

Cornell Centre, Ontario:

Markham's continuing commitment to district energy, CHP and city building

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Maintaining the status quo is often our natural inclination. It is the easiest, safest and least-resistant path. It is said you rarely get fired for repeating models of the past. For some, pursuing the new and innovative comes with unacceptable career risks.

Another observation is that society operates in silos. For projects involving energy and infrastructure requiring the support and cooperation of multiple departments and levels of government, it is much easier to manage what you are assigned to manage and not try to change the world from your individual silo. Unless change is led from the top, breaking down silos may be impossible from the middle ranks.

These two common obstacles – the status quo and silos – are what make the story of district energy in Cornell Centre, Ont., interesting. It is a story of city-building champions, cooperation and breaking down barriers.

Markham District Energy's Bur Oak Energy Centre, commissioned in 2012, currently provides heating and cooling to more than 1 million sq ft of space in five Cornell Centre buildings.

Courtesy Markham District Energy.

MARKHAM'S CORNELL CENTRE

The city of Markham, located just north of Toronto, is considered Canada's high-tech capital as it is home to more than 900 high-technology and life science companies, including 400 corporate head offices. With a population of just over 300,000, Markham is one of the fastest-growing and most culturally diverse cities in Canada. The population is projected to grow to more than 450,000 within 20 years.

At the foundation of Markham's plan to accommodate this growth is the development of four major high-density communities. One of these urban growth areas is Cornell, located on the eastern border of the municipality.

Cornell is an award-winning planned development designed in the mid-1990s according to principles of "new urbanism" – an approach to urban development promoting mixed-use communities that value connectivity, high-quality design and human-scale open space. Today, Cornell is home to thousands of residents and small businesses.

Though Cornell has seen extensive residential development over the years, many areas of the community remain undeveloped, most notably Cornell Centre. Covering 250 acres, Cornell Centre is intended to be the heart of Cornell, a higher-density, mixed-use subdivision with a retail core. Over the next two decades, it will develop into a center of approximately 10 million sq ft of residential, commercial and institutional buildings and will be home to more than 10,000 residents and 10,000 jobs.

MARKHAM'S COMMITMENT TO DISTRICT ENERGY

In Markham's New Official Plan, a statutory document required by the Ontario Planning Act, the city council sets out policy on how growth will be managed and strategies relating to land-use planning, urban design and sustainable development. In this plan, the future of district energy is

clear. It is the policy of Markham City Council to

- work in partnership with city-owned utility Markham District Energy (MDE) to provide leadership in the design, development and use of community energy in Markham and to promote Markham as a demonstration site for new technologies addressing climate issues and energy;
- encourage eco-industrial activities in business parks and the retrofit of existing business parks in ways that support and maximize cogeneration opportunities and district energy; and
- support sustainable development in Markham's communities through the integration of land-use, transportation and infrastructure planning, and building and site design to maximize district heating and cooling systems.

MARKHAM STOUFFVILLE HOSPITAL

Located in the heart of the developing Cornell Centre, Markham Stouffville Hospital is a large-community, full-service teaching hospital. Back in 1960, a local Markham farmer had a vision for improved health care

and gifted 50 acres to the municipality for the sole purpose of building a hospital for Markham and surrounding residents.

The farmer's vision was finally realized in 1990 when Markham Stouffville Hospital was first constructed (then 331,000 sq ft) to serve a population of 77,000. By the late 1990s, a hospital expansion was well overdue as the population had tripled. In 2007, the hospital received provincial approval to expand to 705,000 sq ft. With the groundbreaking celebrated in 2009, the expanded facility was completed in 2012.

With the hospital's original heating, cooling and emergency power assets approaching end of life and the pending expansion of the facility, this was the perfect opportunity for MDE and the city of Markham to consider a second district energy system with Markham Stouffville Hospital as its anchor load.

