Cassels

The Landscape of Geothermal Energy as a Renewable Energy Source

Christopher W. McLelland, Viviana Berkman, Neil Burnside

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The boom in wind and solar energy is here to stay. Scotland is closing in on 100% renewable power, mostly from wind, which would have been unimaginable even ten years ago.[1] Solar is now the cheapest electrical generation in history.[2] But wind and solar are variable – sometimes the sun isn't shining or the wind isn't blowing, and there are fewer hours of sunlight but more windy days in the winter. Energy storage is part of the solution, but so are constant, predictable and reliable power sources.

Enter geothermal energy. Geothermal technologies harness natural heat beneath the earth's crust to produce fluids with temperatures of at least 120 °C. [3] These fluids are then used to generate electricity or utility-scale heat. Geothermal complements wind and solar by providing reliable green energy generation, with new plants often exceeding 90% uptime.[4] The power output of a geothermal operation can be adjusted on demand, competing directly with other so-called "dispatchable" generation such as hydro, nuclear, or natural gas with carbon sequestration. Geothermal also produces more power in the winter months,[5] helping offset the effect of reduced solar generation and the winter peaks of electrical demand seen in most provinces.[6]

Investors are taking notice: start-ups such as Calgary-based Eavor are attracting investment from giants such as BP and Chevron.[7] Global geothermal investment increased 594% to $676 million in the first half of 2020.[8] But, unlike world leaders in geothermal energy such as New Zealand, Turkey, and Iceland, Canada's regulatory landscape is underdeveloped and uncertain. In order to attract international and national capital, it is imperative that Canada's provinces and territories provide clear and consistent regulations and policy for the generation of geothermal energy.

Geothermal Technologies

Geothermal energy can be produced independently or alongside oil and gas production. The three most common geothermal technologies are conventional hydrothermal, open loop enhanced geothermal systems (EGS), and closed loop advanced geothermal systems (AGS).

Conventional Hydrothermal

Conventional hydrothermal is used in areas where extremely hot water or steam has been pushed close to

the surface. These systems are commonly seen in volcanically active countries such as Iceland or New Zealand. A well is drilled into natural pockets that reach temperatures as high as 370 °C and the steam or heat is harvested, often by extracting the water and flashing it to steam. In Canada, these resources are only found in British Columbia and the Yukon.[9]

EGS Systems

Conventional hydrothermal resources are rare convergences of high heat, porous rock, and subsurface water – all at relatively shallow depths. EGS projects remove porosity and water from the equation, dramatically increasing the number of viable sites. In EGS projects, high pressure fluid is injected into hot rock through an injection well, fracturing the rock and creating its own reservoir of heated fluid. A production well harvests the fluid back to the surface, uses it to produce heat or power, and returns cooled fluid back to the injection well to be re-injected. The system is referred to as “open loop” because the fluid is flowing freely through the rock formation.

Although EGS’s so-called “fracking” is based on oil and gas technology, the geothermal industry is keen to distance itself from it. EGS uses a benign fluid, usually water, which removes any concerns about contaminating the water table. The system also operates at far less pressure and at a smaller scale than oil and gas fracking.[10]

AGS Systems

AGS takes this one step further by removing the need to withdraw or inject fluids at all. It operates somewhat like an underground radiator – a closed loop containing a coolant picks up heat underground and transfers it to the surface, where it is harvested as heat or power.[11] AGS can use a single well, which is more common as a retrofit of an existing oil and gas well, or multiple wells. In either case, the fluids in the rock formation remain undisturbed.

AGS can be deployed nearly anywhere, so long as the coolant loop can be drilled deep enough to reach suitable underground temperatures. This greatly reduces the exploration risk associated with geothermal energy and allows for far more flexibility in project sites. Proponents of the system hope that this flexibility will allow for more scalable systems.[12]

Canadian Start-ups

Canadian start-ups are leveraging their oil and gas drilling expertise to attract international attention in the geothermal sphere. These projects demonstrate the potential for development of geothermal energy and the existing talent for Canada to become an industry leader.

