



Canadian Consulting Engineering Awards 2013
 Alexandra District Energy Geothermal System
 City of Richmond

A. PROJECT INFORMATION

Project Name:	Alexandra District Energy Geothermal System, City of Richmond
Location:	9600 Odlin Road, Richmond, BC V6X 1C9
Completed by:	July 2012
Category:	E. Natural Resources, Mining, Industry, Energy
Firm Name:	Stantec Consulting Ltd.
Firm Address:	1100 – 111 Dunsmuir Street, Vancouver, BC V6B 6A3
Role in the Project:	Prime Consultant
Member of the Association of Consulting Engineering Companies of Canada (ACEC)?	Yes
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P.Eng.?	Yes



B. PROJECT SUMMARY

Recognizing the benefit of a district energy system as a strategic initiative for advancing towards a more sustainable community, the City of Richmond engaged Stantec Consulting to design the Alexandra District Energy Utility (ADEU) geothermal system. The system currently provides space heating, cooling and domestic hot water, serving over 400 residences as well as a daycare. The system provides a safe, clean, and reliable external energy source, while reducing greenhouse gas (GHG) emissions.



Project Highlights:

Innovation

The ADEU sustainable energy system extracts energy (renewable geothermal energy) from the ground, using a network of 385 boreholes, each 76m (250') deep, drilled in a massive geo-exchange field, beneath a city greenway corridor.

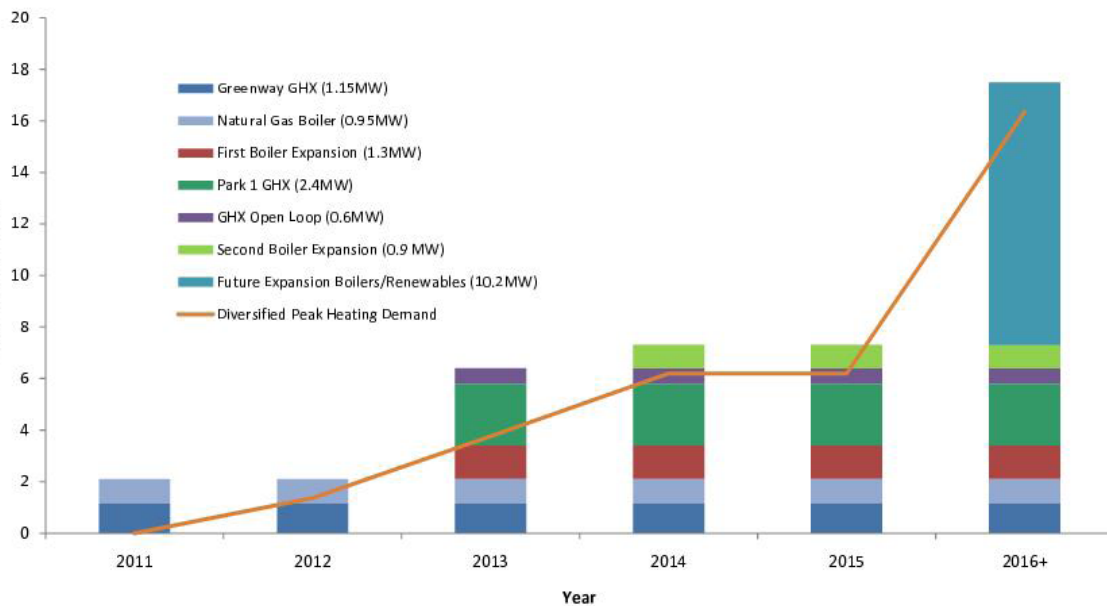
1.3 kilometers of 500mm (20") diameter, high density polyethylene supply and return mains distribute water to and from the geothermal field to the connected buildings. Inside each building, an energy transfer station monitors the heating and cooling requirements of the building and modulates the flow of water from the utility.

Heat pump units in each building elevate the water temperatures for heating or rejects heat into the ADEU system for cooling. During the peak heating season, the system has been designed to operate at a minimum supply temperature of -1°C (30°F) with a 6°C (10°F) temperature drop. During the peak cooling season, the system will operate at a maximum supply temperature of 32°C (90°F) with the same 6°C (10°F) temperature rise. The flow rate is carefully managed to ensure that pump energy is not wasted by circulating water when it is not required.