A CITY-BUILDING INITIATIVE

The planning of Cornell Centre and the approved expansion of Markham Stouffville Hospital converged in 2007. At the same time, the city of Markham approved a new



Courtesy Markham District Energy.

Markham Stouffville Hospital's recent expansion doubled the size of the current facility. The hospital will also undergo significant renovations to the existing building, slated for completion in 2014.

community center facility – housing swimming pools, gymnasiums, an indoor track, performance studios and library – to be constructed adjacent to the hospital. Together, Markham Stouffville Hospital and the Cornell Community Centre & Library would create a significant health and wellness campus.

Since 2000, Markham had already experienced success with its first district energy investment serving its downtown plan known as Markham Centre. Markham also knew that most district energy systems require two key elements: champions and anchor loads. While Markham District Energy saw the technical potential for a district energy investment, it had early challenges securing the anchor load and the champions.

STATUS QUO BARRIER

When Markham Stouffville Hospital was first approached by MDE in 2007 with the concept of becoming an anchor customer for a new district energy system, its long-standing consultants were opposed. It was argued

that handing over critical energy services to a third-party provider was not the norm and could be risky. The contractors bidding on the expansion added that it would be more cost-effective to give them the contract for the central utilities plant as an extension of their hospital construction project. It was also argued that the coordination of construction with MDE could be very risky and, if mishandled, costly to the hospital. The fear was raised that if MDE were ever late, significant contract extras could result.

CHAMPIONS EMERGE

With these objections on the table, the champions emerged at the hospital and at the city. The concept of city building goes beyond the interests of one party or the interests of the status quo suppliers. If the hospital became the anchor load to a new district energy system, which would grow over time to serve customer space totaling 10 million sq ft, the hospital would benefit from being part of a large, diversified energy system with significantly higher redundancy

levels and professional management operating the energy assets. This was appealing to the Markham Stouffville Hospital board and senior management on one condition: MDE had to demonstrate that it could provide and deliver under contract heating, cooling and electricity to the hospital at a competitive cost compared to what the facility itself would have otherwise provided. While higher reliability, environmental performance and contribution to the city-building vision were all important factors in district energy's favor, cost-competitiveness was key amid the reality of shrinking health care funding.

SILLO BARRIER

After the hospital consultant's analysis was completed in late 2008, and the hospital decided in principle to be an anchor customer of a new district energy system in early 2009, a new barrier appeared. In Ontario, hospitals have two funding sources: one for capital projects and the other for operating expenses. Surprisingly, the two funding "departments" at the



Courtesy Markham District Energy.

The Cornell Community Centre & Library officially opened in February, with a direct connection to the Markham Stouffville Hospital. Together, these facilities create a unique health and wellness campus.

provincial Ministry of Health are not connected, aligned or coordinated.

This funding model creates a problem for district energy. The district energy rate structure has a fixed capacity charge (for capital recovery) and a second charge for metered variable energy. On the surface this seems easy to solve: Simply put aside the avoided capital dollars in a trust to pay for the fixed capacity charges over time. However, the Ministry of Health funding models are strict and rooted in legislation. At one time this one issue was feared to become a deal killer and end the bigger vision.

Janet Beed, Markham Stouffville Hospital president and chief executive officer, gives credit to Ministry of Health officials who found an acceptable path forward within their strict funding guidelines. In the end, the district energy charges mirrored a conventional budget for a hospital not connected to district energy; and unexpectedly, champions emerged in the Health Ministry. The ministry's solution was to "allow" the hospital to buy down future district energy

fixed capacity charges with capital funds that it would have otherwise used to pay for the conventional central utilities plant as part of the redevelopment. Again, what may appear as a simple solution required careful thought and levels of approval given the structure of provincial health care funding and the precedent this decision might create.