In 2020, Saskatoon-based DEEP Earth Energy Production Corp. drilled a breakthrough EGS project: a 3.5 km deep 90-degree horizontal well. It was the deepest horizontal well ever drilled in Saskatchewan and the world's first 90-degree well for geothermal power.[13] It is the first EGS project in Canada to produce electricity and will produce 3 MW, or enough to power 3,000 homes. The well is part of a larger 20 MW geothermal project, which is expected to begin construction in 2023.

Calgary-based Eavor Technologies Inc. has developed and patented an AGS system called the Eavor-Loop™. In early 2020 it celebrated a successful proof of concept in Rocky Mountain House, Alberta. Its investors include BP Ventures, Chevron Technology Ventures, Temasek, BDC Capital, Eversource, Vickers Venture Partners, and Precision Drilling.[14]

FutEra Power Corp., a subsidiary of publicly traded Alberta-based Razor Energy Corp., is co-producing 30% geothermal and 70% natural gas power in Swan Hills, Alberta. The innovative project uses well retrofits and re-injection of produced water from natural gas production to maximize the re-use of existing assets, requiring no new surface footprint. It will produce 3 MW to 5 MW of geothermal power.[15]

Legislation and Regulatory Framework

The legislative and regulatory frameworks in the Western Canadian provinces vary considerably in terms of their stage of development. The following is a brief overview of the different regulatory regimes.

British Columbia

The *Geothermal Resources Act* (British Columbia) (BC GRA) governs development and production of geothermal resources in British Columbia.[16] British Columbia defines geothermal resources as heat, steam, or water heated by the earth to 80 ?C or more.[17] Section 2 of the BC GRA reserves the right, title, and interest in these resources for the government.[18]

Geothermal licensing is regulated by the Ministry of Energy, Mines and Low Carbon Innovation (BC MELCI). Proponents first apply to purchase a geothermal tenure through a competitive bidding process overseen by BC MELCI.[19] Tenure then proceeds through two phases. In the permit phase, proponents purchase the exclusive right to drill exploratory wells in a specific area. After a well is drilled, the proponent can submit a development plan and secure a 20-year renewable lease for the resource.

BC MELCI has delegated the regulation of wells to the British Columbia Oil and Gas Commission (OGC).[20] The OGC issued its first regulations specific to geothermal wells in 2017, with updates in 2019 and 2020.[21] Permits are required to drill, access land, harvest trees, and construct or operate geothermal facilities and pipelines. All of these activities must meet the OGC's standards for health and safety, personnel certification, environmental protection, notifications to the public and regulator, ongoing monitoring, and

record keeping. Projects in excess of 50 MW also require an environmental assessment by both the provincial and federal governments.[22]

Alberta

In October 2020, the Government of Alberta introduced Bill 36, the Geothermal Resource Development Act (AB GRDA), which has received royal assent and will come into force on proclamation.[23] Alberta defines a geothermal resource as the natural heat from the earth below the lowest point of non-saline groundwater.[24]

Alberta intends to incorporate geothermal resources into its existing legislation and regulatory regime for hydrocarbons.[25] Unlike British Columbia, where the rights to geothermal resources are vested in the Crown, interests in geothermal resources are vested in the mineral title holder(s). This means that a mineral rights holder for oil, gas, and coal could object to and prevent a geothermal project from proceeding. Moreover, in a split title scenario, the proponent will need to negotiate with all of the freehold mineral rights owners. As a result, proponents may face more project risk in Alberta then British Columbia.

Once the AB GRDA is proclaimed, the Alberta Energy Regulator (AER) will have the authority to regulate the development of Alberta's geothermal resources from initiation through to closure. The AER has issued a draft directive (the Draft GRD Directive) that incorporates applicable oil and gas regulatory instruments while outlining processes and requirements that are unique to geothermal energy.[26] The AER is currently seeking feedback on the Draft GRD Directive.[27]

One anticipated difference from oil and gas production is that the *Surface Rights Act* will not apply to geothermal resource development.[28] In other words, a proponent cannot use the surface access granted for an *Oil and Gas Conservation Act* (OGCA)[29] regulated well for a geothermal well. Instead, applicants must re-obtain written consent from the owner of the land for surface access and submit it as part of the geothermal resource development application. This presents an additional regulatory hurdle for well retrofits.

