HOT COMMODITY

GEOTHERMAL ELECTRICITY
in Alberta

GETTING TO 'GO' | *Removing regulatory barriers to energy innovation* | Case Study

CANADAWEST FOUNDATION | NATURAL RESOURCES CENTRE

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Executive SUMMARY

Innovative technologies promise to provide goods and services better, cheaper and in ways never envisioned before. But often these technologies are ahead of the regulatory curve and stumble because the regulatory environment is designed in ways that exclude them.

One example is geothermal energy for distributed electricity production. Geothermal energy – broadly described as the natural heat of the Earth – is renewable, controllable and clean. Distributed generation – small-scale electricity production at or near where the electricity will be consumed – is reshaping how the world thinks about electricity grids. Both are relative novelties in Alberta.

With an increasing need for low-emission, reliable electricity in Alberta, geothermal energy provides a big opportunity. With its existing oil and gas industry and significant accompanying technical expertise relevant to geothermal drilling, the province is particularly well-positioned to take advantage and develop a geothermal industry.

However, Alberta's regulatory environment is not yet adapted for both geothermal development and distributed electricity production. Without an appropriate regulatory framework, Alberta will continue to lag behind other jurisdictions in benefiting from geothermal and distributed energy resources.

This paper uses a novel geothermal electricity technology – Eavor-Loop – as a test case to understand how innovative technologies can be treated by Alberta's regulatory environment. The findings, however, are not unique to this specific technology. They apply to any technologies seeking to use geothermal energy or to produce small-scale distributed electricity in Alberta.

Alberta's laws do not yet regulate geothermal development – imposing significant uncertainty for would-be geothermal developers. A legal definition of geothermal resources does not exist, and it is not clear who owns them or how the rights to their development can be obtained. It is also unclear how the physical activities associated with geothermal development will be regulated. Ambiguity on these issues is holding back Alberta from developing another source of clean energy.

To harness Alberta's geothermal resources, the province must develop a legal framework that enables responsible development, provides investment clarity and that is technology agnostic, i.e., does not get in the way of the wide array and ever-changing suite of emerging geothermal technologies.

Distributed generation, which includes small-scale geothermal electricity generators, can serve isolated electric loads such as remote communities or industrial sites. When it connects to the wider grid, it generally interconnects at the lower voltage distribution level. Distributed generation differs from traditional generation sources, which tend to be large centralized power plants that are far away from electricity demand centres and must transmit their electricity over high-voltage transmission lines.

For distributed electricity production, Alberta's laws and regulations reduce costly regulatory burdens for distributed generation only in limited circumstances. This holds back many forms of potentially beneficial distributed generation. At the same time, regulated electricity markets exclude or limit options for payment for the benefits distributed generation can provide to the grid. Finally, there is little incentive for electricity distribution utilities to proactively work with developers to connect with the grid; there are no provincewide standards for distributed generators to work with regulated electricity distribution utilities.

GEOTHERMAL DEVELOPMENT

WE RECOMMEND THE GOVERNMENT OF ALBERTA TAKE THE FOLLOWING ACTIONS:

- → Create a clear, technology agnostic definition for geothermal resources
- → Explicitly address ownership of geothermal resources by vesting ownership interest with the province
- → Develop a simple, streamlined, tenure system to dispense rights to develop geothermal resources that enables first movers
- → Use existing expertise within the Alberta Energy Regulator to regulate the physical activities of geothermal development
- → Adapt existing regulation to recognize the unique characteristics of geothermal development

DISTRIBUTED GENERATION

WE RECOMMEND THE GOVERNMENT OF ALBERTA TAKE THE FOLLOWING ACTIONS:

- → Expand regulatory exemptions for small-scale distributed generation to include generators not physically located at the site of consumption
- → Compensate distributed generators for the value they create
- → Investigate realigning utility incentives to favour the deployment of distributed generation, establish standardized interconnection procedures across distribution utilities, and improve data sharing between utilities and developers to improve site selection

Innovation and regulations

GETTING TO 'GO'

Conventional wisdom says we need to spur more innovation to drive economic, environmental and social progress. In many cases, the innovation is already happening. However, the adoption of new technological innovation at a commercial scale is another story – it takes complete solutions that include financial resources, willing customers and, in regulated sectors, regulators that are on board and ready for new solutions. Regulatory challenges can be mitigated by flexible regulatory regimes that accommodate new innovation, and by moving quickly when foreseeable innovation is not compatible with existing regulatory structures.

Canada has not linked innovation policy and regulatory policy.[1] We are experts at assessing negative impacts of development, but we do not adequately assess the impact of failing to innovate. Legislators and regulators are challenged every day by new technologies that do not fit existing regulatory regimes – think deep geothermal energy, drones, autonomous vehicles, cybersecurity and many more innovations that do not hit the front pages. These new products, processes, practices and procedures allow industry to be cleaner, cheaper, safer and better. They challenge the current rules that favour incumbent technologies and business models. But by its nature, the safety and effectiveness of new technology may be unproven. This is a critical gap. Legislators and regulators need to find better ways to encourage and enable innovation while ensuring other public interest goals are met.

The Canada West Foundation is undertaking a series of research and convening activities, *Getting to 'Go': Removing regulatory barriers to energy innovation*, to address key questions in the context of energy innovation:

- What are the basic goals of regulation? Going back to first principles, we need to revamp our understanding of our regulations and their purpose. We regulate products and services in the public interest, but to what end? Health? Safety? Security? The efficient functioning of markets?
- How do we ensure responsible outcomes without stifling the adoption of innovations necessary to achieve our environmental, economic and social goals? What are the barriers and opportunities in our regulatory process and culture for the adoption of innovations? Can we square both a prevention and promotion mindset?
- Who does it best elsewhere, and how? What is being done in other jurisdictions and even other sectors that can be applied to reduce the regulatory barriers to energy innovation adoption? For example, how do regulators engage with technology developers early in the development process to provide guidance and staged approvals, without compromising final approval? Are there different approaches for different types of innovations?

The goal of this series is to make recommendations for a regulatory environment that:

- accomplishes its key public interest goals;
- does so cost effectively and in a timely fashion;
- is nimble, adaptable, technology agnostic; and
- has the culture and resources to support the adoption of innovations.

[1] Future work by the Canada West Foundation will highlight examples of other jurisdictions and sectors, where regulatory policy is explicitly considered within the national innovation strategy. The Netherlands is a good example of a country where regulation was explicitly recognized as a barrier to innovation to be addressed as reported in a publication conducted by a consortium of European universities, sponsored by the EU. Industrial Innovation in Transition, *Overview of eleven member states innovation policies*, January 2017. (https://www.iit-project.eu/deliverables/)

With an increasing need for low-emission, reliable electricity, geothermal energy provides a big opportunity. With the right technology, investment and regulatory climate, these resources can be developed in Canada.

INTRODUCTION

Reducing greenhouse gas emissions and maintaining economic prosperity will require reliable, affordable and increasingly cleaner electricity coupled with responsible economic development. Innovative new technologies and business models will be a key component to achieve these goals both in Alberta and around the world – if government unlocks the door. The regulatory environment can inhibit innovation by excluding or inappropriately treating new technologies and business models. This paper examines the regulatory challenges to innovative renewable and small-scale electricity innovations in Alberta using a novel geothermal electricity technology called Eavor-Loop as a test case.

As a geothermal electricity technology, Eavor-Loop intersects two complex regulatory domains – resource development and electricity generation. In Alberta, both of these domains present challenges to innovative technologies using geothermal energy or producing electricity on small and distributed scales. As a subsurface natural resource, geothermal energy lacks a regulatory framework to manage its development that other subsurface resources such as oil and gas, minerals and groundwater have in Alberta. Small-scale electricity generation deployed in a distributed fashion must also navigate a regulatory regime created to enable large-scale centralized power generation and that has only just begun to adapt to small-scale generation.

Geothermal energy is like other subsurface natural resources such as oil and gas, minerals, and groundwater, which typically have regulatory regimes that delineate property rights, tenure and resource conservation considerations. On the other hand, it cannot be reasonably depleted if properly managed. This makes it similar to other renewable resources such as wind and solar.[2]

Electricity generation is also a highly regulated process. Generators must secure approval from the provincial electricity regulator, and most must compete to serve electricity demand in an organized wholesale power market. This regulatory regime was developed at a time when it was necessary to enable reliable, large-scale centralized power generation. But with the advent of economically viable small-scale and distributed electricity generation, things have changed. Regulators are now grappling with how to enable these technologies where they make sense – both to achieve the benefits of renewable energy production and maintain the benefits of utility scale generation and transmission. In addition, resource development and electricity generation regulatory regimes incorporate environmental, economic, social and cultural impact assessment; safety standards; and compliance.

