Geothermal Energy in Alberta – Opportunities and Challenges

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Alberta is world-renowned for its energy resources and a regulatory framework that focuses on their responsible development, while ensuring public safety, environmental protection, and resource conservation. A combination of economic and environmental considerations over the past five years has led to an increased interest in geothermal energy by the general public, industry, academia, and government.

Alberta's subsurface can be subdivided into shallow depth/low temperature (4 to 40°C), medium depth/medium temperature (40 to 150°C), and deep/hot temperature realms (>150ºC). These realms lend themselves to different geothermal technologies and usages, from domestic ground-source heating and cooling systems (geoexchange) based on closed- or open-loop recirculation and heat-exchanger technology in the low-temperature realm, to large-scale direct steam generation in the high-temperature realm.

Low-temperature, shallow geothermal heating and cooling systems have become increasingly popular for installation in residential and commercial buildings, however, data on the number and kind of installations in Alberta are not available, since the industry is unregulated. Deeper resources involving production of warm to hot saline groundwater are presently uneconomic, but as binary cycle technology improves, these resources may reach a threshold of economic viability that will make saline aquifers valuable for their heat content. The ultra-deep (>5 km) geothermal resource is also of growing interest as it could provide virtually limitless amounts of energy for base load electricity generation, however, economics and technical challenges of deep drilling and stimulation still have to be overcome.

Alberta Geological Survey (AGS), with funding from the Alberta Energy Innovation Fund through an Alberta Energy grant conducted an investigation of the importance of geoscience information for the implementation of ground-source heat pump (geoexchange) systems in Alberta. The results indicate that information on the geology (thickness and composition) and hydrogeology (water table) of Alberta's preglacial and Quaternary drift deposits are of particular importance. System performance is extremely sensitive to dewatering due to groundwater production and/or drought conditions. Mutual interference of geoexchange systems is unlikely to be a problem when spaced at a typical rural or acreage density; however, care must be taken in the placement and design of geoexchange systems in urban settings to avoid mutual interference.

In addition, AGS is undertaking regional mapping of saline aquifers in the deep subsurface below the Alberta Industrial Heartland, centred near Edmonton. The goal of this project is to map the saline aquifers from the crystalline basement to the lowermost aquifer of the Colorado Group in order to assess their potential for future water production or storage, geothermal energy, and their intrinsic capacity to safely store liquid or gaseous wastes, like CO_2, over long periods of time. Ultimately, AGS' goal is to complete maps of saline aquifers across Alberta and

characterize them for the purposes listed above. A forward-looking understanding of the potential cumulative effects of different pore space usages in the subsurface of Alberta is required for their responsible management.

Alberta Geological Survey maps and quantitatively inventories the nonsaline and saline groundwater resources in Alberta. Though there is really only a single groundwater resource in Alberta with gradations of salinity, the AGS program structures its activities based on relative groundwater salinity to ensure a strong linkage between AGS outcomes to Alberta's policy and regulatory framework for groundwater.