The AB GRDA adopts many of the same licensing concepts as the current AER Directive governing oil and gas licenses and approvals.[30] Licenses are required to drill and operate a geothermal well, and the work must adhere to all specified drilling procedures.[31] All geothermal development applications will be publicly viewable on the AER website for at least 30 days. These applications must disclose any areas of potential concern, such as requested or approved variances, a lack of surface access, or any objections.

Saskatchewan

Saskatchewan has more geothermal wells in production than Alberta. Despite this, it currently lacks the regulatory framework that Alberta is implementing. It appears that the province intends to continue relying on its oil and gas legislation to guide geothermal development.

Saskatchewan does not define geothermal resources, and consequently does not have a licensing regime specific to geothermal resources. However, because brine contains minerals such as lithium, proponents must acquire those mineral rights prior to drilling.[32] The use of water, including groundwater, is also subject to a water licensing regime.[33]

The activities required to exploit a geothermal resource are subject to the *Oil and Gas Conservation Act*.[34] This includes drilling, extracting or injecting fluids from a subsurface formation, surface leases, public notice requirements, and lease of space (the areas underground formerly occupied by a Crown mineral). The Minister has broad powers to issue orders regarding rate of extraction, storage, transportation, treatment, processing, and disposal.[35] Notably, however, the regime does not regulate the operation of the geothermal facility above ground.[36] Overall, proponents currently face fewer geothermal-specific regulations in Saskatchewan than other provinces.

Regulatory Challenges for Geothermal Production

The developing regulatory regimes in the western provinces poses two particular areas of uncertainty for geothermal production. First, it remains a matter of contention whether the Crown should levy a royalty on geothermal production. Second, it is unclear how Aboriginal rights and other indigenous interests will be considered.

In cases where the Crown is a mineral rights owner, the Crown would be entitled to impose a royalty as part of licensing. This can occur in any province. However, geothermal production reduces carbon emissions and does not normally become depleted over time. This diminishes the moral argument for royalties, which are typically imposed so that future generations can benefit from the depletion of a non-renewable resource.

There is currently no royalty framework for geothermal resources in Alberta or Saskatchewan. In British Columbia, lessees who produce geothermal resources for purposes other than testing must pay a prescribed royalty or an amount agreed to be paid in lieu thereof.[37] However, no such royalty has been imposed to date.

In 2018, the Government of British Columbia sought comments on a proposed royalty regime. The Canadian Geothermal Energy Association (CanGEA) supported a royalty on all geothermal energy sold in the province provided there was no duplication in charging when both heat and electricity are produced. CanGEA agreed with the government's proposed 10-year royalty holiday to new geothermal projects but suggested the royalty be 1% (instead of 3%) to align with the royalty rate charged on wind energy.[38]

Arguably there should be no royalty attached to geothermal production to incentivize companies to enter this market space. Or, if a province does implement a royalty regime, there should be a royalty holiday at least until all of a project's capital costs are paid out, and perhaps for a fixed time period beyond payout to

incentivize the development of geothermal resources.

With regards to Aboriginal rights, regulators will need to consider how they can best fulfill the Crown's fiduciary duty to indigenous groups and the duty to consult and accommodate. This will likely differ between jurisdictions: for instance, Alberta created the Aboriginal Consultation Office to manage the consultation process and granted it concurrent decision-making authority,[39] while British Columbia prefers an approach where proponents develop a project specific consultation program which is reviewed by all appropriate decision makers.[40] Consultation procedures may also need to account for different considerations in a regime where geothermal resources vest in the Crown, such as British Columbia, compared to a regime where resources can be privately owned, such as Alberta.