[2] On short time scales, geothermal energy can be extracted faster than the Earth can replenish it in localized areas depending on the characteristics of the geologic formation and rate of energy extraction.

Eavor-Loop

as a test case

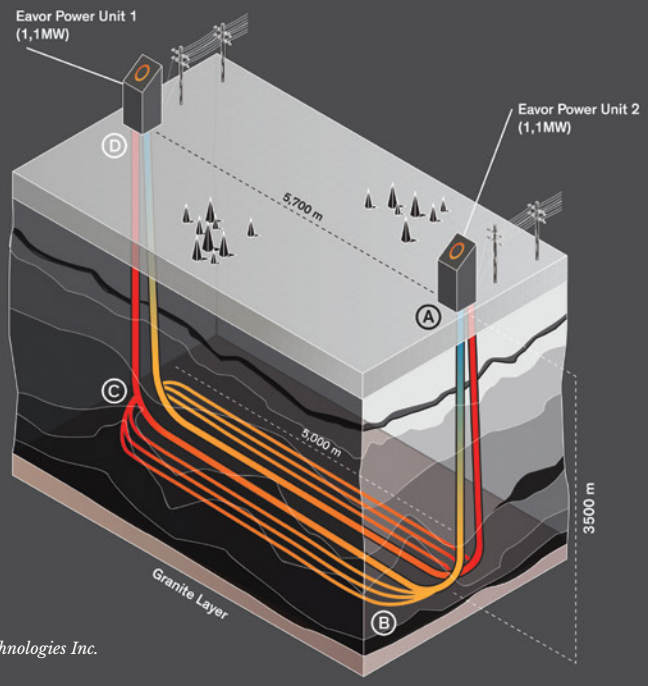

Diagram courtesy of Eavor Technologies Inc.

Eavor-Loop is a novel way to harness geothermal energy for small-scale distributed electricity production. The technology works by connecting two vertical wells with horizontal wells drilled to heat depth. The connected wells are encased, and a working fluid is circulated through them to extract the natural geothermal heat. The heat brought to the surface is converted to electricity by a specialized generator that requires lower temperatures than conventional generators. The working fluid is continuously circulated through the closed-loop system. A typical commercial scale site will produce between one to two megawatts for on-site power use or to be fed into the distribution or transmission electricity grid.

The technology provides a test case for Alberta's regulatory innovation ecosphere because it introduces several things that are novel in Alberta and to some degree, the world. First, it uses a subsurface renewable resource – geothermal energy – for electricity generation, which has not been done in Alberta (or Canada) to date. Second, it uses geothermal energy to produce electricity using a closed-loop system that avoids interacting with subsurface water resources, which differs from geothermal electricity generation seen elsewhere in the world. Third, it can be developed at brownfield sites such as abandoned oil well sites, which reduces new surface disruption and can aid ongoing monitoring of abandoned wells. Fourth, it uses lower well temperatures to produce electricity than has been required in the past. Finally, it produces small-scale distributed electricity, which is becoming more common (e.g., solar) but is still relatively new to an electricity regulatory regime designed for large-scale centralized power plants.

The technology also provides an appealing test case because its qualities align with multiple provincial policy goals. As a renewable and non-emitting electricity resource, geothermal aligns with provincial climate change policies to reduce greenhouse gas emissions. Additionally, it can provide valuable benefits to the grid by operating in a distributed fashion providing dispatchable power unlike other renewable resources such as wind and solar. Finally, as a technology that uses existing oil and gas technology, know-how and infrastructure, it represents a way to leverage Alberta's comparative advantages, especially in precision drilling, and potentially develop an exportable business to the rest of the world.

Information from *https://eavor.co/technology/*

With improving technologies, geothermal resources are becoming increasingly viable for power generation.

This report explores the regulatory domains of both resource development and electricity generation for their treatment of a new technology such as Eavor-Loop, but the issues identified do not apply to Eavor-Loop alone. Other technologies and business models that use geothermal energy or generate electricity on a small scale and in a distributed fashion will face the same treatment. Alberta's regulatory environment should enable their development when and where it makes economic sense, and it should avoid prescribing certain technologies or solutions.

FOR GEOTHERMAL & DISTRIBUTED ELECTRICITY INNOVATIONS, ADDRESSING REGULATORY BARRIERS CAN HELP ALBERTA:

- **Reduce greenhouse gas emissions cost effectively**
- **Capitalize on emerging technologies that can be applied around the globe where current technology is viable**
- **Move electricity regulation forward to meet the changing nature of distributed generation**
- **Build on existing provincial comparative advantages including subsurface resource development**

GEOTHERMAL ENERGY

Geothermal energy can be broadly described as the natural heat of the Earth. This heat can be extracted from the subsurface and used for different purposes such as space heating for buildings, process heat for industrial applications and electricity generation.[3] Regardless of the end use, the use of geothermal energy requires transferring the heat stored within a subsurface medium (e.g., water reservoir, hot rocks) to the surface via a transporting medium (e.g., water) where the heat can be used directly or transformed into another form of energy. There are a number of different ways to extract geothermal energy as described on page 10.

The use of geothermal energy does not create emissions, and it can provide constant and consistent energy. It has demonstrated this value for decades around the world – primarily in places with favourable geology and geothermal activity at or very close to the surface such as Iceland, New Zealand and California. In Canada, however, geothermal development lags. We produce no geothermal electricity. There are many factors contributing to this. One major cause is that, with few exceptions, most of Canada's higher-temperature geothermal resources are deeper, less accessible and more expensive to develop. Coupled with Canada's natural abundance of other inexpensive electricity resources such as hydroelectricity and coal, there has been little incentive to pursue geothermal development. But with an increasing need for low-emission, reliable electricity, geothermal energy provides a big opportunity. With the right technology, investment and regulatory climate, these resources can be developed in Canada.

Alberta is particularly well-positioned to take advantage of geothermal energy. With its existing oil and gas industry, there is significant technical expertise relevant to geothermal drilling, as well as temperature data from tens of thousands of oil and gas wells.[4,5] The Canadian Geothermal Energy Association (CanGEA) and the Government of Alberta have used this data to map the potential for geothermal heat and electricity from existing oil and gas wells. In their study, they found approximately 500 wells with temperatures greater than 120 C, more than 7,000 wells with temperatures greater than 90 C, and tens of thousands of wells above 60 C. With improving technologies, these geothermal resources are becoming increasingly viable for power generation.

Geothermal energy is a subsurface natural resource comparable to resources such as oil and gas, minerals and groundwater. While geothermal energy shares a similarity with these resources due to its geologic nature, it also differs from these resources in a very important way – it cannot be reasonably depleted by human use. The heat retained within the Earth is massive, and heat is continuously produced through the decay of radioactive elements within the Earth. In most cases, extracted heat is replenished by heat located deeper within the Earth at time scales reasonable for energy production. In some cases, local geologic characteristics may mean geothermal energy is replenished slowly or the medium through which the heat is extracted may not be completely renewable such as an underground water reservoir, but the Earth's ability to provide heat is constant. For this reason, geothermal energy is similar to other renewable natural resources such as solar and wind energy; unlike these resources, the energy is not dependent on the weather or time of day.

[3] This report does not address "geo-exchange" applications which are shallower wells used in conjunction with a heat exchanger to heat or cool individual homes and buildings.

[4] Aletta Leitch, Sara Hastings-Simon, and Brendan Haley. "Heat Seeking: Alberta's Geothermal Industry Potential and Barriers." Pembina Institute, December 2017. http://www.pembina.org/pub/heat-seeking

[5] "Potential of Geothermal Energy from Co-Production in Alberta Using Existing O&G Wells." Canadian Geothermal Energy Association, 2017. https://www.cangea.ca/reportanddashboards.html

Geothermal
energy extraction methods

There are different ways to extract geothermal energy. Broadly, these methods can be classified as follows:

Natural hot water reservoir geothermal systems

These applications access geothermal energy through existing underground reservoirs of hot water either through natural means (e.g., hot water springs) or drilling. This type of geothermal energy access is highly locational dependent as it requires accessible underground reservoirs at usable temperatures. Hot water or steam pumped from the aquifer may then be returned after the heat is extracted. Different technologies can return all or some of the water depending on evaporation.

