District energy warms up Alberta's suburbs

Community Energy Planning Mission Case Study

- Alberta's climate, urbanization, growth and other factors set the stage for district energy systems.
- Strathcona County's new district energy system is expected to reduce greenhouse gas emissions by 1,100 tonnes per year.
- Okotoks' innovative solar thermal storage district energy system will meet 90 per cent of the community's heating needs with solar energy.

OVERVIEW

Two Alberta communities, Strathcona County and the Town of Okotoks, have implemented district energy systems to meet residents' space heating needs during the province's cold winter months and through the rest of the year. District energy is the supply of heating, cooling or both to multiple buildings from a central source; a district energy system is the physical infrastructure needed to deliver this supply. District energy systems reduce greenhouse gas (GHG) emissions and other pollutants, and lower energy and maintenance costs for building owners. They are also quieter, safer, and more reliable, comfortable and convenient for building occupants than in-building or in-suite mechanical systems. Alberta's climate, increasing urbanization, growth, competitively priced generation sources, and access to low-cost inputs strengthen the prospects for district energy in the province. Strathcona County and Okotoks are innovative examples of this technology at work in new suburban communities.

CENTRE IN THE PARK HAS DISTRICT HEATING AT ITS CENTRE

A district energy system is a key feature of Centre in the Park, a new mixed-use, pedestrian-oriented urban centre under development within the suburban municipality of Strathcona County, Alberta. When it is completed, the 4.2-hectare site will include 390 apartments and commercial, retail and public buildings. The new system currently provides heating to several municipal buildings, including County Hall and a sports arena, as well as to some residential customers.

To provide heat and hot water to the system's customers, water is pumped from the main boiler in the Energy Centre through pipes to individual properties. The system is controlled by outdoor air sensors and ramps up in the cold winter months.

Green hub for shared heat

The 3,300-square-foot Energy Centre — the hub of the district energy system — was designed to complement the architectural style of Centre in the Park. The building's features earned it a Silver rating under the Leadership in Energy and Environmental Design (LEED) Green Building Rating System®. "LEED doesn't apply well to unoccupied buildings, but it can be done," says Jeff Hutton, manager of Strathcona County's utilities department. The building earned points for its minimal footprint, redevelopment of a contaminated site, reduced site disturbance, stormwater management, construction management, recycled content, use of local and regional materials, energy and atmosphere, water efficiency, indoor environmental quality, and waste innovation and

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design. "The building also has a dedicated space for public education," he adds. The space will be used to promote community energy, energy and water conservation, waste reduction, recycling, and GHG reduction.

Strathcona County's Energy Centre (Photo: Strathcona County/Dwayne Welsh)

Long-term investment

Strathcona County estimates that its district energy system will reduce GHG emissions by 1,100 tonnes per year. Municipal and residential building owners will enjoy cost savings, reliable service and the extra functional space no longer required for mechanical equipment. With the combustion source centralized in the Energy Centre and not in individual buildings, owners will also benefit from improved indoor air quality.

While building owners will realize these benefits immediately, the county's investment is longer term. "The system has a 15- to 20-year payback," notes Hutton. "The municipality needs to support that."

Future possibilities

In the future, the county may explore alternative fuel sources, such as biomass, the municipal waste stream, waste heat from industry or hydrogen. Electrical cogeneration, commonly referred to as combined heat and power (CHP), is a possibility. The county may also consider extending its system to other sites, such as Emerald Hills Urban Village (a new sustainable community under development) or the local hospital.