The Need for Regulatory Certainty

Proponents, investors, and lenders require more certainty for the geothermal sector to flourish. The uncertainty caused by the lag between technology development and evolving regulatory frameworks increases the cost of capital and delays final investment decisions. Governments have the opportunity to address these uncertainties by providing clear guidance on the gaps they see in the legislation and their proposed solutions. For instance, is the lack of a royalty in Alberta and Saskatchewan a momentary gap, or a deliberate policy? Will Saskatchewan legislate a licensing regime for geothermal resources? Policymakers can reduce these uncertainties by providing more guidance on their policy choices, thereby making Canada more attractive for investment in the geothermal industry.

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[1] "Renewables met 97% of Scotland's electricity demand in 2020" (25 March 2021) *BBC News*, online: <bbc.com/news/uk-scotland-56530424>.
[2] Simon Evans, "Solar is now 'cheapest electricity in history', confirms IEA" (13 October 2020) *CarbonBrief*, online: <carbonbrief.org/solar-is-now-cheapest-electricity-in-history-confirms-iea>.
[3] British Columbia, "Geothermal Energy" (last accessed 28 September 2021), online: <gov.bc.ca/gov/content/industry/electricity-alternative-energy/renewable-energy/geothermal-energy>.
[4] David Roberts, "Geothermal energy is poised for a big breakout" (21 October 2020) *Vox*, online: <vox.com/energy-and-environment/2020/10/21/21515461/renewable-energy-geothermal-egs-ags-supercritical>.
[5] Canadian Geothermal Energy Association, "Submission to the British Columbia Utilities Commission Indigenous Utilities Regulation Inquiry" (15 July 2019), online (pdf): <bcuc.com/Documents/Proceedings/2019/DOC_54584_C7-2-CanGEA-WrittenEvidence.pdf> [CanGEA] at 46.
[6] Hydro Québec, "Using energy more wisely in cold weather" (last accessed 29 September 2021), online: <hydroquebec.com/residential/customer-space/electricity-use/winter-electricity-consumption.html>.
[7] Jack Denton, "This technology could transform renewable energy. BP and Chevron just invested" (20 February 2021) *Marketwatch*, online: <marketwatch.com/story/this-technology-could-transform-renewable-energy-bp-and-chevron-just-invested-11613458808>.
[8] "Colossal Six Months for Offshore Wind Support Renewable Energy Investment in First Half of 2020" (13 July 2020) *BloombergNEF*, online: <about.bnef.com/blog/colossal-six-months-for-offshore-wind-support-renewable-energy-investment-in-first-half-of-2020/>.
[9] CanGEA, *supra* note 5 at 4.
[10] Roberts, *supra* note 4.
[11] *Ibid*.
[12] Volker C. Vahrenkamp, "From oil fields to renewable energy: Scaling geothermal" (5 January 2021) *GreenBiz*, online: <greenbiz.com/article/oil-fields-renewable-energy-scaling-geothermal>.
[13] Geoffrey Morgan, "Saskatchewan driller hits 'gusher' with ground-breaking geothermal well that offers hope for oil workers" (27 November 2020) *Financial Post*, online: <financialpost.com/commodities/energy/saskatchewan-driller-hits-gusher-with-ground-breaking-geothermal-well-that-offers-hope-for-oil-workers>.