Enhanced geothermal systems

These applications allow for the extraction of geothermal energy where underground reservoirs do not naturally exist by creating artificial reservoirs using hydraulic fracturing and injecting liquid into the new pathways through hot rocks and then extracting that hot liquid.

Emerging geothermal systems

These applications do not use natural or artificial reservoirs to extract heat from the Earth. Instead, they circulate a working fluid through wells drilled into the subsurface at heat depth. The working fluid collects heat and returns it to the surface. Eavor-Loop falls under this category.

REGULATING THE DEVELOPMENT OF GEOTHERMAL ENERGY

As geothermal energy is a subsurface natural resource, its would-be developers must contend with two primary questions.

1. How and under what conditions can developers acquire legal rights to develop geothermal energy?
2. What requirements are placed on the physical activities associated with extracting geothermal energy?

Alberta has well-established regulatory frameworks that answer these questions for other subsurface natural resources such as oil and gas, metallic minerals and groundwater, but it currently lacks a framework for geothermal energy.[6] Without a regulatory framework, it is unclear who owns title to geothermal resources and what requirements are placed on the physical activities associated with geothermal development.

While it may seem like the lack of a regulatory structure might encourage geothermal development by leaving the industry alone to regulate itself, in fact, the opposite is true. Without a clear, fair and efficient regulatory framework, would-be developers face the uncertainty of an uneven or inconsistent application of existing regulatory structures to geothermal development or of a future framework being implemented that is at odds to their technology or business model. This uncertainty can severely limit emerging technologies by increasing risk and driving away investors – potentially fatal for new innovations trying to get off the ground.

Geothermal projects can presumably move forward on a case-by-case basis (see, for example, recent steps to explore geothermal heating in Hinton, AB), but clarity is required to provide greater certainty for geothermal developers as a necessary first step to enable a healthy geothermal industry in Alberta. The remainder of this section explores how Alberta might construct a geothermal regulatory framework.

[6] Van Hal, Grant. "Legal Obstacles to the Development of Geothermal Energy in Alberta." Canadian Institute of Resources Law, 2013.

The rights to develop geothermal energy

Natural resources are resources found in the natural world that have economic value. As objects of value, natural resources are generally subject to legal regimes governing their development. What is considered a natural resource can change over time as the economic value of things in nature change. As the value of natural resources are recognized, legal regimes governing their use and development become increasingly necessary. For example, underground pore spaces have recently been recognized as a valuable natural resource for their ability to store captured carbon dioxide. This has led to development of constructs to govern their use (e.g., Alberta's 2010 *Carbon Capture and Storage Statutes Amendment Act*).

In Alberta, geothermal energy is starting to demonstrate its value as a resource. Traditional geothermal systems require hot reservoirs (which, in turn, require adequately porous rock to hold the water) at an accessible depth located close enough to where the energy is needed. This has limited its usefulness in Alberta. However, new technology to access and extract geothermal energy makes Alberta's geothermal resources much more economically attractive.[7] The need to define a legal regime for how these resources are developed has become more pressing.

The relevant ministries and regulators in Alberta are preparing to sanction pilot projects for geothermal development, which will be useful for proving the technology and testing potential regulatory approaches. But a robust industry will require greater certainty and security than can be gleaned from a handful of one-off projects. To harness Alberta's geothermal resources, the province must develop a legal framework that enables responsible development but that does not get in the way of the wide array and ever-changing suite of emerging geothermal technologies.

The first step is to define the resource. Then it is essential to determine who owns title to the resource. Once ownership interest is understood, the final step is developing the processes by which the right to develop those resources can be transferred from owner to would-be developers.

Defining the resource

In Alberta, there is no definition of geothermal energy. The term "geothermal" only appears twice in provincial legislation or regulations – once in the *Small Power Research and Development Act*, which permits pilot projects for small-scale electricity production (and has since been closed to applications for any new projects), and once in the *Micro-Generation Regulation*, which delineates rules for certain types of small-scale electricity production.[8] In both instances, "geothermal" is listed as an eligible technology, but is not given a definition or any other consideration unique to geothermal resources. Likewise, the term "geothermal" appears only once in federal legislation (other than taxation legislation), in the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and in four regulations – but is never actually defined.[9]

Other jurisdictions have defined geothermal resources in a variety of ways. Criteria include specific temperature ranges, mediums and depths. For example, British Columbia exempts any water with a temperature below 80 C once it reaches the surface from being considered a geothermal resource.[10] Definitions will also commonly exempt certain substances that may be within the medium used to extract geothermal energy. For example, Nevada's definition of geothermal resources includes "all dissolved or entrained minerals that may be obtained from the medium used to transfer that heat but excluding hydrocarbons and helium." See Appendix A (page 29) for additional jurisdictional examples of geothermal resource definitions.

[7] For example, technology that requires lower temperatures, precision drilling that enables connected wells.

[8] Search made via the Canadian Legal Information Institute database.

[9] The regulations include the *Income Tax Regulations, Mackenzie Valley Federal Areas Waters Regulation, Nunavut Waters Regulation, National Parks of Canada Water and Sewer Regulations*. Search conducted via the Government of Canada Justice Laws website for the term "geothermal" in all federal legislation and regulations. http://laws-lois.justice.gc.ca

[10] *Geothermal Resource Act*, RSBC 1996, c 171, s 1(1).

Without a regulatory framework, it is unclear who owns title to geothermal resources and what requirements are placed on the physical activities associated with geothermal development.

How geothermal energy is defined is important for several reasons.

First, the definition will influence what, if any, existing legal regimes may apply to geothermal energy (e.g., mineral regimes, water regimes). For example, Alberta's *Mines and Minerals Act* broadly defines "minerals" to include a number of naturally occurring minerals such as gold, silver, uranium, natural gas and coal.[11] Defining geothermal energy as a "mineral" would *de facto* place geothermal energy under the authorities set forth in the *Mines and Minerals Act*. Similarly, defining the nature of geothermal energy as a water resource would place geothermal energy under legal regimes governing water use.

Second, an overly rigid definition may exclude otherwise viable geothermal resources from being considered geothermal resources. For example, geothermal resources that are defined by a specific temperature threshold (generally set at a temperature too low for conventional technology) risk becoming outdated if new technology that can use lower temperatures become available. Conversely, a definition that is not prescriptive enough may create uncertainty over how geothermal resources may be treated. For example, defining geothermal resources as water above a certain temperature can allow regulators to exempt these waters from water-use regulations, thereby leaving any water below the temperature threshold to be regulated as a groundwater source. This can be advantageous because it provides clarity on how a geothermal resource contained within a groundwater source will be regulated, yet it may still become outdated as technology progresses.

Who owns the resource

Without a clear definition in Alberta, it is also unclear who holds title to the geothermal energy under the Earth's surface. In the absence of clear legislation or regulation, the presumptive owner of geothermal resources may be the surface owner or the holder of other subsurface rights. However, this presumption could be overturned through new legislation. For example, legislation defining and regulating subsurface pore space explicitly vested ownership of this resource with the province regardless of any individual property claims to land or mines and minerals.[12]

Explicitly addressing geothermal energy ownership through legislation is important because it would provide clarity for obtaining resource development rights and security from future expropriation of geothermal resources. The biggest consideration when addressing this interest will be the degree to which the province ultimately retains title to geothermal energy.

There are a couple of routes the province can take in addressing ownership interest, which will depend on the characterization given to geothermal energy. If geothermal energy is characterized as a unique resource, the province will have the discretion to define the ownership interest of the resource and the process to obtain development

[11] *Mines and Minerals Act*, RSA 2000, c M-17, s 1(1)(p).

[12] Bill 24: Carbon Capture and Storage Statutes Amendment Act, 2010. The Legislative Assembly of Alberta. Third Session, 27th Legislature.

rights. On the other hand, if geothermal energy is characterized within an existing resource regime, the ownership interest and process can flow from this characterization.

Characterizing geothermal energy as a mineral resource would result in Alberta holding the rights to the majority of the province's geothermal resources because Alberta retains ownership of all mineral rights in the province except for those held by the federal Crown (e.g., national parks and First Nations reserves) and a small amount held by "freehold rights" owners (e.g., private owners). In total, the province holds the subsurface rights to 81 per cent of Alberta's 66 million hectares.[13]

Alternatively, characterizing geothermal energy as a water resource (as is the case in New Zealand and Japan) would result in Alberta holding the rights to all the province's geothermal resources. The *Alberta Water Act* states "the property in and the right to the diversion and use of all water in the Province is vested in Her Majesty in right of Alberta except as provided for in the regulations."[14]

Other jurisdictions have taken a variety of approaches to geothermal resource ownership. In some jurisdictions, the presumptive owner of geothermal resources is the surface property owner unless they have been severed from the surface property rights and reserved by another entity (see: Nevada). In other jurisdictions, geothermal resources are explicitly vested with the state or province (see: British Columbia).