BUR OAK ENERGY CENTRE

Roll the clock forward to fall 2012, and MDE completed the Bur Oak Energy Centre and the thermal distribution system to serve the system's first five customers, with Markham Stouffville Hospital as the system's anchor load. The Bur Oak Energy Centre currently provides heating and cooling thermal energy to five customer buildings totaling just over 1 million sq ft, and the plant has been designed to expand to serve another 4 million sq ft of mixed-use development in Cornell Centre that city planners expect within 10 years.

The Bur Oak Energy Centre produces hot water, steam and chilled

water. Emergency power is available to the hospital from a 5 MW diesel generation plant also owned by MDE. Primary power flows onto the site through the Bur Oak Energy Centre, and MDE is responsible for power supply to the hospital regardless of whether it originates from the grid or is produced by MDE's generators.

The hot water system is equipped with three dual-fuel watertube boilers totaling 51.2 MMBtu/hr of capacity. Up to 16,790 lb/hr of steam can be generated by the plant's three 500 HP dual-fuel coil-tube boilers with economizers, and chilled-water is produced by three York centrifugal chillers (two variable-frequency drives) with a total capacity of 3,950 tons. The center also houses the two 2.5 MW emergency power diesel generators. Architecturally, this



Courtesy Markham District Energy.

Bur Oak Energy Centre's three watertube boilers have a total capacity of 51.2 MMBtu/hr with condensing economizers at 88 percent higher heating value.

CORNELL CENTRE DISTRICT ENERGY CUSTOMERS

Markham Stouffville Hospital – a full-service teaching hospital with 320 beds (705,358 sq ft)

Cornell Community Centre & Library – swimming pools, gymnasiums, indoor track, performance studios and library (153,000 sq ft)

Health Services Building – five-story medical office complex (75,000 sq ft)

Medical Office Building – five-story medical office complex (64,816 sq ft)

Markham Fire Station 99 – one of nine fire stations serving the city of Markham (10,826 sq ft)

Future Customers – 10 million sq ft of residential, commercial and institutional building space

two-story energy plant was designed to appear as an extension of a structured parking facility and blends into the wellness center campus.

WHY DID THE HOSPITAL SAY YES?

MDE is committed to providing heating, cooling and electricity to Markham Stouffville Hospital at a competitive cost with higher levels of reliability. Underpinning its decision to connect to district energy, the hospital concluded that energy production is not its core competency. To quote President and CEO Beed: “Markham Stouffville Hospital took an important step forward when it decided to partner with Markham District Energy (MDE). In this critical relationship, the hospital does what it does best by providing high-quality health care to our community; and MDE does what it does best, providing reliable, competitive and environmentally superior energy services to our hospital.”

Other factors entered into the decision. District energy offered valuable LEED (Leadership in Energy and Environmental Design) points as the hospital expansion targeted LEED Silver certification. The hospital knew even as the new expansion opened that the facility would be too small for the community within a decade. A future hospital expansion will require increased energy services, and the district energy system is designed to meet this need.

Finally, with the hospital becoming part of a larger community energy system, it determined it could benefit from the introduction of new technology or the addition of alternative fuels – projects the hospital would not pursue on its own. These could include, for example, combined heat and power or biomass fuel supply.

4 MW COMBINED HEAT AND POWER

Even before the Bur Oak Energy Centre was complete, the promise of CHP was realized. Due to the community-scale thermal grid planned for Cornell Centre, MDE won a provincial competition to construct new CHP capacity. More than 50 submissions were bid in 2011, and MDE



Courtesy Caterpillar.

The Caterpillar CG260-16 generator set arrives at the Bur Oak Energy Centre. The unit will produce up to 5,000 lb/hr of steam and 13.7 MMBtu/hr of hot water when fully operational later this year.

DISTRICT ENERGY RELIABILITY

For greater availability, a typical hospital central utilities plant is required to install and maintain redundant equipment to meet local codes and standards. Markham District Energy (MDE) argued that Markham Stouffville Hospital could benefit from higher reliability if it connected to a community-scale district energy system. Multiple plants providing additional levels of redundancy are further enhanced with dedicated professional staff managing and maintaining the energy assets. To support the argument, MDE reported system availability for its Markham Centre system in the first decade of operations at 99.997 percent for chilled-water supply and 99.998 percent for hot water supply.

signed the first two contracts awarded by the Ontario Power Authority. One of those contracts is for a 4 MW CHP facility to be located in the Bur Oak Energy Centre.

