

CANADIAN CONSULTING ENGINEERING AWARDS 2022

BLATCHFORD DISTRICT ENERGY SYSTEM – PHASE 1

LOCATION: EDMONTON, AB

CLIENT/OWNER: CITY OF EDMONTON

LEAD CONSULTANT: ASSOCIATED ENGINEERING

SUB CONSULTANTS: PINCHIN, START ARCHITECTURE



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PROJECT SUMMARY

With the closure of its municipal airport, the City of Edmonton sought to develop an environmentally-friendly community in this downtown area. Associated Engineering collaborated with the city to design Blatchford Neighbourhood's District Energy Sharing System, powered by renewable energy for heating, cooling, and hot water – the largest system of its kind in Canada. Homes employ heat pumps to share unused energy, reducing greenhouse gas emissions. Sustainable by design, Blatchford is a model for the future.



INNOVATION

When its city centre airport closed, the City of Edmonton sought to redevelop the 536-acre area. The city established a vision that “Blatchford will be home to up to 30,000 Edmontonians living, working and learning in a sustainable community that uses 100% renewable energy, is carbon neutral, significantly reduces its ecological footprint, and empowers residents to pursue a range of sustainable lifestyle choices.”

Associated Engineering was engaged to assess the feasibility and develop the design of the community's renewable energy system. The largest application of an ambient-temperature energy distribution system in Canada, the Blatchford Neighbourhood's District Energy Sharing System features many innovations. The system allows for efficient use of heat pumps, integration of other low-temperature sources, such as geothermal (transferring heat from and to the ground), sewer heat exchange, solar PV, and sharing energy between buildings rejecting heat and those requiring it. The system is also designed to be a modular build-out, as the neighbourhood builds out in stages over 25 years.

The system design uses inter-connected nodes of centralized heat pumps distributing ambient-temperature water to heat pumps in each building. This allows for sharing between buildings and flexibility for connection

of additional energy sources in a staged build-out over time. The design features an innovative use of a number of renewable energy sources: geothermal, sewer heat exchange, auxiliary boilers and cooling towers, and solar photovoltaics as a low-greenhouse gas (GHG) electricity source. This energy strategy offers redundancy and reduces overall GHG emissions. In Phase 1, the nearly three kilometre ambient temperature (~10C) HDPE-pipe distribution system offers a number of advantages that help maximize the efficiency of the system and complimentary energy sources.

Most of the renewable energy for heating and cooling in the first phase uses a geothermal ground heat exchanger. A total of 570 boreholes with HDPE pipe loops which are strategically located and drilled 150 metres beneath a naturalized stormwater retention pond. As the neighbourhood grows, the number of boreholes will increase to 2,100. This geothermal technology taps into an endless source of renewable energy from the earth. Subsequent phases will also utilize the plentiful heat in sewer water that otherwise would be wasted.

Blatchford's visionary neighbourhood District Energy Sharing System provides residents with energy from renewable sources, reducing greenhouse gases, enhancing sustainability, and ensuring the community's energy resilience.



COMPLEXITY

The design and scale of Blatchford's District Energy Sharing System is unique and Canada's largest. Significant time was spent analyzing and exploring design options, details, and potential risks. The team identified and mitigated risks without impacting development timelines and occupancy dates.

Communication was critical to successful project delivery and community acceptance. The team supported the City, preparing numerous reports to City Council, responses to public and media enquiries, and third-party reviews. Supporting City communications helped to alleviate Council concerns and garner public buy-in.

Geoexchange test drilling and conductivity testing were completed to develop a site-specific, 570 borehole field design. The geoexchange system involved design and construction of a large and complex piping system. The three-kilometre distribution piping system (DPS) for

Phase 1 consists of two-pipe (supply/return) fusion welded high density polyethylene pipe, up to 600 millimeter in diameter. To facilitate construction, the DPS is largely collocated with other major utilities.

The first phase had to be commissioned before the homes could be occupied. This included the 3 megawatt Energy Centre One plant, DPS, and GHX field. The team employed a quality-based selection approach for the contractor and a construction strategy that resulted in the commissioning of the energy system on time in 2019. Construction coordination required attention to overlapping land development activities including airport lands demolition and preparation, lots, roads, and services, common shallow utilities, stormwater management and pond preparations. Energy Centre One opened with an initial 1 megawatt capacity, and the geoexchange field as its renewable energy source.