As seen with the regulation of subsurface pore space, as well as the treatment of other subsurface resources such as minerals and groundwater, the practice in Alberta is to vest subsurface resource ownership with the province whenever possible. This would entail defining an ownership interest that vests most geothermal resources with the province, whether by defining geothermal energy as a unique resource vested with the province or as an existing resource that is already primarily vested with the province.

Disposing the rights to geothermal resource development

If geothermal resource ownership is vested with the province, then the province will need to establish a tenure system to dispense and manage the right to develop geothermal resources. Generally, the right to develop a resource can be gained by obtaining ownership of title to the resource or through an agreement that allows a third party to develop the resource (e.g., a lease, licence, permit, etc.). In Alberta, ownership of subsurface resources is generally retained by the province and agreements are made with developers for resource development through various tenure systems.

A tenure system has three main phases. The first phase dispenses development permits to a third-party developer. There are several mechanisms by which the province can dispense rights. Once the right to develop is disposed, the second phase of the system governs exploration and resource confirmation. The development permit holder

[13] Alberta Energy. "Petroleum and Natural Gas Tenure in Alberta." Government of Alberta, September 2016. https://www.energy.alberta.ca/Tenure/Documents/TenureBrochure.pdf.

[14] *Alberta Water Act*. Section 3(2).

conducts work to confirm the existence and quality of the resource for which they hold rights. This phase will generally include some form of rental payment as well as due diligence obligations on the permit holder to ensure permit rights are not hoarded. Once resource confirmation occurs, the third phase of the system governs the actual development of the resource. This phase may include additional due diligence obligations as well as royalties to be paid to the province.

Dispense development rights phase

A province can dispense the development rights for resources through a number of different mechanisms.

A "**free entry" system** allows qualified prospectors to enter specified lands to stake a claim on the subsurface geothermal resources. Once a claim is staked, rights are automatically conferred to the prospector for the exploration and development of any subsurface resources. The province would have very little discretion to allow or deny the claim – in many cases it may supersede the claims of other rights holders. Such a system is commonly critiqued for the impact it has on private landowners, land-use planning, and other resource development interests that are not under free entry systems. For these reasons, many jurisdictions favour systems with more discretion over the disposition of mineral rights. Accordingly, Alberta ended the use of free entry tenure system in 1967.[15]

An alternative to a free entry system is a **discretionary tenure system** that allows the province greater power in approving or denying mineral claims. Generally, the province will have a system to review requests for mineral claims prior to the claim being granted. For example, in Alberta, a multi-agency review is conducted to understand any restrictions (e.g., protected wildlife habitats) before granting any mineral rights for specified land parcels.[16]

This is the system Alberta currently uses for mineral rights as administered by Alberta Energy. Under a discretionary tenure system, there are different mechanisms the province can use to dispose rights to subsurface resources – the primary ones being staking systems and bidding systems.

Under a **staking system (or non-competitive lease system)**, companies and individuals can apply for mineral rights within a specific geographic area, which are then granted by the province under ministerial discretion.[17] Traditionally this has been done through physical claim-staking (e.g., placing stakes in the ground to demarcate desired claims), but Alberta now uses a map-staking system where desired claims can be made through an online web portal. Most of Alberta's non-energy mineral rights are disposed in this manner.[18]

Under a **bidding system (or competitive lease system)**, the province issues mineral agreements for selected parcels through public auctions. A bidding system can help ensure companies with the financial and technical means to develop the project are the ones that secure the rights to develop. Underprepared companies will be less likely to risk acquiring mineral rights for a high price when they might not be able to develop them.

Under a bidding system, the selection of parcels can be "bottom-up," where proponents nominate parcels to be auctioned, or "top-down," where the province pre-selects parcels to be auctioned. A top-down approach requires the province to have the capability to identify parcels with the potential for viable mineral deposits, while a bottom-up approach allows industry expertise to help identify these areas. The majority of petroleum and natural gas agreements in Alberta are issued through a bottom-up bidding system.[19]

While bidding systems help ensure qualified companies secure the rights to develop natural resources, they may not be appropriate for an emerging industry such as geothermal. For example, British Columbia uses a bottom-up bidding system for geothermal resources rights.[20] Developers must propose to the British Columbia Ministry of Energy parcels of land they wish to develop for geothermal resources. Once proposed

[15] Harrison, Judah. "Too Much at Stake: The Need for Mineral Tenure Reform in British Columbia." Ecojustice, June 2010.

[16] Alberta Energy. "Petroleum and Natural Gas Tenure in Alberta." Government of Alberta, September 2016. https://www.energy.alberta.ca/Tenure/Documents/TenureBrochure.pdf.

[17] Alberta Energy. "Alberta Mineral Development Strategy 2002." Government of Alberta, 2002.

[18] Alberta Energy. "Alberta Mineral Development Strategy 2002." Government of Alberta, 2002.

[19] Alberta Energy. "Petroleum and Natural Gas Tenure in Alberta." Government of Alberta, September 2016. https://www.energy.alberta.ca/Tenure/Documents/TenureBrochure.pdf.

[20] *British Columbia Geothermal Resources Act* Section 5(5).

and evaluated, the tenure availability is then put up for public bid via sealed bid. This system has been criticized for potentially inhibiting geothermal development in British Columbia because it causes too much uncertainty for a developing industry.[21] Proponents must expend resources to identify potential viable parcels, but then must compete with other prospective developers for the parcels they have identified. The uncertainty of securing the mineral rights through the auction process can provide a disincentive to identify viable parcels to begin with – especially in a new industry.

Resource exploration and confirmation phase

Once the province dispenses the rights to develop the resource, the permit holder will generally need to perform work to confirm that the resource they hold the rights to exists and is economically feasible. For this reason, the initial dispensation of development rights will be for resource exploration only (e.g., exploration permit). For geothermal resources, confirming the resource may involve drilling an exploration well to assess the underground resource. Once the resource is confirmed, the exploration permit will generally convert automatically to a development permit.

The exploration permit will stipulate a number of things including the delineation between "exploration" and "development" activities, obligations of the permit holder to ensure exploration work is completed in a timely fashion, and any fees associated with the permit such as rental payments. It is important that the exploration permit allows enough work to be done to sufficiently confirm the resource. Without sufficient confirmation, project developers will face barriers to securing project financing. Additionally, appropriate permit holder obligations should be in place to ensure permit holders are not simply hoarding the resource. Rental payments should be commensurate with the province's cost of administering the tenure system.

Resource development phase

After resource confirmation, the exploration permit should automatically transition to a development permit. Like an exploration permit, similar due diligence obligations may be placed on the permit holder to ensure the resource is developed. However, with the development and production of the resource, the biggest difference between the exploration and development phase is the presence of activity that may be subject to royalties.

Royalties

The owners of subsurface resources will typically require compensation for the development of their property through the form of a royalty. For government-owned natural resources, the government will set the conditions and royalties for resource-development rights. For example, developers of oil and gas resources owned by Alberta pay a monthly royalty on production based on the type of project (e.g., oil sands, conventional), the price the resource is sold for, the volume produced and other factors.[22]

As a renewable resource, geothermal energy is not perfectly analogous to other subsurface resources. While the purpose of mineral royalties is to capture value for the resource owner, royalties also negatively impact the development rate of the resource by reducing the developer's profit motive – all else held the same. For commodities such as oil and gas, there is a balance between reducing this motive and keeping as much value for the resource owner. However, for a resource such as geothermal energy, which is not depletable, is a new industry, and for which the exploitation of the resource can contribute directly to provincial policy goals, the case for royalty payments is weaker. This is one area where competing renewable resources comes into play. In Alberta, there are no royalties levied on wind or solar electricity generation (unlike British Columbia). Options include fixed-period royalty holidays (like B.C.), royalties delayed until after pay back is complete, day-one production royalties or no royalties. The royalty decision should consider a) the generally non-depletable nature of the resource; b) the other policy benefits derived from the development of the resource; c) incentives/ barriers to innovation.

[21] Van Hal, Grant. "Legal Obstacles to the Development of Geothermal Energy in Alberta." Canadian Institute of Resources Law, 2013.