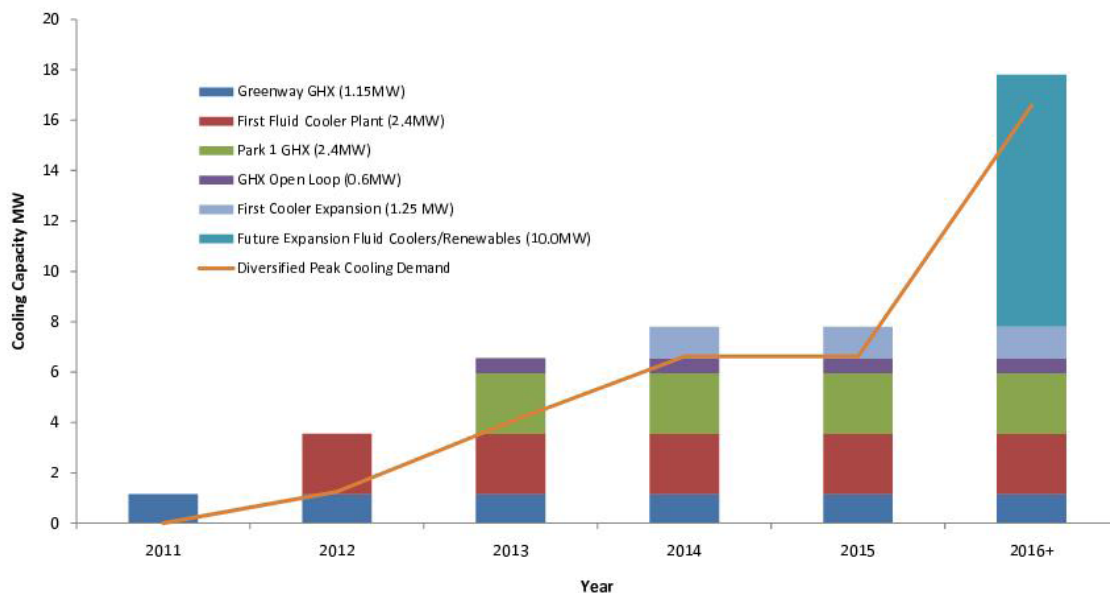
ADEU is designed to allow the connection of additional residences and commercial building into the system. By combining both residential and commercial buildings on the same system, the utility will be able to recover heat rejected by the commercial buildings to provide low-cost heating energy to buildings that require heating, as well improving the operating efficiency of the geo-exchange field.

A 1.0 MW condensing, gas-fired boiler is used as a backup energy source for the geothermal system, as well as providing supplemental heating at peak loads.

Heating - Energy Source Capacity and Peak Demand



Cooling - Energy Source Capacity and Peak Demand



The entire utility is monitored and controlled by an automated DDC system that allows the City of Richmond to monitor energy use and consumption recovery rate.

Due to Richmond's beneficial geology and tidal effected high water table, ADEU's vertical closed-loop geothermal district system is expected to be significantly more energy efficient and cost effective as compared to most other geothermal system. As a result, the utility will be able to serve more buildings at a lower cost and at the same time meet the clients mandate of ensuring that end users will pay equal or lower rates for heating and cooling than they would using a conventional system, and since the utility is self-financing, no cost will be incurred by tax-payers.



Complexity

One key innovation was the utilization of a planned neighborhood greenway corridor as the geothermal field to provide the community with multiple benefits: open green space amenity and an energy source that will bring non-tax based revenue to the community. The geo-exchange field for the first phase of the ADEU is located beneath the public greenway corridor, with nearby public park space available as a future expansion option. By carefully coordinating the landscape planting and construction schedule, there was no impact on the quality of the greenway or the timeline for delivery of these amenities.