SOCIAL AND ECONOMIC BENEFITS

Associated Engineering supported design, construction, and operation planning for Blatchford's energy system. We provided ownership and operations delineation, builder design guidelines, maintenance and operations guides, infrastructure and controls design, stakeholder engagement, regulatory review, end-user pricing analysis (rate setting), and GHG reductions analysis. Review and feedback bodies included the City Finance Department, City Council, public and private stakeholder committees, and third-party technical reviewers. This approach helped ensure that this City-owned and operated community served a wider mandate of innovatively addressing climate change, while balancing technical, financial, and social needs.

A detailed discounted cash flow used a full cost accounting financial model and was developed for multiple design, ownership, and risk scenarios. The model, with integrated dashboard,

was developed as a working tool and provided to the city. This model allowed the city to conduct multiple iterations of risk scenarios and 'what-if' analyses examining different building-out timelines, design standards, and ownership scenarios.

High-temperature geothermal systems typically require distributing at a temperature high enough to meet the most demanding load, often domestic hot water heating. Blatchford's system allows for more flexibility. Homeowners are using water-to-air heat pumps for space heating and cooling, while water-to-water heat pumps provide in-floor radiant heat and domestic hot water heating. The system helps homeowners to minimize energy use and costs.

The Blatchford Neighbourhood exemplifies a community of the future, today, in Edmonton. Blatchford's residents enjoy a sustainable lifestyle, with the amenities to live, work and play in this carbon-neutral neighbourhood, powered by renewable energy.



ENVIRONMENTAL BENEFITS

With almost one million residents, the City of Edmonton plans to double its current population. A changing climate adds an extra level of complexity to achieving this future - whether it's changing demands on infrastructure, how increased density and public transit can be encouraged, or how to be prepared for the increased risks of extreme weather events.

Blatchford showcases what the future could be using sustainable and efficient renewable energy. The Blatchford Energy Strategy commits to higher building standards and employs a unique district energy sharing system using geexchange and sewer heat recovery. This system is based on clean, renewable energy sources, together with solar panels at the energy centres. This approach has the potential to entirely eliminate the emissions associated with heating, cooling, and domestic hot water in the community.

The City of Edmonton's focus was reducing greenhouse gas emissions and minimizing financial

impact to customers. Blatchford's design approach, comprising improved building standards, efficient energy distribution and sharing, and use of renewable energy sources, will reduce greenhouse gas emissions from homes and buildings by about 75% compared to those from a typical Edmonton neighbourhood. At the full buildout of 12,000 townhomes, the community is anticipated to reduce greenhouse gas emissions by about 30,000 tonnes annually.

In addition, a path-lined pond in a naturalized space in the community serves multiple functions, acting as a neighbourhood amenity, bird habitat, and stormwater management facility. The park features a viewing platform over the pond, which attenuates stormwater from the community, alleviating potential flooding.



MEETING CLIENT'S NEEDS

Maintaining the project's tight schedule was critical as the subdivision development was progressing while the main heating process facility, Energy Centre One, was being constructed. Quality-based selection of a general contractor was used to mitigate this risk and the Energy Centre One was successfully commissioned in advance of residential occupancy. Blatchford neighbourhood's district energy sharing system began providing hot water heating, chilled water cooling, and hot water to its residential customers in September 2020. Residents have already discovered the energy system makes Edmonton's coldest and hottest days very comfortable.

The City's Blatchford Energy Strategy was developed around three key pillars that increase resiliency while minimizing emissions: conservation, efficiency, and renewables. The new neighbourhood

successfully incorporates the combined benefits of building energy efficiency, energy sharing within the system, and highly efficient heat pumps, and reduces greenhouse gas emissions. Current projections are that the district energy system will produce more than 90% of its thermal energy output using a combination of renewable heat exchange technologies. Over the next two decades, residents could make Blatchford a hub for an energy transition in one of the most challenging environments in the world.

Since the decommissioning of the municipal airport, the Blatchford Neighbourhood has transformed this downtown area, achieving the City of Edmonton's vision for sustainability and resilience. A model for future developments, the Blatchford Neighbourhood will showcase a carbon-neutral, cold climate, urban community in Canada that is powered by shared, renewable energy.



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MERIT, SUSTAINABLE DESIGN**

Judge's comment: "Stepping into the future. This design puts together so many energy concepts and technologies to culminate towards a smart energy community by really implementing three pillars: conservation, efficiency and renewables. In fact, the carbon-neutral vision for the community harmoniously enabled by Engineering and Geoscience makes this project an example to emulate from. The overall concept will be copied and will only grow and improve from here."