[22] Royalty Review Advisory Panel. "Alberta at a Crossroads: Royalty Review Advisory Panel Report," 2016.

E3 Metals Lithium Extraction & Geothermal Co-Production

While extracting other minerals and resources from the subsurface, geothermal energy can also be brought to the surface. For example, E3 Metals is developing Petro-Lithium, a lithium extraction technology that harvests lithium from brine recovered from reservoirs associated with oil and gas development. As part of the process, significant amounts of heated brine are extracted at fast rates. E3 Metals believes that enough geothermal energy can be captured from this brine to produce geothermal electricity.

Source: *https://e3metalscorp.com/projects/alberta-lithium-2/*

Geothermal co-production

Geothermal energy may be brought to the surface in conjunction with other subsurface resources such as oil and gas. In these instances, it may be economically feasible to use this geothermal energy for useful purposes such as electricity generation, thereby displacing the need to procure this energy elsewhere. A geothermal tenure system should account for these scenarios and allow for the beneficial use of geothermal energy when it is co-produced with another resource. One way to accomplish this is to grant geothermal resource rights along with the rights for other subsurface resources that are disposed to co-producing geothermal energy.

For geothermal co-production from oil and gas wells under existing licence agreements, caution should be exercised prior to granting geothermal rights to these licence holders. The timeframes associated with oil and gas development are generally much shorter than geothermal production, which can go on for decades. Original agreements regarding oil and gas development may have been made under the assumption that development would end in the short-term and the land would be reclaimed to its original use. With geothermal production, this time frame would be greatly increased. Those who may be negatively impacted by this should be consulted prior to the disposition of geothermal rights. Where the development occurs on Indigenous lands, it may be necessary to re-engage in a formal consultation process.

Regulating the physical activity of developing geothermal resources

Once the development rights for geothermal resources have been granted, additional regulations and rules may apply to the physical activities associated with the development of the resource. Additionally, if the geothermal resource will be used to generate electricity, additional regulatory permits and approvals may be needed. This section addresses approvals that may be needed for the physical access and extraction of geothermal energy – electricity generation permits are discussed later in the report.

The activities associated with the physical development of geothermal energy will likely fall under the purview of the Alberta Energy Regulator (AER). The AER is responsible for the development of the province's "energy resources," which is broadly defined as an any energy resource except for hydro.

> *Alberta's energy regulator is mandated with the efficient, safe, orderly and environmentally responsible development of energy resources in Alberta (except hydro) … to consider and decide applications … under energy resource enactments in respect of pipelines, wells, processing plants and other facilities and operations for the recovery and processing of energy resources.*[23]

[23] Alberta *Responsible Energy Development Act* 2012, Mandate of the Regulator 2(1-2).

The AER regulates energy resource activities to protect the environment and conserve water and manage the resource. Energy development projects must obtain AER approval prior to beginning development activities.

Environmental assessments

A significant regulatory requirement for some projects is an environmental assessment, which may be required at both the federal and provincial levels. These processes involve lengthy public consultation and other requirements. It is unlikely geothermal energy projects situated solely within Alberta will be subject to federal environmental assessment requirements.[24] If a provincial environmental assessment is required, it will likely be under the purview of the AER, however that is an important factor to be determined.

In Alberta, projects requiring environmental assessments are governed by the *Environmental Protection and Enhancement Act's* Schedule of Activities. The schedule does not reference geothermal wells but does list the generation of thermal electric power or steam and the drilling, construction, operation or reclamation of a well other than a water well.[25] However, the *Environmental Assessment (Mandatory and Exempted Activities) Regulation* goes on to explicitly exempt "the drilling, construction, operation or reclamation of an oil and gas well" (where environmental assessments are carried out by the AER), as well as wind and solar electric generation under one megawatt.[26] Additionally, mandatory activities under the regulation only include thermal electric generating plants greater than 100 megawatts.[27] It would appear that small-scale geothermal electricity generation would not qualify as a mandatory activity under the *Environmental Protection and Enhancement Act*. However, it is not clear that the geothermal portion would be specifically exempted as oil and gas wells and solar/wind generation might be.

Regulated activities

In addition to environmental assessments, the AER also regulates specific physical activities involved in energy resource development. For example, the AER has issued numerous directives providing specific rules and processes for the physical drilling process once an oil and gas exploration permit or development lease has been issued.[28] Without a clear regulatory framework and definition for geothermal resources, if or how these regulations will apply to geothermal well development is unknown. In most cases, the directives are authorized by regulations and acts that explicitly refer to wells for hydrocarbon development.[29]

Geothermal at non-producing oil and gas well sites

Existing but non-producing oil and gas well sites may be repurposed to produce geothermal energy. With tens of thousands of disused wells, the idea has received a lot of attention. In Alberta, repurposing existing well sites for geothermal production can reduce overall costs by reusing the existing infrastructure including the well, well pad, access road and electrical infrastructure. However, it should be noted that existing wells may not be suited to geothermal purposes, in which case a new well could be drilled using the existing footprint and infrastructure. Development can also create value by allowing the well licence holder to defer costly regulatory requirements associated with abandoning and reclaiming the well site. Well abandonment and reclamation are the process by which oil and gas wells that no longer produce energy resources are made safe and the surface is returned to its original state prior to energy production. The AER has specific requirements for this process, and in some cases, the specific characteristics of a well site can require costly procedures to adequately reclaim the site.

[24] Federal assessment processes are delineated in the *Canadian Environmental Assessment Act,* 2012. The *Regulations Designating Physical Activities* define the specific activities that are subject to the provisions of the act. While geothermal wells are not specifically mentioned, "drilling program" and "exploratory well" are referenced. However, these terms are only used to refer to off-shore activities where federal jurisdiction exists. On-shore wells within provinces are not subject to CEAA, so it is unlikely geothermal wells would be subject as well under these provisions. For electrical generating facilities, CEAA is only triggered if the facility is fossil fuel-fired or hydroelectric and above 200 MW or in-stream tidal and above 50 MW.

[25] *Environmental Protection and Enhancement Act* Schedule of Activities 2(n) and 3, respectively.

[26] *Environmental Assessment (Mandatory and Exempted Activities) Regulation* Schedule 2 – Exempted Activities (e) and (h), respectively.

[27] *Environmental Assessment (Mandatory and Exempted Activities) Regulation* Schedule 1 – Mandatory Activities (k).

[28] See, for example, Directive 008 Surface Casing Depth Requirements, Directive 009 Casing Cementing Minimum Requirements.

[29] See, for example, the definition of "facility" in the *Oil and Gas Conservation Act* which is defined as "any building, structure, installation, equipment or appurtenance over which the Regulator has jurisdiction and that is connected to or associated with the recovery, development, production, handling, processing, treatment or disposal of hydrocarbon-based resources..." citation: *Oil and Gas Conservation Act* 1(1)(w).

Repurposing existing well sites for geothermal production can reduce overall costs by reusing the existing infrastructure including the well, well pad, access road and electrical infrastructure.

The cost of well abandonment and reclamation creates an incentive to transfer the liability to another entity or defer the liability. Using the well site to produce geothermal energy may be one way to achieve this. There is currently no clear guidance on these issues, but there are two potential options. The first is for the licence holder to transfer the liability to a third party that would use the site for geothermal production. This liability could present a major financial barrier to the geothermal producer, preventing development that would otherwise be good for the province. The other is for the licence holder to partner with a geothermal company. If geothermal energy is then produced from the well site, this may delay abandonment and reclamation requirements due to active energy production. It would also deal with potential issues of lease trespass. In the case of orphaned wells, the partner would be the Orphan Well Association.

The reuse of suspended or abandoned well sites for geothermal energy can make geothermal production more economical, reduce the overall environmental impact of geothermal development through brownfield development and address the numerous inactive oil and gas wells in Alberta. However, geothermal production could be used to avoid well site liabilities in non-beneficial ways. Liability holders may see geothermal production as a way to avoid liabilities even in instances where geothermal energy is not particularly useful at the well site – leading to impractical geothermal production. It is important that the deferment of well liabilities is only permitted for legitimate geothermal production and not used solely to avoid environmental cleanup liabilities.

