



THE POTENTIAL FOR DISTRICT ENERGY SYSTEMS TO CONTRIBUTE TO MUNICIPAL CLIMATE CHANGE MITIGATION AND ADAPTATION: LESSONS FROM HAMILTON AND MARKHAM

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## 1. Introduction

In the face of a changing climate and an uncertain energy future it is imperative for municipal governments to become more involved in planning for energy and climate change. Traditional methods of producing and distributing energy are increasingly being called into question, particularly in regards to their efficiency, reliability and resiliency. At the same time as pressures on energy infrastructure systems are mounting, Canadian municipalities are being called upon to make long term plans for the mitigation and adaptation of climate change. A largely untapped opportunity lies at the hands of municipalities to develop local energy solutions that serve business development goals while also contributing to greenhouse gas emission reductions, increased energy security, and enhanced adaptive capacity in response to climate change. Given this context, it is worthwhile to consider the ways in which district energy systems could contribute to the climate change mitigation and adaptation planning in Canadian municipalities.

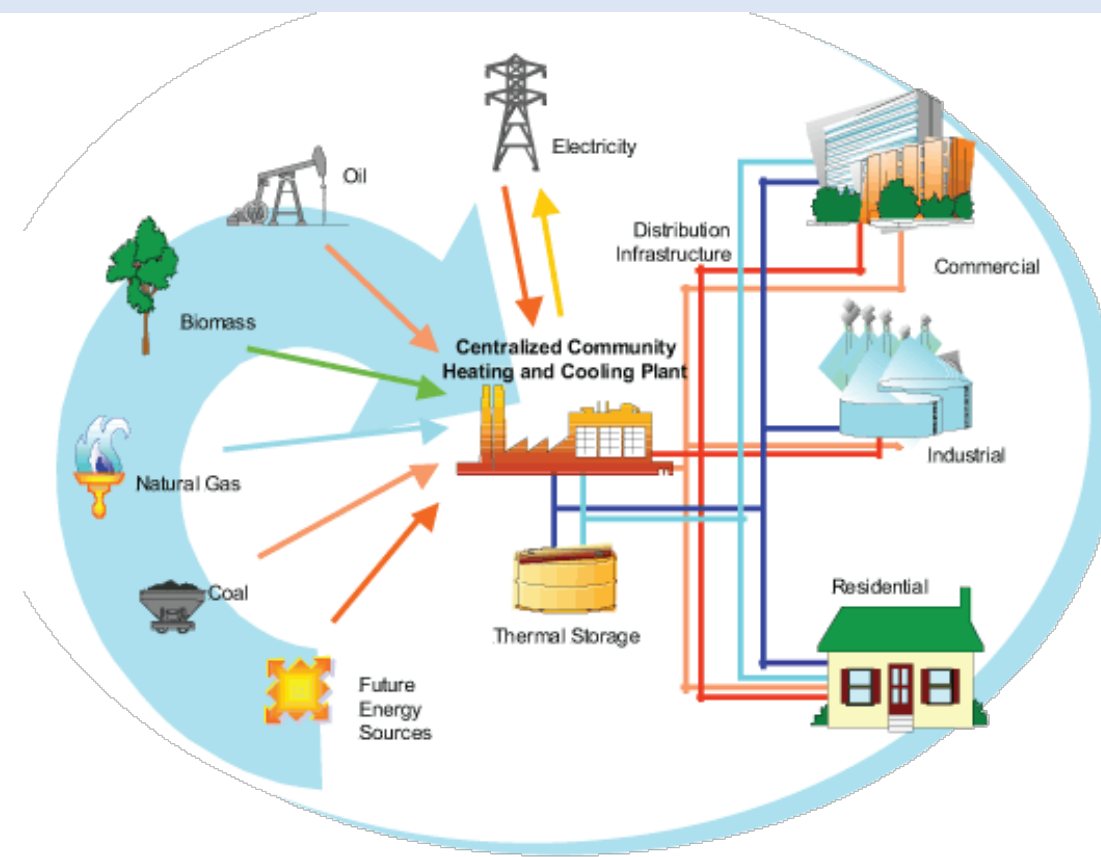


Figure 1 The concept of district energy showing community-based generation facilities, energy inputs and end users. (Source: IDEA)

