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Direct Use of Geothermal Heat:
A Mature and Deployable Solution for Canada

Geothermal energy, or heat from subsurface, is a clean and renewable form of energy that is being developed and utilized in 82 countries around the world. Canada, despite being among the global leaders for actions taken to mitigate climate change, has yet to harness its geothermal energy potential in a meaningful way. Though Canada does have geothermal resources that offer the potential for geothermal electricity production, the potential applications for the direct use of geothermal heat are endless and should be further explored by the Canadian government and developers.

Understanding the Direct Use of Geothermal Heat

The direct use of geothermal heat implies that geothermal energy is used for heating and other industrial or commercial processes. Direct use operations often involve drilling and bringing hot fluids to the surface to extract the heat. After the heat is extracted, the lower temperature liquid is returned to the earth so that it can be reheated and utilized again.

The most common direct use applications utilize temperatures equal to or lower than 60°C for space heating, agriculture, aquaculture, bathing, and snow melting & de-icing. The heat from geothermal fluids can be cascaded, meaning that a resource can be used multiple times for different purposes until the temperature has been lowered to a point where it is no longer useful, thereby utilizing as much of the resource as possible, all the while utilizing a renewable resource and producing little to no GHGs.

Geothermal Heat: An Avenue for Clean Growth in Canada

To better understand how the direct use of geothermal heat can benefit Canada, it is first useful to examine what is currently being done with regard to utilizing Canada's geothermal heat. This section will briefly examine two global case studies to demonstrate why geothermal heating is an easy and readily available tool for promoting clean growth in Canada and then present two projects currently underway in Canada.

Espoo, Finland: Deep Well, Big Rewards

Espoo, the second largest town in Finland has recently achieved a milestone of drilling a 6.4-km-deep well, which is the first of two that will be utilized to provide clean, renewable heat to approximately 26,000 residents. The project is especially notable in that the well was dug through hard bedrock; a tremendous and innovative achievement.

Kirchweidach, Germany: Jobs, GDP, and No GHGs

The geothermal heat project in Kirchweidach, Germany provides a useful case study for potential Canadian applications, as Germany is known to have similar geology to parts of Western Canada (sedimentary basin). The Kirchweidach project is most famous for the 12-hectare greenhouse

that is heated by the direct use of geothermal heat; annually the company saves approximately 6.5 million liters of fuel or approximately 2,150 million tonnes of CO2. Additionally, the greenhouse employs 150 local, full-time staff.

The Netherlands: The Power of Geothermal Heat

The Dutch have a different perspective when it comes to utilizing their geothermal resources. Unlike other countries worldwide, whose focus is on geothermal power generation, the Netherlands have focused their energy on the direct use of geothermal heat for greenhouses and industry. Of the 12 active geothermal projects in the Netherlands, 11 are horticultural projects. The Netherlands have become the second largest global exporter of food by dollar value after the U.S., with only a fraction of the land, and have also become the world leader in in tomato production. The Netherlands has recognized that geothermal energy is an important alternative to natural gas and strives to reduce 0.3 megatons of CO2 emissions annually through the use of geothermal heating for greenhouses.

Concluding Remarks:

The international case studies presented are meant to demonstrate that other countries with similar geological challenges have been able to utilize their geothermal resources in creative ways that provide jobs, clean renewable heat, and in the case of Kirchweidach and the Netherlands - fresh, local produce.

Geothermal Heating Projects as Job Creators

Geothermal heating projects have the benefit of offering clean, reliable heat 24 hours a day, 365 days a year. Unlike geothermal electricity projects, which require substantially higher temperature and harder to access geothermal fluids, geothermal heating projects are generally less complicated to develop and much more readily available across Canada. Geothermal heat can be used in a variety of ways – from district heating, to greenhouse heating, to aquaponics (fish and plant farming) – all of which provide stimulus to the local economy by creating jobs and offering the opportunity for export. This section will examine two international geothermal heating and present a model to demonstrate their ability to create sustainable jobs, stimulate the local economy and promote clean growth.