GEOTHERMAL ENERGY
RECOMMENDATIONS

Alberta can permit geothermal development to proceed on a case-by-case basis by sanctioning pilot projects, but this is not sustainable for full-scale industry development. The province needs to address this issue so it does not inhibit development of geothermal energy across Alberta. Just as the definition of geothermal resources determines how it will be regulated, it is important that the definition and the regulatory path that follows is:

- Technology agnostic: encompasses traditional as well as emerging geothermal technology
- Adapted for the differences between geothermal and other natural resources and adaptable for the differences among geothermal technology. For example, geothermal resource development:
  - May or may not involve extraction of any "tangible" resource except heat;
  - May or may not interact with water, aquifers, or other extractable resources like oil or gas;
  - May involve brownfield development using existing abandoned well pads;
  - Can be completely renewable (with management), so that future generations continue to benefit from the resource into the future, without any loss to them.

A regulatory regime that fails to recognize these differences will create barriers to development. These barriers are primarily from unnecessary or overly involved project approval requirements directly due to the differences among resources and technologies. The goal for this resource, like any other natural resource regulation, should be to maximize both regulatory efficiency and public safety. That is: minimize time for approvals; minimize overlapping or repeated assessments; minimize the number of agencies involved; and maximize application of existing regulatory knowledge, data, and experience. Public and environment safety triggers should be risk-based. For example, the assessment process should recognize differences between new developments and brownfield sites, the likelihood of contamination, or depletion of water resources that can be used for consumption by people or agriculture.

We recommend the Government of Alberta take the following actions:

Create a clear, technology agnostic definition for geothermal resources

Whether through legislation or regulation, Alberta should create a clear definition for geothermal resources that does not discriminate against current or potential future technologies and extraction methods. The definition and resulting regulations should be flexible enough to exempt geothermal resources from water use regulations in scenarios where water is the transportation medium for the geothermal resource and there is no consumptive use of the water (e.g., it is injected back into the ground) or use that otherwise impedes the water rights of other users.

Defining geothermal energy as a mineral resource, as opposed to a water resource, is the preferable route. First, there are many scenarios, such as Eavor-Loop, where geothermal energy can be extracted without the use of water as a transportation medium. Second, mineral resource regulations are typically geared towards the efficient exploration and extraction of the resource, while water regulations typically focus on the fair use and conservation of the resource. As a renewable resource, conservation of geothermal energy is less important and regulation as a water resource could serve to hamper its efficient development.

Explicitly address ownership of geothermal resources

When defining geothermal resources, the province should also explicitly address ownership interest. Whether it resides with surface property owners, mineral rights owners, or some other entity, explicitly defining ownership interest will provide certainty to developers that they are obtaining development rights that exist.

Vesting ownership interest with the province would adhere to past precedents and allow the province to develop a tenure system that reflects the public policy value of developing geothermal resources. For example, this would allow the province to develop a royalty scheme that minimizes costs and encourages development, especially in the early stages of geothermal development in the province.

Develop a simple, streamlined tenure system that enables first movers

If the province holds title to significant geothermal resources, Alberta should implement a geothermal tenure system that ensures the unique properties of the resource are adequately treated as well as makes considerations for its contribution to provincial energy and climate goals.

Due to the likely conservative demand for geothermal resources in Alberta (at least initially), the tenure system should function as a staking system allowing proponents to non-competitively apply for development rights. Claims should not be required to go to competitive bid as this can create additional uncertainty for proponents and limit incentives for initial geothermal exploration, which should be avoided in a new industry. Rules should be in place, however, to ensure resource permits are developed in a timely manner to ensure viable geothermal resources do not go undeveloped.

Extend a royalty holiday to geothermal resources

As geothermal is a new industry, the province should strive to reduce the cost of developing geothermal resources wherever possible. When developing a geothermal tenure system, this principle should extend to royalties. Geothermal development can be a key contributor to provincial public policy goals such as emission reductions. Additionally, geothermal energy is renewable, therefore its use now does not preclude its use for future generations. For these reasons, the province should consider extending a royalty holiday to geothermal resources to encourage the industry to grow. The imposition of royalties could be reviewed once the industry is more established.

Use existing expertise to regulate the physical activities of geothermal development

Geothermal developers will also benefit from clarity on how the physical activities of their development will be regulated. Alberta has an expert regulator with the AER tasked with ensuring “the efficient, safe, orderly and environmentally responsible development of energy resources in Alberta,” which includes resources such as oil and gas. Geothermal resources are energy resources, and many of the processes involved in developing them are similar. Geothermal development should be put under the AER’s purview.

Adapt existing regulation to recognize unique characteristics of geothermal development

Existing regulation should be adapted to consider the unique characteristics of geothermal development and the range of methods used to extract geothermal energy. For example, geothermal development that does not use groundwater as a thermal medium should not be required to fulfill obligations associated with groundwater regulations. Brownfield developments using well pads and drilling technology should undergo less review than greenfield sites. However, the liability for abandoned well remediation should be clarified.

The goal for this resource should be to maximize both regulatory efficiency and public safety.

Distributed GENERATION

Distributed generation refers to small-scale electricity production at or near where the electricity will be consumed. It can serve isolated electric loads such as remote communities or industrial sites, or it can connect to the electric grid. When it connects to the grid, it generally interconnects at the lower voltage distribution level. Distributed generation can come in many forms, from roof top solar to on-site natural gas generators. As Eavor-Loop shows, geothermal electricity production can also be done at a distributed scale. Distributed generation differs from traditional generation sources, which tend to be large centralized power plants that are far from electricity demand centres and must transmit their electricity over high-voltage transmission lines.

REGULATING DISTRIBUTED GENERATION

Both the production and sale of electricity is a highly regulated process. The Alberta Utilities Commission (AUC) is the main electricity regulatory body in Alberta. Electricity generators must apply to the AUC for siting approval, which includes both social and environmental impact considerations. It also regulates tariffs for electricity services. The AUC oversees the Alberta Electricity System Operator (AESO), which is responsible for administering a competitive market for generation and other electricity products (e.g., ancillary services).

Distributed generation's differences from traditional generation have several important implications for electricity regulation. First, as small-scale generation, the localized environmental and social footprint of distributed generation projects is typically less than larger generation. Second, as generation located close to where it is consumed, distributed generation can provide additional benefits to the grid such as reducing congestion on the distribution and transmission system and deferring the need to build additional infrastructure to serve electricity demand, which reduces overall system costs. Finally, as generation generally connecting to the low-voltage distribution grid, distributed generation interfaces more commonly with distribution utilities as opposed to larger generation connecting to the high-voltage grid, which interfaces with the AESO.

The small-scale nature of distributed generation also raises the stakes of regulatory costs and barriers. As smaller projects, distributed generation can be impacted significantly more by the regulatory environment than large-scale generators where these burdens may be less consequential. Even small costs can make or break a distributed generation project's viability.

For these reasons, the regulatory constructs that govern traditional generation are often not appropriate for distributed generation, prompting jurisdictions – including Alberta – to provide different regulatory treatment for distributed generation. This treatment may include reducing regulatory permitting requirements, alternative remuneration schemes and special regulatory direction for the interconnection of distributed generation to the distribution grid. How this treatment is designed and to what projects it applies will have important implications for the

viability of innovative distributed generation technologies. The remainder of this section explores how the Alberta electricity regulatory environment handles distributed generation applicable to geothermal energy in terms of regulatory permitting requirements, remuneration schemes and interconnection processes.

Electric generation regulatory requirements

Unless exempted, an electricity generator in Alberta must file an application with the Alberta Utilities Commission (AUC). The application process includes public consultation requirements and a formal hearing process in front of the AUC, which can be a long and costly process.[30] Accordingly, Alberta exempts some small-scale electricity projects from some of these requirements. Specifically, the AUC exempts distributed generation from filing an application if it meets the following criteria:[31]

- It is at least one of the following:
  - It is less than 10 megawatts and solely for the owner's own use, or
  - It is less than one megawatt and not for the owner's own use
- It adheres to all of the following:
  - No person is directly and adversely affected
  - The power plant complies with AUC *Rule 012: Noise Control*
  - There is no adverse effect on the environment
  - If it is connecting to the distribution grid, it has obtained an operating agreement from the wire owner to which it will interconnect

The Alberta *Micro-Generation Regulation* expands AUC application exemptions for larger distributed generators that meet certain criteria.[32] Specifically, distributed generators are considered micro-generators if they meet the following criteria:

(i) exclusively uses sources of renewable or alternative energy,

(ii) is intended to meet all or a portion of the customer's total annual energy consumption at the customer's site or aggregated sites,

(iii) has a total nameplate capacity that does not exceed the lesser of five megawatts or the rating of the customer's service,

(iv) supplies electric energy only to a site that is located on property that the customer owns or leases, and

(v) is located

  (a) on the property referred to in subclause (iv), or

  (b) on property that the customer owns or leases that is adjacent to the property referred to in subclause (iv);

In practice, the *Micro-Generation Regulation* criteria expands AUC application exemptions for generators between one and five megawatts that are not solely for the owner's own use, which means these projects may – at times – export electricity to the grid and still qualify for an exemption. However, these projects are still restricted to a size meant only to meet the total annual energy consumption of the site.