[14] Eavor, “The World’s first truly scalable form of Clean Baseload Power demonstrated by Eavor Technologies Inc.” (5 February 2020) press release, online: <eavor.com/press/the-worlds-first-truly-scalable-form-of-green-baseload-power-demonstrated-by-eavor-technologies-inc/>.
[15] FutEra Power Corp., “Construction to commence on the first co-produced geothermal power project in Alberta, and Canada” (4 May 2021) press release, online (pdf): <static1.squarespace.com/static/5ba9071b9d41490a35a48592/t/60915c32ff106f403b18e003/1620139059403/Razor+Press+Release+May+4+2021.pdf>
[16] RSBC 1996, c 171 [BC GRA]
[17] *Ibid*, s 1(1).
[18] *Ibid*, s 2.
[19] British Columbia, “Geothermal Exploration & Sales” (last accessed 28 September 2021), online: <gov.bc.ca/gov/content/industry/electricity-alternative-energy/renewable-energy/geothermal-energy/exploration-and-sales>. See also the *Geothermal Resources General Regulation*, BC Reg 11/2021.
[20] BC GRA, *supra* note 16, s 12.
[21] *Geothermal Operations Regulation*, BC Reg 214/2020.
[22] Clean Energy BC, “What is Geothermal Power?” (last accessed 28 September 2021), online: <cleanenergybc.org/sector/geothermal/>.
[23] SA 2020, c G-5.5 [AB GRDA].
[24] The Act uses the term Base of Groundwater Protection, which is defined in Alberta Environment and Parks, “Water Wells and Ground Source Heat Exchange Systems Directive” (11 December 2018), online (pdf): <open.alberta.ca/dataset/5bc817ba-3d6d-45cd-a403-2e727abe665e/resource/508b38c0-0ca7-4fbe-8a90-cfeb5139e122/download/directivewaterwellsgroundsourceheatexchange-dec11-2018.pdf>.
[25] The AB GRDA makes consequential amendments to the *Environmental Protection and Enhancement Act*, RSA 2000 c E-12; the *Mines and Minerals Act*, RSA 2000 c M-17; the *Oil and Gas Conservation Act*, RSA 2000 c O-6; the *Pipeline Act*, RSA 2000 c P-15; and the *Responsible Energy Development Act*, SA 2012 c R-17.3.
[26] Alberta Energy Regulator, “DRAFT Directive [XXX]: Requirements for Geothermal Resource Development” (July 2021), online (pdf): <static.aer.ca/prd/documents/directives/DirectiveXXX_GeothermalEnergy.pdf> [Draft GRD Directive].
[27] Alberta Energy Regulator, “Invitation for Feedback on Proposed New Requirements for Geothermal Resource Development” *Bulletin 2021-31* (4 August 2021), online: <aer.ca/regulating-development/rules-and-directives/bulletins/bulletin-2021-31>.
[28] RSA 2000, c S-24.
[29] RSA 2000, c O-6.
[30] Alberta Energy Regulator, “Directive 067: Eligibility Requirements for Acquiring and Holding Energy Licenses and Approvals” (April 2021), online (pdf): <static.aer.ca/prd/documents/directives/Directive067.pdf>.
[31] Alberta Energy Regulator, “Directive 036: Drilling Blowout Prevention Requirements and Procedures” (March 2019), online (pdf): <static.aer.ca/prd/documents/directives/Directive036.pdf>.
[32] DEEPCorp, “DEEP Successfully Secures Mineral Rights for Brines & Is Commencing with Spring/Summer Testing and Drilling Program” *News Release* (8 May 2019), online: <deepcorp.ca/deep-successfully-secures-mineral-rights-for-brines-is-commencing-with-spring-summer-testing-and-drilling-program/>.
[33] *The Water Security Agency Act*, SS 2005, c W-8.1, s38.
[34] RSS 1978, c O-2. The “geothermal industry” is included in paragraph 2(1)(j.1) by virtue of the *Oil and Gas Conservation Regulations, 2021*, RRS c O-2 Reg 6.
[35] *Oil and Gas Conservation Act*, *ibid*, s 17.
[36] See Saskatchewan, “Storage Project Application” (last accessed 28 September 2021), online: <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> (“[t]he geothermal project application is only applied to the subsurface activities”).
[37] BC GRA, *supra* note 16, s 17.
[38] CanGEA, *supra* note 5 at 20.
[39] Alberta, “Joint Operating Procedures for First Nations Consultation on Energy Resource Activities” (31 October 2018), online (pdf): https://static.aer.ca/prd/documents/actregs/JointOperatingProcedures.pdf at 1-2.
[40] British Columbia, “Clean Energy Production in B.C.” (April 2016), online (pdf): <gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/natural-resource-major-projects/major-projects-office/guidebooks/clean-energy-projects/clean_energy_guidebook.pdf> at 92-94.

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