



Alexandra District Energy Utility

Global District Energy Climate Awards - 2021





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Alexandra District Energy Utility (ADEU)
9600 Odlin Road, Richmond, BC, Canada

Lulu Island Energy Company / City of Richmond

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<https://www.richmond.ca/sustainability/energysrvs/DistEnatCity.htm>

Executive Summary

The City of Richmond has committed to reduce the community's greenhouse gas emissions by 33% by 2020, and 80% by 2050, relative to 2007 levels. The City identified district energy as a key strategy to achieve its GHG emissions targets, and decided to incorporate the Lulu Island Energy Company (LIEC) to manage district energy utilities on the City's behalf. In 2012 the City completed the construction of the first district energy system in the City of Richmond—the Alexandra District Energy Utility (ADEU). ADEU is a low carbon district energy system that utilizes ground-source technology to deliver heating, cooling, and domestic hot water pre-heat services to customers in Richmond's West Cambie neighborhood.

Since ADEU started operations in 2012, the West Cambie neighborhood has continued to grow. The ADEU system currently provides energy to 12 buildings, connecting over 2,200 residential units and over 2.3 million square feet of floor space. The use of renewable ground-source energy for space heating, cooling and domestic hot water helps reduce greenhouse gas emissions and reduce the community's reliance on fossil fuels. ADEU's control system prioritizes the use of a renewable energy source, moving on to the cooling towers or gas-fired boilers only when necessary. By reducing the need to burn natural gas, ADEU also significantly reduces air pollution in the neighborhood. The ADEU is an example of how successful policy mechanisms and revenue generation can be used to implement innovative large-scale low carbon district energy systems.



How it started

The City of Richmond has committed to reduce the community's greenhouse gas emissions by 33% by 2020, and 80% by 2050, relative to 2007 levels. The City identified district energy as a key strategy to achieve its GHG emissions targets, and decided to incorporate the Lulu Island Energy Company (LIEC) to manage district energy utilities on the City's behalf.

In 2010, a local developer was preparing to build two multi-unit residential buildings on adjacent sites when he approached the City. This developer had built a geothermal field under one of his previous buildings to provide space heating and cooling and was planning to do the same for these two developments, but he wanted to build one geothermal field in leased City park space for his geothermal field. The City immediately identified the opportunity and rather than lease land, entered into agreement with the developer to design and build the district energy system servicing his two developments.

As the City was finalizing this agreement, other developments began to occur in the neighbourhood. The City offered additional density bonus to the developments that were already in the process. At the same time, the City developed and implemented a service area bylaw, which required that all future developments in the area would connect to the Alexandra DEU.

In July 2012, the construction of the first district energy system in the City of Richmond – the Alexandra District Energy Utility (ADEU) – was completed. Since then, the ADEU has continued to grow and today provides energy to nine buildings, connecting over 2,200 residential units and over 2.3 million square feet of floor space.



How the system works

The ADEU is an ambient temperature district energy system that delivers heating and cooling services to connected buildings. ADEU uses ground-source heat pump technology to extract heat from the ground via a network of 726 vertical closed-loop boreholes, each 250 feet deep. Energy travels from the energy centre through 3.6 km of distribution pipes in the street to the connected buildings.

Buildings are equipped with heat exchangers that utilize the energy delivered by ADEU for space heating, space cooling, and domestic hot water. Heat pumps in the buildings elevate the temperatures for heating or reject heat to the ADEU system for cooling. ADEU's control system prioritizes the use of a renewable energy source, using cooling towers or gas boilers only when necessary.



Phased Expansion

Phases 1&2

In 2012, the City completed the construction and commissioned the first phase of the ADEU district energy system, which consisted of the ADEU energy plant, the first geoexchange field, as well as the North loop distribution piping. The distribution piping system was expanded as part of Phase 2 in 2013. This allowed more developments to connect to the ADEU.

Phase 3

In 2015, a second geoexchange field was installed to meet the demands of new developments in the area. Three 1,500 kW condensing, gas fired boilers are used as a backup energy source to the geoexchange system, as well as providing supplemental heating at peak loads. Two 2,550 kW evaporative fluid coolers will provide backup and peak loads during the hotter months.

Phase 4

In 2016, an innovative central heating and cooling plant powered by low-carbon air source heat pumps (ASHPs) was added to provide heating and cooling to 284,000 SF of new retail space. The SmartCentres mini-plant reduces greenhouse gas (GHG) emissions by reducing natural gas use by up to 70% compared to conventional alternatives.

Phase 5

After completing a detailed analysis, it has been determined that two additional geoexchange fields will be required in year 2026 to continue providing customers with the established 70% renewable energy target. The design of the two geoexchange fields has been completed and construction is planned to start in early 2025.



Technology & Innovation

One key innovation was the utilization of planned neighborhood greenway corridors for installing the geoexchange fields. This approach provides the community with multiple benefits: open green space amenity and an energy source that will bring non-tax based revenue to the community.