The exemption criteria mean that any distributed generation that is above one megawatt and is not sized solely for on-site consumption will be required to undergo the AUC application process. This added regulatory burden can result in unnecessary and inefficient outcomes in one of two ways.

First, it could place unnecessary regulatory burdens on otherwise viable distributed generation sites. Since the exemption criteria require distributed generation above one megawatt to be sited directly at the site of consumption, scenarios where the ideal location for distributed generation is only *near* as opposed to *at* the site of consumption will be additionally burdened. For example, Eavor-Loop can be sited at abandoned well sites near other

[30] See AUC *Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System*.

[31] *Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments*. Section 1.4.3.

[32] Alberta *Micro-Generation Regulation*, Section 1(1)(h).

electricity loads (e.g., homes, industrial centres). Building on abandoned well sites can reduce its overall footprint and environmental impact. Yet distributed generators above one megawatt sited at abandoned well sites would not qualify for AUC application exemptions. If the costs of these regulatory burdens are too high, the distributed generation might not be built or a less than ideal site with a larger footprint might be chosen to take advantage of the exemption instead.

Second, even when sited at the point of consumption, the exemption criteria may artificially restrict ideal distributed generation size. For example, the ideal size of a distributed generator such as Eavor-Loop will depend in part on the amount of accessible geothermal energy at the site. Imagine a site with an electricity demand of one megawatt that has enough accessible geothermal energy to power a two-megawatt distributed generator. Under the current exemption criteria, a two-megawatt generator would be subject to AUC application requirements since it is larger than the on-site electricity demand. It would not matter if there was another electricity load nearby that would also benefit from this distributed generation.

The main consideration should be whether it can safely interconnect with the grid.

Remuneration for distributed generation

There are multiple options for distributed generation connected to the grid to receive compensation for electricity services depending on the characteristics of the generator. The first option available to nearly any electricity generator is through directly selling electricity through competitive markets administered by the AESO. Another option is available for distributed generation operating under Alberta's *Micro-Generation Regulation*. In addition to these options, the Government of Alberta directly procures electricity through the Renewable Electricity Program (REP) and is currently implementing a new market to compensate electricity generators for the capacity they provide to the system.

Selling directly into the Alberta power pool

Alberta operates an open and competitive market for electricity generation. Qualifying generators bid generation into the Alberta power pool in various quantities and prices. The AESO then dispatches generators in order from lowest to highest bids to meet electricity demand. Generators that are dispatched receive a uniform pool price for their electricity, which is the bid price of the last generator dispatched (e.g., the most expensive generator dispatched). In this way, generators are compensated for the electricity they provide, and in theory, generation will only be built and operated if there is an expectation of an acceptable return from selling electricity into the competitive market.

Distributed generation may participate in the Alberta power pool. To participate, a distributed generator has to register as a pool participant. There is different treatment based on generator size. Generators that are five megawatts and greater must submit bids to the power pool and respond to dispatch orders from AESO. Generators five megawatts and below do not submit bids and do not actively participate in the market. Instead, they act as "price takers" and receive the pool price for any electricity exported to the grid.

In addition to selling electricity into the power pool, some distribution utilities have specialized tariffs for distributed generation. The two largest distribution utilities in Alberta by geographic area – Fortis Alberta and ATCO Electric – both have such tariffs.[33] These tariffs provide a credit to generation customers that reflects the reduction in system access service charges caused by the distributed generator. System access service charges are levied by the AESO on distribution utilities (who then pass them on to their customers) to recover transmission-related costs. In this way, the tariff provides some compensation to distributed generators for the value they provide in reducing the need for transmission services by producing electricity closer to where it is consumed.

[33] See Fortis Alberta's Option M Tariff and ATCO Electric's D32 Tariff.

In the near future, generators participating in the Alberta power pool will have a different way to earn revenue. The province is currently undergoing a process to implement a capacity market in addition to its current energy market. A capacity market makes payments to electricity generators for the reliable capacity they can provide to the grid as opposed to an energy-only market, which makes payments only for the electricity they provide to the grid. In other words, a capacity market compensates for the *ability* to provide electricity when it is needed, rather than the actual provision of electricity. The purpose of a capacity market is to ensure there is enough capacity on the grid to supply peak electricity demand and ensure reliable electricity supplies. In practice, a capacity market will reduce potential revenues from the energy market since generators will be able to bid in lower when they are also receiving capacity payments. If distributed generators are unable to participate in this new capacity market, this could result in an overall decrease in their possible revenues.

Micro-Generation Regulation

Alberta's *Micro-Generation Regulation* governs remuneration for distributed generation meeting micro-generation criteria. For micro-generation that is less than 150 kilowatts, the distributed generator is credited at the retail rate of electricity for the generation site for any electricity exported to the grid. For micro-generation greater than 150 kilowatts, the distributed generator is credited at the hourly pool price for electricity exported to the grid. Neither remuneration scheme contains provisions that account for grid benefits besides the generation of electricity, and generators operating under the *Micro-Generation Regulation* are not eligible for the specialized tariffs that provide credit for reductions in system access service charges.

Renewable Energy Program (REP)

Starting in 2017, Alberta launched a program to procure an additional 5,000 megawatts of renewable energy capacity by 2030 called the Renewable Energy Program (REP). Thus far, REP is being implemented through a series of auctions to procure renewable energy capacity with the first round resulting in nearly 600 megawatts of wind generation at record low prices. As of this writing, two additional rounds have been announced and will be administered similarly to the first round.

REP's auction format awards contracts to qualifying projects that have the lowest bid in terms of cost per megawatt-hour. Qualifying projects must be (1) new or expanded renewable projects, (2) connected to the distribution or transmission grid, (3) 5 megawatts or larger and (4) be an eligible fuel as defined in the *Renewable Electricity Act* among other requirements. The contracts guarantee a fixed price per megawatt hour for renewable generation over a 20-year period.

Geothermal electricity is eligible for REP. The *Renewable Electricity Act* lists "heat from the Earth" as an eligible fuel, so it appears that geothermal resources would qualify.[34] However, it will be difficult for small-scale distributed generation to participate in this program due to the minimum size limit of five megawatts. It may be possible to aggregate several projects together to meet this minimum requirement.

Under the current auction structure, qualifying geothermal electricity is unlikely to be selected. Since the auction structure selects projects based on the lowest acceptable price developers are willing to take, winning bids will generally be from the lowest cost resources. As the first REP auction showed, this resource is predominantly wind. Geothermal electricity is unlikely to compete with the low prices of wind energy. While minimizing costs should be a primary goal of REP auction structure, it should not be the only goal. Judging projects solely on cost of electricity fails to account for differences in value of electricity between projects. Geothermal electricity is unlikely to have the lowest cost among various renewable energy options such as wind, but it will likely have a higher value of electricity produced since it can operate 24/7 and is dispatchable. Solar electricity is in a similar boat since it tends to produce electricity at times when it is more expensive.[35]

[34] *Renewable Electricity Act,* Section 1(l)(iii).

[35] Shaffer, Blake. "Solar Electricity & Future Rounds of the Renewable Electricity Program (REP)." Canadian Solar Industries Association, November 2017. http://www.cansia.ca/uploads/7/2/5/1/72513707/20171116_cansia_represearch_submitted__002_.pdf.

The regulation of distributed generation should focus on enabling – and not blocking – high-value projects where they make sense.

Interconnecting to the grid

Unless a distributed generator is serving an isolated load, it will need to interconnect to the distribution grid. The *Electric Utilities Act* requires distribution utilities to "connect and disconnect customers and distributed generation in accordance with the owner's approved tariff and with principles established by the Commission regarding distributed generation."[36] The interconnection process is largely a technical and administrative process determined on a utility-by-utility process.

The interconnection process can have significant implications on project viability. In some cases, safely interconnecting distributed generation to the grid will require costly upgrades to the grid, which are generally borne by the generator. These costs can often run into the millions of dollars, and for distributed generation, these costs can make the overall project uneconomical.

