Feature Story

A Canadian Renaissance:

District energy, new development go hand in hand

District energy is on the move across Canada. From British Columbia to Nova Scotia, new systems are being developed at a faster pace than ever before. Municipalities are using district energy to help meet their greenhouse gas reduction goals, attract new development and tap underutilized local resources. Combined heat and power is becoming more common, and natural gas-fired plants are being augmented with energy from geoexchange, solar thermal, biomass, biogas, deep water cooling and waste heat recovery sources. There is no one-size-fits-all model, with technology, ownership and financing mechanisms varying considerably across the map. The following profiles offer a snapshot of this activity in a handful of Canadian communities today. Collectively, they illustrate a range of approaches to building and expanding community energy systems.

Hamilton: Hamilton Community Energy

What happens when a community energy provider teams up with a renowned university's innovation park? In the case of Hamilton, Ont., the answer is a hybrid energy system that combines solar thermal, geoexchange and conventional technologies.

Hamilton is a port city of approximately 500,000 residents located in a densely populated region at the west end of Lake Ontario. It is home to Hamilton Community Energy (HCE), a division of Hamilton Hydro Services, Inc., which is a subsidiary of Hamilton Utilities Corporation, a private corporation wholly owned by the city of Hamilton. Established in 2002, HCE provides hot water district heating, domestic hot water and backup electricity to 2 million sq ft of commercial, institutional and multifamily properties in downtown Hamilton. Each of its customers is EcoLogo-certified, a qualification that is part of the LEED® (Leadership in Energy and Environmental Design) certification process.

Just 1.8 miles from this downtown system lies a very different landscape: a once-vacant brownfield that is being transformed into a premier innovation park. The new facility, McMaster Innovation Park, is being developed by McMaster University, and is funded in part by both the city of Hamilton and the province of Ontario. McMaster Innovation Park is building on the university's reputation as a premier research institution to develop new programs in advanced manufacturing and materials, nanotechnology and other areas in which it has recognized research strengths.

> HCE anticipates that approximately 85 percent of the combined cooling requirements will be serviced by the geoexchange system.

In 2009, McMaster Innovation Park completed its first project in the former brownfield: the renovation of an old

With 157 rooms and 165,000 sq ft of space, the CANMET-MTL includes facilities for casting, rolling and forming metal, and designing and testing new materials. The federal lab will assist academic and industry partners with developing new metal technology that will improve Canada's industrial competitiveness.

The award-winning Hamilton Community Energy plant is seamlessly integrated into the surrounding community. It shares a wall (upper right) with a local downtown high school.

Westinghouse appliance manufacturing facility into a high-tech office, laboratory and conference facility called the Atrium@MIP. 2010 saw the completion of a second facility, the CANMET Materials Laboratory (CANMET-MTL), which was designed to LEED Platinum standards with many energy-conserving features including solar walls. The CANMET-MTL is a three-story, 165,000-sq-ft building housing the Canadian government's Materials Technology Laboratories. Among its many features are a mini steel mill (used for testing materials) and solar thermal panels on the roof, which are connected to the hybrid energy system. But McMaster Innovation Park wanted to go even farther, and asked HCE to consult on the feasibility of installing a geoexchange system.

"As our discussions evolved, we discerned that there was a huge opportunity to start a district energy loop that would leverage the potential of solar thermal and geoexchange technologies with the boilers and chillers that had already been installed in the Atrium," says Ron Harten, general manager of HCE. "We were given the job of coming up with a plan to integrate all of these elements, hire the engineers, and put the pipes in the ground."

McMaster Innovation Park contracted with HCE to provide a total turnkey 'design-build-own-and-operate' solution. In just under a year, Harten and his team built a geoexchange system consisting of 81 500-ft geo wells, four heat pumps and associated auxiliaries. The new geo field, along with the district energy piping connections, is located between the Atrium and CANMET-MTL facilities. With this solution, HCE will supply heating and cooling for more than 350,000 sq ft of space in the Atrium and CANMET-MTL buildings utilizing a combination of energy technologies. For the cooling requirements the system will use a combination of heat pumps interfaced with the geoexchange field in cooling mode and two chillers. HCE anticipates that approximately 85 percent of the combined cooling requirements will be serviced by the geoexchange system.

