited regulatory provisions addressing geo-exchange and geothermal power plants, there is no comprehensive regulatory regime governing the exploration and development of geothermal resources in Alberta. A comprehensive regulatory regime is imperative for the successful development of Alberta's geothermal resources. This regime must:

- define the geothermal resource;
- clarify ownership of and access to the geothermal resource;

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[106] *Small Scale Generation Regulation*, A.R. 194/2018, s. 1(l).

[107] *Ibid.*, s. 1(g).

[108] *Ibid.*, s. 5.

- provide a licensing regime for explorative and development activities; and

- address environmental regulatory matters such as environmental assessment, and abandonment, reclamation and remediation requirements.

As well, there must be provisions addressing connection into the existing electrical system, and the appropriate level of royalties payable (if any). Issues specific to the interface between the geothermal industry and the oil and gas industry (such as liabilities associated with reworking an abandoned oil or gas well) must also be addressed. Detailed discussion of these missing pieces in Alberta's regulatory landscape is found in *Module 2: The Missing Pieces in Alberta's Regulatory Landscape and a Path Forward for Geothermal Energy Development*. However, a very brief overview of these missing pieces is provided below.

6.1 Definition of Geothermal Resource

The definition of geothermal resource is a key issue with potential legal implications for ownership, tenure, and licensing. In some jurisdictions, geothermal energy is considered an attribute of water (thereby triggering application of the relevant water law). In other jurisdictions, geothermal energy has been treated in the same way as oil and gas resources (modification of an existing oil and gas regime to accommodate geothermal). Geothermal resources could also be defined in a *sui generis* manner meaning it is not water and not a mineral but rather a unique resource.

While a clear legal definition of geothermal resources is essential to an effective regulatory regime, it can be difficult to formulate such a definition. Geothermal heat can exist in alternative forms: steam/vapour dominated systems,

hydrothermal/hot water systems, or hot dry rock formations.[109] An overly rigid definition may exclude otherwise viable geothermal resources from being considered geothermal resources.[110] On the other hand, a definition that is not prescriptive enough may create uncertainty over how geothermal resources may be treated. [111]

6.2 Ownership of Geothermal

Clear title to geothermal resources is critical for effective development of the resource.[112] Without clarity around ownership and control of the resource, there is more risk and uncertainty surrounding use of geothermal resources. Alberta has no explicit legislative statement regarding ownership of geothermal resources (or heat). Without a clear legislative statement, recourse to the courts may be required to resolve ownership and control issues. Once ownership of geothermal resources is established, the matters of access and tenure (in the case of Crown ownership) can be addressed. Any grants of tenure by the Crown for geothermal resources should undergo environmental screening for impacts on species at risk, water resources, habitat and so forth.

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[109] Paul McDevitt and Del Wells, "Energy Market Impacts of the Legal Definition of Geothermal Energy in the Western United States", (1982) 22 Nat. Resources J. 391.

[110] Nick Martin, *Hot Commodity: Geothermal Electricity in Alberta* (Calgary: 2018, Canada West Foundation).

[111] *Ibid*.

[112] P. Dumas, M. Serdjuk, R. Kutschick, S. Fraser, S. Reith, and T. Koelbel, Report on Geothermal Regulations: Report presenting proposals for improving the regulatory framework for geothermal electricity (September 2013) GEOELEC, European Union. See also Bart van Campen, Comparison of Geothermal Regulation between Chile, Philippines and New Zealand (April 2015) Proceedings World Geothermal Congress (Melbourne, Australia, 19-25 April 2015) available at www.researchgate.net/publication/280621073.

6.3 Licensing Regime

It is recommended that the appropriate regime for licensing geothermal development vary with the type of development: shallow geothermal (geo-exchange) versus deep geothermal (direct heat and power plants).

6.3.1 Shallow Geothermal (Geo-exchange)

As previously described, there is already some existing regulation around geo-exchange systems that are completed above the base of groundwater protection (with the exception of horizontal closed-loop systems).[113] Given the typically small scale and the lack of need to access special geological conditions (i.e. do not require deep well construction), there is likely existing capacity to regulate these systems via building codes, municipal land use and development requirements, and environmental laws of general application. An extensive licensing regime addressing exploration, development, and operations is not necessary (and would likely be an impediment to adoption).

However, if there is wider adoption of shallow geothermal applications, there may be a need to revisit the authorization process due to potential subsurface and surface impacts.[114] As well, additional guidelines and directives for design and installation might be appropriate.

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[113] See *Directive* at 1.2(2)(c): **Base of Groundwater Protection** is the depth at which groundwater is estimated to transition from non-saline to saline.

[114] See Stefanie Hähnlein, Peter Bayer, Grant Ferguson and Philipp Blum, "Sustainability and policy of the thermal use of shallow geothermal energy" (2013) *Energy Policy* 59:915-925.

6.3.2 Deep Geothermal (Direct Heat and Power Plants)

The licencing system and associated decision-making should address all stages of geothermal development: exploration, development, operations, decommissioning, and reclamation-remediation. Along with establishing a predictable licensing process, the licensing system should address environmental matters (such as security and environmental assessments). The licensing regime should enable the conditioning of licences, along with providing sufficient enforcement powers.

6.4 Environmental Concerns

Although geothermal activities have a smaller environmental footprint than fossil-fuel based activities, this does not mean exploration an d development of geothermal resources is without environmental impacts. Environmental considerations include impacts of fluid chemicals, reservoir subsidence, noise and visual impacts, surface impacts, and habitat disturbance. The licensing regime should address matters such as security, environmental assessments, pre-construction surface and sub-surface surveys, and reclamation-remediation requirements.

6.5 The Geothermal - Oil and Gas Interface

There must be consideration of the interaction and potential conflicts between the oil and gas industry, the geothermal industry, and other subsurface interests. As well, given the potential for co-production and reworking of existing oil and gas wells into geothermal wells, there are significant issues of liability to be addressed.

7: Considerations for Moving Forward: Policy Support

Another imperative for successful development of Alberta's geothermal resources is a policy regime designed to encourage a nascent industry. Geothermal energy developments have very significant up-front drilling costs and may ultimately result in low-producing or dry wells. This risk may be off-set to some extent by existing oil and gas data.[173] Further, given similarities to oil and gas development, the experience managing risk for these developments may be applicable to managing risk of geothermal energy development. [174] However, policy tools designed to off-set or alleviate the inherent financial risk are likely required to encourage geothermal energy development.[175]