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De-risking Geothermal for Direct-use Heating in Canada: Lessons Learned from Europe

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Summary

Geothermal for direct-use heating is a proven technology that has been utilized for decades all over the world (e.g. Germany, France, and the Netherlands). With Canada's cold climate, space and water heating represents a significant energy demand, but Canadian geothermal heating is an emerging form of energy relative to other markets. This is primarily due to the challenge in competing with relatively abundant, low-cost forms of Canadian energy such as natural gas. As Canada explores the transition to a net-zero energy system, geothermal has potential to become an important part of the energy mix. Canada can redeploy the wealth of data, equipment, and expertise honed from decades of hydrocarbon development into advancing geothermal and providing reliable, zero-emissions, baseload energy that enhances energy security while reducing emissions in the Canadian energy market. As with how Canada's oil sands were commercialized, there is an opportunity to develop a locally untapped resource by taking advantage of innovative practices. On such innovation is utilizing learnings from other markets with similar geologic conditions. These experiences can be leveraged to reduce risk and mitigate uncertainty to accelerate advancement of Canadian geothermal energy. For example, direct-use heating projects in the Netherlands producing geofluids with temperatures up to 120°C from aquifers in sedimentary basins at a depth range of 1500-2500 m reflect similar conditions found in many portions of Alberta, northeastern British Columbia, and southern Saskatchewan. Strategic advice and practical experience from delivering these types of projects can create value in Canada by providing key quality assurance services as well as commercial and technical insights that guide critical cost-saving decisions.

Method

Similar to Moore's Law, which describes the rate at which computational capacity doubles, Wright's Law (also known as the "experience curve") posits that for every doubling of units produced, costs will fall by a constant percentage (Nagy et al., 2013). A specialized case of Wright's Law: Swanson's Law, observes that the price of solar photovoltaic modules drops by 20% for every doubling of the total shipped volume of solar panels (Partain et al., 2016). A major barrier to adopting new forms of energy is competing with the economics of mature technologies (which have already iterated along the experience curve to establish a low-cost equilibrium) while the new technology has not yet benefited from the lower costs associated with scale. One method of disrupting the status quo is importing skills, technologies, or innovative practices that have been incubated, tested, and grown in a foreign market. Introducing skills that have been developed in a similar but more mature market unlocks opportunities as the locally novel technology benefits from learnings, cost savings, and general momentum developed elsewhere. These factors help the newcomer compete with incumbent systems. This is especially true with respect to mitigating uncertainty and risk associated with technologies pioneering into new regional markets.

Observations

The technical and commercial knowledge honed through years of experience building direct-use heating geothermal projects in regions with relatively cool geothermal gradients is especially relevant to many parts of Canada which tend to lack the high temperature, high enthalpy geologic conditions found in countries with well-developed geothermal industries such as Iceland or New Zealand. Geothermal gradients in regions where direct-use geothermal heating is commonplace: sedimentary basins in Germany, France, and the Netherlands, are in a similar range as those found in the Western Canadian Sedimentary Basin (Bauer, 2018; Bonté et al., 2013; Mijnlieff, 2020; Weides & Majorowicz, 2014). Lessons learned about the nuances in building and operating direct-use geothermal projects in low temperature environments may be more valuable for Canadian geothermal than expertise developing high enthalpy projects in regions with far higher subsurface temperatures than are typically found in Canada.

Key geothermal capabilities developed in regions that parallel the Canadian market provide essential services to screen project opportunities, facilitate site selection, model financial performance, complete due diligence, and assess geo-hazards. These skills provide strategic advantages in reducing risks associated with geothermal project development. Many of the skills that help de-risk a geothermal project in a deep sedimentary basin are familiar to professionals working in oil & gas: geophysical, petrophysical, reservoir modelling, and geo-hazard analysis. Delivering these insights for geothermal projects reduces uncertainty, identifies critical aspects of a project, and generally helps developers avoid surprises when bringing a project online. For example, geothermal reservoir modelling, analyzing fracture containment, assessing caprock integrity, modelling a reservoir's temperature profile, and identifying seismic or subsidence risks are services that can provide consequential value to change the risk profile of a potential project. Once a geothermal project comes online, expertise in optimizing an asset's production, mitigating corrosion, treating scaling, and monitoring potential subsidence or seismic activity can also have tremendous upside for the efficiency of a geothermal project's operation.

Strategic advisory services also extend beyond technical, engineering, or geoscience expertise into the realms of stakeholder management, supporting procurement decisions, providing quality assurance services on system design, offering regulatory guidance, assessing funding proposals, and completing financial analysis. This is especially true for potential developers who already hold a diverse portfolio of conventional and renewable energy assets. Energy advisory services can unlock value for clients who are interested both in better understanding how geothermal energy fits into broader carbon management plans while exploring other novel technologies that are emerging as sources of value in the energy transition. Expertise completing systemic analysis of the energy value chain uncovers new opportunities and provides strategic benefits to organizations operating in the rapidly changing energy landscape.

Additive Information

Canada may soon benefit from projects like Trias Westland in the Netherlands: pictured above during the drilling campaign. Trias Westland is a geothermal energy project with two doublets (i.e. a deviated well-pair consisting of a production and injection well) at 2.3 km depth, supplying more than 45 MW_{TH} of sustainable thermal energy to greenhouse facilities and nearby residences. The project utilizes GRE lined tubing: an innovative, corrosion-resistant glass fiber reinforced epoxy in the geothermal wells. The geothermal operation is supported by Veegeo Sproule personnel, who provided project management and strategic advice during the realization phase and who are currently providing production engineering advisory services to optimize heat production.

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