MDE is installing a Caterpillar CG260-16 generator set with hot water and steam heat recovery technology. In addition to the thermal capacity produced by the boiler plant, heat recovery technology will recover up to 5,000 lb/hr of steam from the engine's exhaust flow and up to 13.7 MMBtu/hr of hot water from the jacket and oil cooler circuits. This project is the first in North America employing Caterpillar's recently introduced CG260 series of high-efficiency gas generator sets.

Operational by October 2013, the 4 MW CHP facility will provide power to the local grid during peak hours and thermal energy to the Cornell Centre district heating grid. During grid emergencies, the CHP system will maintain 100 percent of the hospital's operations and also keep the community center fully functional. Despite the Bur Oak Energy Centre having a 5 MW diesel generation plant with 72 hours of fuel storage to provide emergency power to the hospital (by code), the CHP plant provides a higher level of resiliency to the health complex and would not have been installed without the larger district energy

System Snapshot: Bur Oak Energy Centre, Cornell Centre, Ont.

	Steam/Hot Water/ Combined Heat and Power System	Chilled-Water System
Startup Year	2012 – Steam and hot water systems start up October 2013 – CHP to be added	2012
Number of Buildings Served	5	5
Total Square Footage Served	1,009,000 sq ft	1,009,000 sq ft
Capacity	Current: 16,790 lb/hr steam 51.2 MMBtu/hr hot water 5 MW emergency power diesel generators Additional in October 2013: 4 MW electricity 5,000 lb/hr steam 13.7 MMBtu/hr hot water	3,950 tons chilled water
Number of Boilers/Chillers	Current: 6 boilers (3 steam, 3 hot water) Additional in October 2013: 1 heat recovery steam generator 1 hot water heat recovery boiler	3 chillers (centrifugal)
Fuel Types	Natural gas, oil, heat recovery	Electric
Distribution Network Length	Steam – 722 trench ft Hot water – 2,766 trench ft	Chilled water – 2,766 trench ft
Piping Type	LOGSTOR preinsulated	Epoxy-coated steel
Piping Diameter Range	2 to 8 inches	2 to 12 inches
System Pressure	150 psig	150 psig
System Temperatures	203 F supply/149 F return	39 F supply/59 F return

Source: Markham District Energy.

thermal load or the fact that MDE led the CHP initiative.

FUTURE OF DISTRICT ENERGY IN CORNELL CENTRE


The hardest part of the system development is over. The champions emerged, and the anchor load said yes. With phase one of the plant and distribution systems operational, the rest is up to Markham District Energy. If the district energy service is competitively priced, and the system operates at a comparable reliability to MDE's Markham Centre system, future customers will enthusiastically connect. The long-term goal is 100 percent connection of all future build-

ings in Cornell Centre. This can be achieved with support from the city of Markham's official plan and policies.

The plant has been constructed to expand the production equipment and distribution system to serve an estimated 5 million sq ft of future mixed-use development. Eventually, a second district energy plant in Cornell Centre is planned to serve the full buildout with additional CHP capacity to match the growing thermal load.

A FINAL THOUGHT

Markham is the only municipality in Canada to own and operate two district energy systems. Operational excellence combined with policies

supporting the development of district energy will ensure the systems in Markham Centre and Cornell Centre continue to expand and prosper. 



Bruce Ander, PEng, joined Markham District Energy Inc. as president and chief executive officer in 2002. He has spent his career in the Ontario energy sector specializing in district energy and combined heat and power. Ander is a former chair of the Canadian District Energy Association and currently an IDEA board member. He can be reached at bander@mdei.ca.