New Mexico: The US' Geothermal Greenhouse State

New Mexico is the leading US state with regard to developed geothermal heated greenhouses. A useful example to illustrate the benefits of a geothermal heated greenhouse is the New Mexico State University's 28-acre greenhouse, which has created 250 full-time jobs, with an estimated payroll of $3.7 million per year and estimated sales of $13.4 million. New Mexico has a total of 50 acres of geothermal greenhouses, which represents $5.6 million in payroll and $20.6 million in sales, which the majority are made to out-of-state buyers. It is also worth noting that the greenhouses pay royalties for geothermal production.

Iceland Resource Park: A Society Without Waste

The Iceland Resource Park is an excellent example of what can be done through the utilization of geothermal heat. Geothermal heat is supplied to a variety of businesses, including the Blue Lagoon, cosmetics manufacturers, biotechnology companies and aquaculture companies. These businesses utilize the geothermal heat within their daily operations. In 2016, the total number of employees at the Resource Park was over 900 and also accounted for 600 indirect and induced jobs. (source: GREBE Project).

Geothermal Agriculture and Aquaponics Model

Generally, the necessary temperature for a geothermal heated agriculture or aquaponics project is around 70°C. 21 acres of greenhouses generate net revenue of $5.2 million USD annually, cost approximately $15-$20 million USD, which equals a payback of approximately 3 to 4 years. Moreover, a project of this size generates approximately 8 jobs per acre, which equals 168 full-time jobs for 21 acres. (Source: Economics of Heat vs. Power Only, Jerry Smith, NREL 2015)

Concluding Remarks:

In both cases presented, geothermal direct use projects have the potential to create a large number of permanent jobs as well as attract businesses and tourists in the case of the Iceland Resource Park and offer the potential to export produce and other goods in both cases. Moreover, the model presented demonstrates that geothermal direct use agriculture and aquaponics projects can offer a short payback period and create a large number of permanent jobs. These case studies and the model suggest that geothermal direct use projects such as greenhouses, aquaponics, and geothermal heat parks can be extremely beneficial to the local economies in that they create jobs, emit little to no GHGs and promote clean growth. These applications could be particularly beneficial for empowering and the promotion of self–sustenance for northern and rural communities in Canada.

Direct Use Applications in Canada

The direct use of geothermal heat can be found throughout Canada in various applications, however these applications are very limited considering the vast amount of geothermal heat available in Canada. The following case studies will illustrate direct use applications in Canada

in attempt to demonstrate that the technology is readily available and should be deployed on a larger scale.

Springhill, Nova Scotia: Mining for Heat

Springhill, a former coal mining town, has long had its sights set on utilizing geothermal heat from their old, flooded mine workings. In the late 1980s the town first began utilizing the fluids from the flooded mine for an industrial heating and cooling system. Since then, with advances in technology and increasing interest in renewable energy, Springhill has began looking into modernizing their geothermal system to use the mines heat to fuel a geothermal business park, where businesses such as a greenhouse will look to make use of the clean renewable heat in their day to day operations.

Moose Jaw: Renewable Mineral Spa

What originally started as an effort to locate natural gas in the early 1900s, led the City of Moose Jaw to discovering what they refer to as "liquid gold," hot geothermal water that now feeds the Temple Gardens Mineral Spa hot pool. The wellhead temperature is around 45°C and the mineral water loses less then one degree as it goes from wellhead to the Spa. The Temple Gardens Mineral Spa is a great example of how geothermal fluids can be used for eco-tourism.

Whitehorse, Yukon: Northern Hot Pool

Yukon is well-known to possess high quality geothermal resources, which can be verified by the plentiful amounts of hot springs throughout the province, most notably, Takhini Hot Springs, a local business that makes use of geothermal heat for their hot pool spa. More recently, North Star Agriculture has set its sights on utilizing this heat for an aquaponics project designed to provide northern families access to local, sustainably farmed food year-round.

Concluding Remarks:

These Canadian projects along with the aquaponics project being developed in Whitehorse are meant to illustrate that there is interest within the private sector to tap into Canada's geothermal heat resources. From the reuse of existing infrastructure such as flooded mines or abandoned wells, to the potential to drill wells to heat a greenhouse or a district heating system, the opportunities for clean, renewable growth are endless for Canada.

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If you have any questions about references within this document, please contact: info@cangea.ca.