## 2. District Energy Systems

The concept of district energy is not a generation process or fuel source in itself, but is a system of distributing energy. In a district heating and cooling system, energy is produced at a central location and then distributed to a number of different buildings in a network of circulation pipes. Some district energy systems also include a component of electrical power production through a process known as combined heat and power (CHP), or cogeneration. District energy systems can be supplied by one or more types of fuel and may consist of a combination of heat sources and technologies, as illustrated in Figure 1. They can be implemented on different scales - from supplying the needs of a development parcel or a neighbourhood, to serving an urban district or even a city region. For municipalities, district energy is a tool for achieving greater energy security, reducing greenhouse gas emissions, managing rising energy prices, increasing economic competitiveness, and achieving financial benefit through selling of electricity (Hawkesworth, 2008; Gilmour & Warren, 2008).

## 3. Case Studies - City of Hamilton, ON

District energy systems currently in use in Hamilton provide service for all three components of district energy: heating, cooling and electrical power. The Hamilton Community Energy Centre produces both heat and electricity from a CHP facility that is distributed to 10 large buildings clustered on the west side of downtown Hamilton. There is also a district cooling loop operated by Hamilton Central Utilities Plant that services the downtown core (see Figure 2). Both systems are designed in a way that allows for future expansion to other customers as demand arises. The implementation and continued expansion of these district energy systems provides an example of how the City of Hamilton is reforming municipal practices and planning tools to integrate energy concerns into land use decision-making in its downtown core.