The ADEU is phased to provide “just in time” connections of utility service to match the speed of development to avoid tying up capital unnecessarily. As more developments come on stream, the piping and equipment in the energy centre can be expanded to meet the heating and cooling needs of the community. In order to fund future expansion, revenue generated by the utility will fund any borrowing costs.

The district energy system has been designed to allow future phases of the development to utilize several different renewable energy sources, such as geo-exchange (open and closed loop), solar thermal, sewer heat recovery, biogas, or air-source.

Initially, the distribution system will operate without any antifreeze (based on simulation results). The loop temperatures will be monitored and logged, and in the event that temperatures approach freezing, allowances have been made to add glycol to the operating system.

Social and Economic Benefits

The ADEU will generate revenue and have a positive rate of return over time, and therefore will not become an additional financial burden on the taxpayers. The district energy utility was a good candidate for municipal investment and as the demand for heating and cooling services grows in the Alexandra area, capital expenditures will be offset by additional revenues over time. The ADEU will act as a network component for a growing district energy utility system, creating an important asset for the Richmond Community. The business model results show a 6.5% internal rate of return over a 30-year period.

Achieving scale was important in ensuring that the ADEU is economically competitive. Securing early utility adopters was critical, and implementing the mandatory ADEU hook-up through the service area bylaw secured the customer base to support its long-term investment business case. Working with developers on their new developments prior to construction provided immediate connections to the ADEU, which was essential to reduce upfront in-building equipment cost and long term maintenance costs to developers/owners.

It is estimated that ADEU provided the equivalent of 105 jobs during construction and eight jobs on an ongoing basis. ADEU also provides opportunities for new technology operations, maintenance training, and helps to ensure new skills development and current-day relevance of the workforce. ADEU may empower environmentally conscious citizens to feel that they are participating in positive change in reducing greenhouse gas emissions and energy use.





Environmental Impact

ADEU contributes to substantial GHG emission reduction. The use of renewable geothermal energy for space heating, cooling and domestic hot water will help to avoid atmospheric changes caused by GHG emissions. Also by reducing the need to burn natural gas, ADEU reduces air emissions which are produced by the direct combustion of natural gas. As a result, geothermal energy is considered to be a healthier and environmentally more sustainable alternative to other fuel sources.

By minimizing consumption and waste, this system is more efficient than traditional energy supply systems. ADEU increases energy use efficiency by matching energy supply with energy demand. It is adaptable to future technologies and sustainable energy sources such as ground water and sewer energy extraction, plus solar and other evolving renewable energy technologies as they are developed. ADEU also enables building owners to conserve energy and improve operating efficiency, thus protecting the environment and saving money.

ADEU is currently reducing up to 750 tonnes of greenhouse gas emissions annually by utilizing geothermal energy and reducing the dependency on non-renewable energy sources. As a locally sourced renewable energy source, the ADEU and the City of Richmond will be protected from possible energy supply volatility due to its non-reliance on fossil fuels. It is estimated that at build out, ADEU will achieve a reduction of up to 6,000 tonnes of GHG emissions annually, which is equivalent to removing approximately 2,000 cars off the road each year.



Meeting Client's Needs

The City of Richmond is taking an integrated approach to energy, emissions and broader sustainability management. As part of the City's overarching Sustainability Framework, Richmond Council has adopted both a Strategic Energy Program and a Strategic Climate Change Program. Key targets include:

- 10% reduction in total community-wide energy consumption from 2007 levels by 2020
- 33% carbon reduction below 2007 levels by 2020
- 80% carbon reduction below 2007 levels by 2050.

The City of Richmond was early to recognize the benefits of the district energy systems and identified district energy as a key strategic initiative for advancing towards more sustainable energy systems which reduce long-term costs, use energy wisely and reduce GHG emissions. The ADEU geothermal energy system was one of its first major GHG emissions projects that targeted and achieved the required energy and carbon reduction targets by using the untapped renewable energy in the ground.

The project also met the client's fundamental financial objectives e.g.:

1. The annual energy cost to the customers has to be equal to, or less than, the cost for the conventional energy systems for the same level of service, and
2. The ADEU has to be financially self-sufficient – all costs have to be fully recovered through user fees applied to serviced properties only.

