30. Response to Question 30

General Summary

The three operating district heating (DH) networks in Brampton, Dearborn and Oakville are part of the total energy transformation of each campus to create operational breakthroughs and to serve as a Living Classroom for a wide range of new educational offerings. Operationally these transformations all include energy efficiency retrofitting of most of about 450,000 m^2 of buildings and comprehensive campus-wide metering and control. The fourth site is a newer campus, Mississauga, where all new construction is being designed, constructed, and operated to the highest global systematic energy efficiency levels and structurally designed to be DE-Ready. This Description focusses on the district energy aspects within the overall energy transformation. The Description should as be seen as a snapshot in time, as the colleges' Integrated Energy Master Plans (IEMP) take a multi-decade view including continuous improvement, solution extension, and continuing decarbonization.

The three district heating networks are designed to serve a wide range of existing building ages and conditions. While there were distinct conditions on each site, their DH design followed the same basic requirement to use modern DE engineering, technology and operating practices typically used by city-scale DE utilities in areas such as Scandinavia and Germany. For the network and service conditions this included:

- Pre-packaged Energy Transfer Stations from a global leading supplier
- Thermal metering meeting municipal utility norms
- EN standard pre-insulated network designed and configured by global leading engineering and material suppliers
- Designed to initially operate at Generation 3 level, and at 4 or even 5, levels in future as the multi-year retrofit and new construction requirements of the IEMP reshape the demand and lower-carbon sources will be added to the supply mix
- Cost-benchmarked against levels typical in countries with higher market volumes than the US and Canada

For the DH supply, the IEMP requirements on all three sites included:

- Mix of power grid, network natural gas, and on-site clean and renewable conversion and sources that immediately and cost-effectively significantly reduce GHG emissions
- Heat storage
- Globally economically and technically benchmarked
- Supply portfolio flexibly configured to include lower-carbon supply alternatives in time
- Campus-wide control capability to optimize efficiency, cost, and emissions, and to teach active dispatching
- Energy Centers that are designed and configured for teaching

In all cases, the DH was a part of the total energy and climate investment that is meeting or exceeding a targeted Internal Rate of Return set by the institutions' CFOs.

Henry Ford College – Dearborn Network

Background

Henry Ford College consists of two campuses, the main campus with 18 buildings with GFA of 87.729 m^2 and the east campus with two buildings with GFA of 5,676 m^2. Buildings were built between 1963 and 2011. Prior to the IEMP transformation, 8 buildings on the main campus were supplied by islanded heating and cooling plant. The other 10 buildings were supplied with heating from a central boiler plant hosted in the Facilities Management Building. Three boilers built in 1963 with a capacity of 4.1 $MW_{th,}$ provided water with a supply temperature of 192°C. The heat was distributed to the buildings through a high temperature network of about 1.6 km. The pipe runs were in tunnels or inside buildings. The typical return temperature was 116 °C. While the networks were reasonably well maintained, they were over 40 years old and likely to need major repairs or replacement. Age and operating temperatures also contributed to significant losses.

The same 10 buildings were also supplied with cooling from a central chiller with a 2.7 MW_{th} capacity located in the Liberal Arts Building. Cooling was distributed in a parallel network that had been relatively recently reinsulated.

Modern District Heating

The old high-temperature network was replaced by a pre-engineered district heating network supplied from Denmark. It followed EN 253 Level 2 et al requirements. It followed completely new routing, with local installation crew training carried out by installers from Denmark familiar with large-scale municipal system installation. The network initially serves 11 of the campus' 18 buildings, representing about 75% of the GFA. A further 4 buildings will be added, bringing the served GFA to about 90%. The network currently operates in the medium temperature range.

The DH network is connected to all served buildings with pre-packaged Energy Transfer Stations, designed n Denmark, and assembled in Michigan. As is normal practice, the ETS includes all the necessary controls and metering, as well as the heat exchanger.

The DH network is supplied from a completely new energy center, appropriately called the "Energy Learning Centre" or ELC. This is in a newly renovated Technology Building, the campus' largest building and the focus for most technical education. The heating plant consists of 6 modular high-efficiency condensing boilers, combined with two high-heat rate CHP engines. The combined maximum heat capacity is 11.6 MW_{th}. Heat storage of $50m^3$ is being installed, and all new ancillary equipment including variable speed pumps. The ELC has been designed to host groups of visitors and student classes and is a visible campus feature.

On the cooling side, the existing network was retained. Increased end-use efficiencies allowed a new smaller 1.7 MW_{th} chiller to be installed.