The heating loads will be supplied using heat pumps interfaced with the geoexchange field in heating mode, the solar thermal system (on the CANMET-MTL roof) and hot water boilers (in the Atrium). Domestic hot water and heating loads will be served first by the solar thermal system, with incremental heating then supplied by the heat pumps and geoexchange field. Heating peaks and heating supply redundancy will then being supplied by the hot water boilers.

The district energy system is designed to maximize excess captured solar energy to charge the geoexchange well field, which will be utilized later when the geoexchange system is in heating mode. It is one of the few systems in Ontario employing a hybrid of renewable, green and conventional technologies in a district energy concept.

"We've taken a whole-building approach to sustainability in the design and construction of the CANMET Materials Technology Laboratory, and a district energy system is a key element of that approach," says Zach Douglas, president and chief executive officer of McMaster Innovation Park. "We are thrilled to be working with Hamilton Community Energy, an organization that shares our commitment to innovation. The district energy system is a critical element in our plan to become LEED Platinum-certified. We also expect it to be cost-effective and deliver efficiencies for our tenants." The CANMET-MTL celebrated its grand opening on Feb. 23, 2011.

Calgary: ENMAX Energy Corp.

Forbes magazine has called it the world's cleanest city. The 2010 Mercer Quality of Living Survey ranked it as the world's number one eco-city. It operates a public light rail system powered entirely by the wind, and the city has a fleet of nearly 200 vehicles running on biogas. District energy, however, is a relative newcomer to Calgary, Alta. (pop. 1,071,000), Canada's fourth-largest city.

Ever since the 1988 Winter Olympics put Calgary on the international map, the city has become a magnet for tourism, attracting more than 3 million visitors annually. A culture of entrepreneurism has made it appealing to a variety of businesses, and it recently launched a bold plan to revitalize one

of its oldest neighborhoods, known as the East Village, into a modern high-density urban village with all-new infrastructure including a district energy system. Planners chose to locate the plant adjacent to the East Village and near the downtown core, but practicality was not their only consideration. The stylish, glass-enclosed Calgary Downtown District Energy Centre was also designed to be a symbol of Calgary's progressive approach to energy and environmental stewardship. It was conceived at a time when significant East Village development appeared imminent; since then, however, construction has slowed considerably. When the Energy Centre went on line in March 2010, it had only one customer: the 750,000-sq-ft Municipal Building, which previously was served by seven separate boilers.

The CA$50 million ($51.5 million) District Energy Centre currently houses three natural gas-fired boilers with a design load of 119 MMBtu/hr, and expansion capacity of up to 205 MMBtu/hr. The hot water system has the capacity to serve 10 million sq ft of building space. The system is owned and operated by ENMAX Energy Corp., a wholly owned subsidiary of the city of Calgary. ENMAX and its affiliates provide electricity, natural gas and fiber optic services to more than 600,000 residential, commercial and industrial customer locations in Alberta, and they compete in Alberta's restructured electricity industry. Partial financing was provided by the Canada-Alberta Municipal Rural Infrastructure Fund (CAMRIF), a partnership among the federal, provincial and municipal governments.

> The biggest challenge in promoting district energy is overcoming a lack of awareness about this technology.

Even though the District Energy Centre is essentially owned by the municipality, the city is not offering any incentives to attract customers. "Calgary is an entrepreneurial city, and the city is not requiring anybody to sign up," says Adrian Begley, interim vice president of district energy for ENMAX Corp. "The city recognizes the value of district energy and what it represents. But we are competing against the alternative, which is the standard boiler installation both for retrofits and new installations. I believe the city is looking to see, in a competitive market, how we are going to demonstrate to people that there are savings with district energy."