Besides being explicitly directed to interconnect distribution generation by legislation, distribution utilities do not have strong incentives to proactively work with developers seeking to interconnect with their grids. The regulated distribution utility business model rests on building infrastructure (e.g., power lines, substations, etc.) to serve electricity demand and generating revenue through tariffs based on the consumption of electricity. Interconnecting distributed generation does not generate revenue (in some cases it can reduce it).

This lack of incentive can lead to additional interconnection barriers precisely because there is no motivation to reduce interconnection barriers within the utility. For example, a utility may require costly grid upgrades to connect a generator after an initial high-level interconnection technical analysis suggests the project cannot safely connect under current grid conditions. However, a more in-depth analysis may prove that upgrades are not needed. Whether the more in-depth analysis is conducted is often at the discretion of the distribution utility.

[36] *Electric Utilities Act*, Section 105(1)(k)

DISTRIBUTED GENERATION
RECOMMENDATIONS

The regulation of distributed generation should focus on enabling – and not blocking – high-value projects where they make sense. This can be accomplished by reducing unnecessary regulatory burden on distributed generation, implementing remuneration schemes that account for the additional value distributed generation can provide to the grid, and finding ways to reduce unnecessary interconnection costs.

We recommend the Government of Alberta take the following actions:

Expand regulatory exemptions for small-scale distributed generation to include generators not physically located at the site of consumption

Alberta already provides regulatory requirement exemptions to some distributed generation projects. These exemptions are often predicated on the generation being sited at the physical site of consumption. The most high-value locations for distributed generation may not necessarily be directly at the site of consumption but located nearby. Alberta's regulatory exemptions for distributed generation should consider these scenarios and extend exemptions to distributed generation regardless of the degree of on-site consumption.

Compensate distributed generation for the value it creates

The remuneration schemes available to distributed generation need to account for any and all value it creates including electricity generation, capacity, and transmission and distribution benefits. There are clear ways for receiving compensation for electricity generation, but compensation for other values are less clear or unavailable. With the implementation of a new capacity market, Alberta should ensure that distributed generation that is capable of providing capacity value to the grid is adequately compensated for this value. Some utilities have distributed generation tariffs that provide some remuneration for transmission benefits, but these schemes are not available to generators operating under the *Micro-Generation Regulation*. For incentive programs such as REP, Alberta should seek to incentivize generation through both cost and value.

Reduce interconnection costs

Streamlining and reducing the cost of the interconnection process can be achieved through a number of measures.

Most broadly, realigning distribution utility incentives to favour the deployment of distributed generation on their systems can help encourage distribution utilities to take proactive steps to enable distributed generation. If utilities can realize greater returns by enabling cost-effective distributed generation on their systems, they will be more inclined to reduce interconnection costs and support generation developers. Jurisdictions in the United States are investigating ways to alter traditional distribution utility business models to achieve this.[37]

More discrete steps include establishing more standardized procedures across distribution utilities within the province, which can help reduce developers' costs operating in different utility jurisdictions. The Interstate Renewable Energy Council (IREC) has developed model interconnection standards that many jurisdictions in the United States have adopted.[38] Utilities can also share data with developers that show where on their grids distributed generation is most valuable and where it will be most costly to interconnect. This information can help developers site their projects where they make the most sense (from a grid perspective) and avoid wasting resources developing projects in areas where interconnection costs are too high.

[37] See New York State's Reforming the Energy Vision proceeding

[38] https://irecusa.org/publications/model-interconnection-procedures/

CONCLUSION

Alberta's climate plan is driving the development of new energy technology – technology that is more efficient, produces fewer emissions, uses less water, has a smaller footprint and a smaller negative impact overall. Innovators have stepped up to the challenge. So much so, that they are getting out ahead of the regulatory world meant to ensure that these technologies in fact achieve society's goals.

Regulation and regulators play a role. Adoptions of innovations are held back when the regulatory environment is unclear. From a technology perspective, geothermal electricity production is already happening; now, Alberta needs to establish a regulatory environment to enable its development, which will in turn help achieve provincial emissions reduction goals.

Technologies that use geothermal resources or produce distributed electricity will benefit from clear regulatory frameworks that provide investment clarity and appropriately value their benefits. To enable the development of geothermal resources, Alberta should develop a regulatory framework that is technology agnostic and provides a straightforward pathway for developers to secure the rights to geothermal resources.

For distributed electricity production, Alberta's laws and regulations consider distributed generation in certain circumstances but exclude many forms of potentially viable distributed generation. Compensation arrangements for distributed generation benefits provided to the grid are limited. Finally, there are no provincewide standards for distributed generators to interface with regulated electricity distribution utilities.

APPENDIX A | *Jurisdictional examples*

Geothermal resource definitions

Jurisdiction	Definition	Source
British Columbia	"Geothermal resource'' means the natural heat of the earth and all substances that derive an added value from it, including steam, water and water vapour heated by the natural heat of the earth and all substances dissolved in the steam, water or water vapour obtained from a well, but does not include: **(a)** water that has a temperature less than 80C at the point where it reaches the surface, or **(b)** hydrocarbons;	*Geothermal Resource Act*, RSBC 1996, c 171, s 1(1).
United States – Federal	''Geothermal resources'' means **(i)** all products of geothermal processes, embracing indigenous steam, hot water and hot brines; **(ii)** steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations; **(iii)** heat or other associated energy found in geothermal formations; and **(iv)** any byproduct derived from them;	*Geothermal Steam Act* of 1970
California	For the purposes of this chapter, "geothermal resources" shall mean the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil, hydrocarbon gas or other hydrocarbon substances.	Section 6903 of California Public Resource Code
Nevada	"Geothermal resource" means the natural heat of the earth and the energy associated with that natural heat, pressure and all dissolved or entrained minerals that may be obtained from the medium used to transfer that heat, but excluding hydrocarbons and helium	CHAPTER 534A – GEOTHERMAL RESOURCES NRS 534A.010
Arizona	"Geothermal resource'' means: **(a)** All products of geothermal processes embracing indigenous steam, hot water and hot brines. **(b)** Steam and other gases, hot water and hot brines resulting from water, other fluids or gas artificially introduced into geothermal formations. **(c)** Heat or other associated energy found in geothermal formations, including any artificial stimulation or induction thereof. **(d)** Any mineral or minerals, exclusive of fossil fuels and helium gas, which may be present in solution or in association with geothermal steam, water or brines.	ARS 27.651
Montana	"Geothermal resource'' means the natural heat energy of the earth, including the energy, in whatever form, which may be found in any position and at any depth below the surface of the earth, either present in, resulting from, created by, or which may be extracted from such natural heat and all minerals in solution or other products obtained from the material medium of any geothermal resource.	77-4-102 MCA, State lands code
Utah	**(4)** "Geothermal fluid" means water and steam at temperatures greater than 120 degrees centigrade naturally present in a geothermal system. **(5) (a)** "Geothermal resource" means: **(i)** the natural heat of the earth at temperatures greater than 120 degrees centigrade; and **(ii)** the energy, in whatever form, including pressure, present in, resulting from, created by, or which may be extracted from that natural heat, directly or through a material medium. **(b)** "Geothermal resource" does not include geothermal fluids.	73-22-3 Utah Code
Iceland	Geothermal energy in this Act means, on the one hand, reserves of energy in the bedrock, and, on the other hand, a constant flow of heat from the bowels of the earth which does not constitute groundwater.	Act on the survey and utilisation of ground resources. Chapter 1, Article 2.

Ownership

Jurisdiction	Ownership Interest	Source
British Columbia	The right, title and interest in all geothermal resources in British Columbia are vested in and reserved to the government and the government may dispose of them only under this Act.	*Geothermal Resources Act*. [RSBC 1996] CHAPTER 171. Section 2.
Nevada	Ownership of geothermal resources. The owner of real property owns the rights to the underlying geothermal resources unless they have been reserved by or conveyed to another person.	CHAPTER 534A – GEOTHERMAL RESOURCES NRS 534A.050
Oregon	Ownership rights to geothermal resources shall be in the owner of the surface property underlain by the geothermal resources unless such rights have been otherwise reserved or conveyed. However, nothing in this section shall divest the people or the state of any rights, title or interest they may have in geothermal resources.	522.035 ORS
Utah	Derives from an interest in land and not from an appropriative right to geothermal fluids.	73-22-3 Utah Code
Iceland	To private land is attached ownership of resources in the ground, while on public land they are the property of the State of Iceland, unless other persons can prove their right of ownership.	Act on the survey and utilization of ground resources. Chapter 1, Article 3.

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