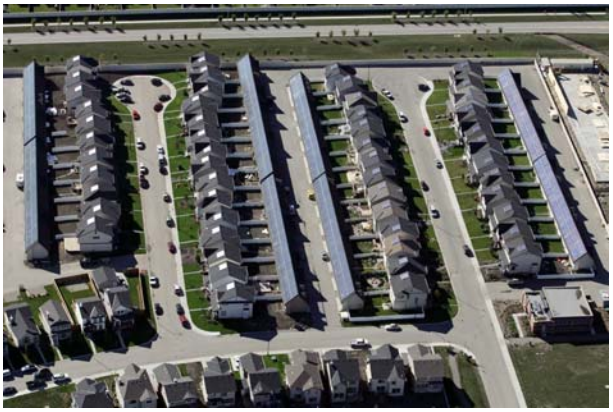
STORING OKOTOKS' SUMMER SUN

At Drake Landing, a new subdivision in Okotoks, Alberta, a new district energy system provides heat to 52 single-family homes. The first of its kind in North America, this innovative solar thermal storage district energy system combines with in-home solar domestic hot water systems to nearly eliminate GHG emissions. It is anticipated that the system will meet 90 per cent of the community's heating needs with solar energy when it is in full operation. The remaining 10 per cent will be met with natural gas. "We've been told it's the most ambitious solar project in the world," says Keith Paget, manager of special projects for the Sterling Group of Companies, the builder of the project.

Okotoks receives solar energy comparable to Italy, Greece and Miami, Florida, making it a prime candidate for using solar energy as a heating source. By capturing and using this renewable resource, each Drake Landing home emits 4.5 fewer tonnes of GHGs than a conventional home in one year and uses 30 per cent less energy.

From rays to residences

In the summer, 800 solar collectors located on top of residents' garages absorb the heat from the sun — about 1.5 megawatts of thermal energy on a typical summer day. This energy heats a glycol solution that moves from the collectors through an underground trench system to a heat exchanger in the hub of the district energy system, the fully automated Solar Energy Building. The glycol passes through the exchanger, transfers heat to water stored in two large, 120,000-litre insulated storage tanks, and continues through the loop back to the collector system. From the storage tanks, the heated water is distributed to the borehole thermal energy storage (BTES) field, an underground system of 144 boreholes where heat is stored for use in winter. Finally, the water returns to the storage tanks to be reheated and repeat the process. When heat is needed, stored thermal energy is distributed from the storage tanks to Drake Landing residences.



Drake Landing solar collectors (Photo: Natural Resources Canada/Doug McClenahan)

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The system runs only as needed. The supply of sun energy and demand for heat determines the rate of fluid movement throughout the various parts of the system. On very cold days on which the community's heating needs exceed the capacity of the BTES field, two back-up natural-gas-fired boilers supplement the system.

"Everything is doing better than expected," reports Bill Wong, project manager at SAIC Canada and the project lead for Drake Landing. The project team estimates that it will take three years to ramp up the system to meet 80 per cent of the community's heating needs with solar energy; the ultimate goal remains 90 per cent. The team uses a sophisticated modelling tool to monitor the system's performance.

Investing in knowledge

Funded by a consortium of partners including the Federation of Canadian Municipalities' Green Municipal Fund™ (GMF), the construction of the Drake Landing solar community totalled approximately $7 million, not including hundreds of volunteer hours contributed by many of the project partners. Each house sold for an average of $380,000. The $7 million project cost included a significant amount of one-time research and development that would not be necessary were the initiative replicated in another community. "It would cost $4 million if we did it again somewhere else," says Wong. To realize economies of scale, Wong suggests that the optimal size for such a community is a minimum of 200 to 300 homes. "The system would be the same," he explains, "we would just need bigger boreholes."

WESTERN SUCCESSES LEAD THE WAY

Space heating accounts for the greatest share of energy use in a typical Canadian home, making it the largest energy expense for homeowners and the greatest source of residential emissions. District energy systems are a viable alternative to in-building mechanical systems, offering many environmental, economic and health benefits. As more Canadian communities explore ways to reduce their environmental impacts and energy costs, Okotoks and Strathcona County offer innovative and successful options for a more sustainable future.

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ADDITIONAL RESOURCES

This case study highlights sites visited by delegates on the 2007 FCM Community Energy Planning Mission. For additional information on the Mission, including more Mission case studies, presentations and the 2007 Mission Report, visit the FCM Centre for Sustainable Community Development Website at <www.sustainablecommunities.fcm.ca/Community_Energy_Mission>.