Begley says that his biggest challenge in promoting district energy is overcoming a lack of awareness about this technology and demonstrating to customers the long-term cost benefit compared to on-site systems. "We're comfortable with our pricing structure, so if the customers were to hire an independent engineering contractor to compare our pricing with a standard boiler installation, they will see that it represents a savings for them." Potential customers also value the green attributes of district energy, he adds.

In keeping with its green image, Calgary has set an aggressive target of reducing its municipal greenhouse gas emissions 20 percent by 2020 and 80 percent by 2050, based on 2005 levels. Its latest "Target Minus 80" plan identifies key strategies to achieve this goal including the increased use of green power, capturing methane from landfills, greening its vehicle fleet and improving building energy efficiency. So where does district energy fit in this plan?

"I don't think the city was thinking about district energy when they set the greenhouse gas reduction goals, because the District Energy Centre wasn't there yet," says Dennis Elias, director of stakeholder relations for ENMAX Energy Corp. "When it became apparent that district energy could play a significant role in hitting their target, they became a lot more interested, for obvious reasons. Initially, people didn't connect the dots between greenhouse gases and district energy, but now that it's actually here, interest is growing. The city sees it as a flagship facility."

The Calgary Downtown District Energy Centre currently houses three natural gas-fired boilers and has the capacity to add a fourth. It was designed to showcase district energy technology and the city's commitment to progressive energy management.

The Calgary Municipal Building recently switched from an aging conventional boiler system to the new district energy system.

Markham: Markham District Energy

The evolution of the district energy system in Markham, Ontario demonstrates what can be accomplished when municipal leaders, planners, private businesses and energy providers can work together toward a common goal. In just one decade, Markham District Energy (MDE) has commissioned three plants and connected 6 million sq ft of building space to its hot and chilled-water networks. A fourth plant is currently under construction that will provide heating, cooling and electricity to a new hospital and surrounding properties. And there's more to come.

"One of the things that our company will be doing in its second decade is evolving into renewable energy," says Bruce Ander, president of Markham District Energy, a private company whose sole shareholder is the city of Markham. "Solar, biomass and biogas are all on the table. Ontario has made a dramatic move toward green energy. Two years ago they put into law the Green Energy Act, which has introduced a feed-in tariff – in other words, a premium price – for solar, wind and biogas developers. Some were critical, claiming the prices are too high, but it's done what it was intended to do, which is create jobs and add renewable energy capacity to the Ontario grid. For the biogas opportunity, MDE is talking with a local developer who is in the organic waste business. They would do the production of the biogas and MDE would introduce it as a supplementary fuel to natural gas at our combined heat and power facility. We are also working to secure a supply of local biomass for a biomass boiler. And we have an agreement to install a solar installation. So within the next three years we'll probably have one or all three of those alternate fuels in play. They won't replace our natural gas primary fuel, but they will certainly diversify our fuel mix."

> MDE has been able to work with the municipality to convince companies to locate in Markham.

From the very beginning, one of the key ingredients in MDE's success has been its ability to work in partnership with the municipality to convince companies to locate in Markham. In 1999, IBM became the first customer of the initial Markham Centre system, choosing to build its new software laboratory in Markham in part because of the promised reliability of the district energy system. IBM thus served as the anchor for the subsequent expansion of the system.

Ten years later, Markham District Energy was able to leverage its record of uninterrupted service to IBM to convince Bell Canada to build its new data center in Markham. "MDE owned property that was ideal for Bell's needs, and we offered a robust district cooling system and on-site power generation," recalls Ander. "They also liked the green attributes that we would bring. Ultimately, they chose to invest in Markham because of the district energy connection. So there's an economic development story there."

When the deal was announced last year, Stéphane Boisvert, president of Bell International Markets, said that "Bell is eager to leverage Markham District Energy's highly efficient and fully redundant energy infrastructure to reduce Bell's energy footprint, while also providing unique opportunities such as capturing the significant heat generated by large-scale data center operations for use in community heating." The data center is scheduled to open in spring 2011.