The City of Richmond's dedication to sustainability was also evidenced in the construction of the building itself, where the use of wood became a logical decision in terms of utilizing renewable, low-carbon materials. The typical approach would have been to construct this type of building out of high-embodied energy concrete and steel. However, by having a clear mandate and openness to innovation, the City embraced a local, renewable alternative made from beetle-killed wood – Cross Laminated Timber (CLT) – as the main structural component throughout the building.

ADEU has been designed to allow future phases of the development to utilize several different renewable energy sources; the SmartCentres mini-plant was the first district energy systems in Canada to provide heating and cooling to large-format retail buildings using air-source heat pump technology.

Additionally, an energy transfer station links the mini-plant to the main ADEU system, allowing the ASHPs to send the excess energy produced to other ADEU customers. Few, if any, district energy systems in Canada use multiple low carbon heating and cooling sources, which adds to the project uniqueness.



The Business Model

The ADEU business model was guided by three major objectives:

- The annual energy cost to the customers had to be competitive to the cost for the conventional energy systems for the same level of service,
- The system had to be financially self-sufficient – all costs had to be fully recovered through user fees applied to serviced properties only, and
- The system had to contribute to achieving a sustainable and low carbon community.

The primary strategy for construction phasing of ADEU was to match service capacity closely with demand at any given stage. In this way, capital expenditures that don't immediately generate revenue are minimized, and payback periods are reduced. This approach has allowed the City and LIEC to continue to expand and build low carbon energy systems at a competitive cost.

The total capital investment to date has been \$24M. Based on the best estimations and underlying assumptions, the project internal rate of return (IRR) is 8.27% and payback period is 20 years. In the context of a growing base, ADEU financial, operational and environmental results show the DEU is progressing as planned.



Results and Impact



Today, ADEU provides renewable energy to about 2,200 residential units and 314,000 square feet of commercial floor space. To date, ADEU has delivered more than 41,130 MWh of energy and avoided more than 6,800 tCO₂e of GHG emissions. It is estimated that at full build-out, ADEU will result in reductions of more than 1,200 tCO₂e of GHG emissions every year. However, the benefits of entire ADEU system are going far beyond just reducing GHG emissions.

Protecting the environment

ADEU enables building owners to conserve energy and improve operating efficiency, thus protecting the environment. By reducing the need to burn natural gas, ADEU also significantly reduce air pollutants. ADEU is adaptable to future technologies and sustainable energy sources such as ground source heat, ground water heat, sewer heat and solar all serving to reduce the City's dependency on non-renewable energy.

Social benefits to the community

ADEU's infrastructure is largely underground. Therefore, it does not interfere with the aesthetics or activities in the neighbourhood's community open space. Given the energy plants visual prominence in a park and along the road, the public art display showcases better the facility and the park in which it is located. The building's interior is visible through large windows thus providing a view of the infrastructure within.

Economical sustainability

ADEU is phased to provide "just-in-time" connections of utility service to match the pace of the developments and avoid deploying capital unnecessarily. As the demand for services grows in the ADEU service area, capital expenditures will be offset by additional revenues over time generating a positive rate of return. All costs are fully recovered through user fees applied to serviced properties only – the ADEU is financially self-sufficient.

Improved Efficiency/Reliability

ADEU technology is proven and is reliable. Building owners can rely on the ADEU system since it has built in backup systems and its performance is monitored continuously. The ADEU system increases energy use efficiency by matching the energy source with the use. It also increases community energy resiliency by reducing reliance on external energy sources.

Innovation

Utilization of planned neighbourhood park as the geoexchange field provided the community with the multiple benefits: open green space amenity and an energy source that will bring non-tax based revenue to the community.



ADEU Video:

<https://youtu.be/w8nNAT9QLw0>

Awards and Recognition

The ADEU has been recognized as an exemplary district energy system by multiple national and international organizations. The ADEU system has truly become a symbol of 'what cities can do about climate change' and has inspired other local governments and organizations.

Energy Globe Foundation

Canadian Energy Globe National Award - 2013

In 2013, the Energy Globe Foundation recognized ADEU as the best project in Canada for its focus on energy efficiency, renewable energy and the conservation of resources.

Canadian Geo-Exchange Coalition

Excellence Award - 2014

In 2014, the Canadian Geo-exchange Coalition Excellence Award recognized the Alexandra District Energy Utility geothermal/geo-exchange system for its quality of installation and design.

International District Energy Association (IDEA)

System of the Year - 2016

In 2016, ADEU was recognized by the IDEA as the *System of the Year* following its major Phase 3 expansion. This award is the highest honour the IDEA confers to district energy systems.



Association of Energy Engineers

Canada Region Institutional Energy Management Award - 2017

This award recognized the City for its dedication and performance in the energy efficiency and renewable energy industry, and for leading the way with its District Energy program.

Association of Energy Engineers

Canada Region Innovative Project of the Year - 2018

The ADEU Phase 4 expansion project was recognized for its innovative approach to service commercial customers using renewables and making a significant impact on climate change.

International District Energy Association (IDEA)

Public Sector District Energy Leadership Award - 2018

In 2018, the IDEA also recognized the City of Richmond with the *Public Sector District Energy Leadership Award*, recognizing the City for its ongoing support for district energy.