Sheridan – Oakville Network

Background

Prior to the implementation of the Integrated Energy and Climate Master Plan (IECMP) in 2016, Sheridan's Oakville Campus was partially supplied with steam for heating and domestic hot water by a central steam system with condensate return. Piping and boiler systems had been in service for 25-30 years and were approaching or at end-of-life. Network heat losses were estimated to be above 50 percent. Another small group of buildings shared two end-of-life hot water boilers, effectively forming a very small islanded high-temperature district heating network. Other buildings were heated by individual boilers or natural gas-fired rooftop units.

Modern District Heating

A new 2 km medium-temperature DH network was laid according to EN253 Level 2 et al norms. This now connects most of the campus buildings, which were added to the new network coordinated with the implementation of the building efficiency measures. The detailed network design was completed by a global engineering company from Denmark.

The DH network connects to 140,000 m2 of buildings. Individual buildings are connected to the network via pre-packaged Energy Transfer Stations typically used in large European municipal networks.

A completely new energy centre has been built in the renovated basement of a building formerly used for archival storage. It is configured to be attractive and welcoming for visitors and suitable for student classes. The centre supplies heating with 6MW of natural gas condensing boilers, operationally designed for peaking and back-up. The center is designed to incorporate a natural gas CHP plant delivering 1.4 MW_{th} of thermal baseload heat with1.2 MW electrical capacity. The CHP sizing was modelled to optimize economic return, reliability, GHG performance and flexible tariff response. The Centre design also includes 100m3 of heating storage.

The campus also operates a smaller district cooling system supplied with 3MW_{th} of cooling from a mix of electric and absorption chillers and supported by 50m3 of cooling storage.

Sheridan-Oakville Community Energy Planning

In 2016, Sheridan signed a Memorandum of Understanding with the host community, the Town of Oakville - population of 165,000. Sheridan teamed with the Town and other community stakeholders to develop a comprehensive energy and climate plan for the entire community. The combined planning included district energy expertise from Germany and Denmark. During the development of the plan, the Oakville "Living Classroom" was used to explain various aspects of the integrated solutions being discussed. The resulting Community Energy Strategy was unanimously approved by the Town Council in 2020 and calls for significant areas of the Town to consider implementing municipal scale district energy, ultimate serving about 20% of the Towns future heating needs.

Sheridan – Brampton Network

Background

Prior to the Sheridan IEMP, the Brampton Campus already had a relatively efficient hot water-based district heating system serving most of the buildings on the campus with the exception of a large new student residence. However, the aging system was heavily interconnected between the primary and secondary systems and operated at a very low supply-return temperature differential. Combined with relatively inefficient buildings, the efficiency and service levels were often challenging.

Modern District Heating

A new 1.5 km DH network following the same global norms as Oakville and Dearborn was installed serving a total of 93,000 m2 was installed with construction starting in 2016 and heating services being supplied in 2017. Consistent with complete thermal integration of the Living Classroom the large student residence was added to the network. As in Oakville, the network had final engineering completed by a leading Danish company optimizing following parameters:

- Low operating supply temperature for minimal heat/energy loss, which reduces operating costs

- Maximum delta T at energy transfer stations for maximum energy transfer and maximum value for pumping costs, which reduces operating costs
- Maximized pipe flow capacity to allow for smaller pipes, which reduces capital investment

The DH network is connected to the buildings using pre-packaged Energy Transfer Stations. On the cooling side, there is a chilled water network serving 25,000 m2 GFA. The DH and DC networks are supplied by a custom-designed energy centre located in a major new engineering building. The energy centre contains a comprehensive portfolio of energy supply and storage to both operationally optimize the heating and colling services, and to be a distributed energy teaching facility. The center contains:

- 2 natural gas CHP engines with 0.52 MW_{th} of heat and 0.4 MW_{el} power
- 3 MW_{th} of peaking/ backup gas condensing boilers
- 50 m^3 (1,766 cu ft) of heat storage
- 2.69 MW_{th} of combined absorption and electric chiller cooling
- 50 m^3 (1,766 cu ft) of cold storage

The heat supply portfolio will be adapted over time to further enhance operating efficiency and maximize the flexibility of district energy to decarbonize heating.

The Energy Centre has been designed to be a welcoming and appropriate destination for visitors and student classes. There is generous spacing for groups, and nearby classrooms that overlook the centre. It has been designed as an iconic structure with architecturally pleasing glass walls to openly underline the energy and climate commitments and engage people passing by on the campus. It is increasingly being used to support the image of the campus as a whole.

Sheridan-Brampton Community Energy Planning

In 2016, Sheridan also signed a MoU the City of Brampton - population 797,000. Sheridan teamed with the City and other community stakeholders to develop the Brampton Community Energy and Emissions Reduction Plan, unanimously approved by the City Council in 2020. During the development of the CEERP, the Brampton “Living Classroom” was extensively used for briefing and discussion with stakeholders. CEERP calls for significant areas of the rapidly growing city to consider implementing municipal scale district energy.

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