Markham District Energy is also partnering with the new Markham Stouffville Hospital that will soon form the nucleus of the Markham East system, which is separate from the original system in Markham Centre. In 2007 MDE, the city and the hospital came together to talk about a community energy project for which the hospital would become the anchor load. The hospital carved out a piece of its land for the plant that will be leased to MDE for 99 years, and the two parties have signed a long-term energy agreement. The hospital complex totaling 800,000 sq ft will be completed in 2013.

The new East Plant will be fired by natural gas, providing the hospital with primary power, emergency power, steam, hot water and chilled water. Solar panels on the roof will serve as an additional thermal resource. However, unlike most self-contained hospital systems, this system will deliver energy services to the surrounding community as well. "Today, in addition to the hospital, we have a community center under construction, a new fire station and a new five-story health complex for doctors," says Ander. "So out of the gate we'll have a little over a million square feet connected to the new district system. And there's a lot of density that will be built all around that core over the next few years."

If Markham's story points to the importance of leadership at the municipal level, what role, if any, is played by federal or provincial governments? Says Ander, "Energy policy is driven at the provincial level. In Ontario, one of the things that we all think is important is CHP, and the ability for an entity to construct a CHP plant right now is dependent upon a feed-in tariff program that is expected to be introduced this spring by the Ontario Power Authority on behalf of the provincial government. Then at the federal level there are overarching tools that are available. At the end of the day, though, district energy is driven by municipal leadership. The municipality has to want to have it happen in their community and then develop an energy plan in concert with its urban developments."

The 16-story Tridel Circa complex, located in Markham Centre, is the first Canadian high-rise condominium to sign with a district energy utility.

Who Sets the Policy?

In Canada, energy policy is set primarily at the provincial level, as is planning, regional growth and environmental policy. In addition, provincial governments govern the regulatory regime for natural gas and electric systems operations. Some provinces offer fiscal incentives to incent changes in electric systems, and to customers for energy efficiency investments. Ontario, for example, has feed-in tariff programs for renewable generation and a recently introduced CHP Standard Offer Program for small-scale CHP in certain areas of the province. In many Canadian provinces, the electric utilities are government-owned and -controlled, at either the provincial or the municipal level. Utilities can support community energy planning and serve as financial counterparties for electricity procurement from CHP facilities.

At the national level, a portion of the federal gasoline tax is allocated to the Gas Tax Fund (GTF), which provides predictable and long-term funding directly to municipalities. The allocation to each municipality is determined at the provincial/territorial level based on a per capita formula. The GTF supports sustainable infrastructure such as public transit, drinking water, community energy systems, solid waste management, and roads and bridges. Municipalities can pool, bank and borrow against this funding, providing significant additional financial flexibility. For the period 2007-2014, municipalities will receive a total of CA$11.8 billion in gas tax funding. However, municipalities have considerable leeway in deciding how to invest these funds, and district energy is only one of many worthy options.

Tapping Local Energy Sources

While most Canadian district energy systems rely on natural gas as their primary fuel source, communities are also finding creative ways to tap underutilized local resources such as geoexchange, seawater and waste heat from industrial processes. The following exemplify this quest for finding new energy sources close to home.

British Columbia

As a leading energy provider in British Columbia, FortisBC is a wholly owned subsidiary of Fortis Inc., a Canadian-owned company that serves approximately 2.1 million customers with assets exceeding CA$12 billion. FortisBC delivers natural gas, electricity and thermal energy solutions to more than 1.1 million customers in 135 communities.

FortisBC (formerly known as Terasen Inc.) is in the detailed engineering and design stage for a project in Quesnel, B.C. (pop. 9,300) that will tap into the heat from an existing sawmill to operate a combined heat and power plant. The system will provide 5 MW of thermal energy to buildings in the downtown core and 2 MW of electricity for the local grid. The municipality was able to secure more than CA$4 million in funding through the Innovative Clean Energy technology fund.

The city of Kelowna (pop. 106,000) is considering two new district energy systems. In the growing South Pandosy commercial district, FortisBC plans to capture the waste heat from the city's main wastewater treatment plant to power a system serving new developments as well as existing loads. Meanwhile, the nearby downtown area could soon be served by a system that taps into waste heat sources from a local sawmill; waste heat from the large Sun-Rype juice manufacturing facility and Tolko Industries could provide yet another local energy source.

Nova Scotia

On Canada's East Coast lies the province of Nova Scotia and the port city of Halifax (pop. 291,000), where East Port Energy, a division of privately held East Port Properties, is planning a trigeneration system that will produce heat and electricity using gas-fired engines. The seawater heat exchangers will supply cooling to customer buildings while also providing heat rejection for the centrifugal chillers located at the plant. Using seawater will allow the local electric utility, Nova Scotia Power Inc., to reduce its generating capacity requirement by 4.5 MW when the plant is operating at design cooling load. This is a real reduction in capacity because the cooling customers will avoid the power requirement that otherwise would be required for conventional chillers.

"At full buildout, the site will have three cogeneration units with a combined capacity of 22.5 MW," explains John Lindsay, president of East Port Energy. "When you add the 4.5 MW avoided through the use of seawater for air conditioning, our solution will reduce future generating capacity growth requirements by 27 MW." That reduction could be important to Nova Scotia Power, which is under a mandate from the provincial government to reduce greenhouse gas emissions.

The proposed system is poised to take advantage of Halifax's projected growth. "There's a significant amount of new development occurring within the planned thermal distribution area of the project," says Lindsay. "The projected cost is CA$150 million, which we expect to finance with private equity and perhaps some debt. East Port will build and manage the system, but we do not intend to own it. We are talking to companies in the ownership business that have an interest in this project. The city has shown great support for all aspects of the project and is considering becoming one of its first thermal energy customers."

Halifax already has the distinction of having North America's first seawater air-conditioning system, constructed by Purdy's Wharf Development (now East Port Properties) in 1985 for Purdy's Wharf, a complex consisting of 18- and 22-story office towers and a four-story commercial building. Today, seawater

provides all of the required cooling for all three buildings for 10-1/2 months of the year; during the other six weeks, when the seawater temperature exceeds 50 degrees F, the water is used to cool the condensers of the conventional chillers. The combined annual savings attributed to avoided power costs and reduced maintenance, freshwater use and water treatment were CA$104,000 when the complex was commissioned.

The Purdy's Wharf complex in Halifax is home to North America's first seawater air-conditioning system.

Want to Know More?

Learn more about Canadian systems by visiting districtenergy.org, where you will find the following recent feature stories:

- "University of Calgary Converts to Cogen: New system slashes emissions amid building boom" – First Quarter 2011
- "Revitalizing Regent Park: System helps re-energize Toronto social housing" – First Quarter 2010
- "Blue Skies for Dockside Green: Biomass gasification heats harborfront community" – Fourth Quarter 2009
- "Going for the Gold: Sewage heat recovery to serve Olympic Village" – Third Quarter 2008
- "'Smart Growth' in Markham Centre: District system, community planned together" – Second Quarter 2008
- "North Vancouver's Progressive Vision: 'Mini-plants' and a sustainable energy future" – Third Quarter 2006
- "Into the Deep: Enwave taps lake water to cool Toronto" – Second Quarter 2005

One of Ontario's new district energy systems was designed for Regent Park, a mixed-use community developed by Toronto Community Housing. When completed, it will have 12,500 residents plus a variety of community facilities and retail establishments. All buildings are designed to LEED standards and all receive their heating, cooling and hot water from a CA$60 million community energy system. Read the full story in the first quarter 2010 issue of *District Energy*.