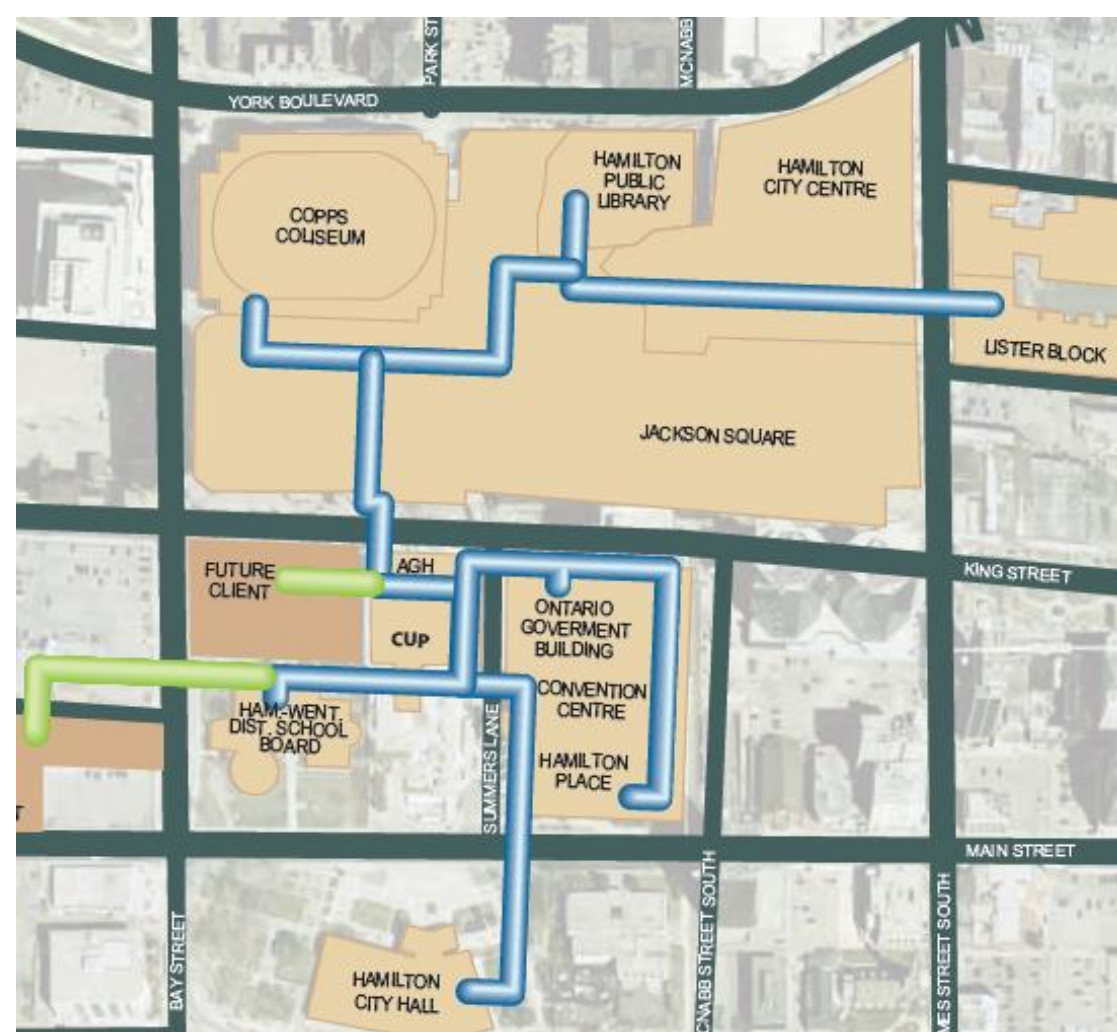


Figure 2 Existing and proposed connections to district cooling loop in downtown Hamilton. (Source: City of Hamilton)

## Town of Markham, ON

Markham District Energy Inc. (MDE) operates a district energy system based on a natural gas-fired CHP plant which provides heating, cooling and electricity services. The Town of Markham has planned to absorb anticipated population growth and employment density in three key high density Urban Centres: Markham Centre (shown in Figure 3), Cornell Centre, and Langstaff, all of which will be serviced by district energy. Recognizing the potential for implementing progressive planning approaches in these high growth, high density areas, the Town has established a [performance measures] system under which developers are encouraged to meet design and land use standards through a variety of measures, one of which may be to connect to the district energy system. This process is an example of how the Town of Markham is working with developers and landowners to offer a unique energy supply system that will contribute to the long-term emission reductions of the municipality, among other benefits.



Figure 3 Proposed plans for the overall build-out of Markham Centre showing the location of the Markham District Energy generation facility. (Source: Town of Markham)

## 4. Contribution to Climate Change Mitigation and Adaptation

District energy systems in Hamilton and Markham were examined in order to identify synergies between management of district energy systems and municipal climate change mitigation and adaptation planning. The study illustrated that district energy systems have many characteristics that can contribute to climate change planning in municipalities, including:

- **Greenhouse gas emission reductions** through increased efficiency of fuel use, waste heat recovery and displacement of peak power, as well as the ability to adapt to less carbon intense or carbon neutral sources of fuel, such as renewables.
  - For example, in Markham a greenhouse gas emission reduction of approximately 50 per cent over conventional development has been realized through increased efficiency of fuel use in the urban district to which district energy has been applied.
  - HCE has an agreement with the City of Hamilton to displace all of the municipality's peak energy demand. During periods of peak demands, the provincial grid turns to the use of gas and coal-fired plants. These plants have higher emissions per kilowatt compared to that of HCE; therefore, by utilizing power generated by HCE instead of the provincial grid during peak times, the municipality's energy use results in fewer greenhouse gas emissions.
- **Adaptability** in response to changing conditions including the ability to make technological improvements and switch fuels as market factors change, and to employ expert knowledge in order to closely manage the efficiency of the system and take advantage of opportunities to utilize local, renewable energy sources.
  - District energy managers in Hamilton are exploring the possibility of adding incremental capacity to the system through placement of a ground source heat pump where it is technically and economically logical.
- **Flexibility in scale** that allows for energy management and system development in response to localized conditions and opportunities, including the ability to increase generation capacity of the system incrementally as overall demand increases, as well as the flexibility to deploy components of the system as necessary in response to fluctuating energy demand.
  - In Markham, district energy infrastructure has been purposefully placed in areas of planned high density and mixed use. MDE is thus prepared to construct and deploy new energy generation capacity for the system in relation to the timing of development and growth in these areas which will cause increased energy demand.
- **Contribution to energy self-sufficiency and security** by sheltering customers from market volatility, and providing communities with back-up power and built-in redundancies in case of a failure in the provincial power grid.
  - The district energy systems in both Hamilton and Markham maintained service during the province-wide blackout in August 2003.

## 5. Recommendations for Municipalities

The following recommendations are meant to encourage the conditions necessary for municipalities to take advantage of district energy as a tool for climate change mitigation and adaptation:

- **Recommendation 1:** Provisions for district energy should be included in high level plans and policies related to growth and land use planning.
- **Recommendation 2:** For areas where there is a district energy system in place, the option for landowners to connect to the district energy system should be stimulated through the site plan approval process.
- **Recommendation 3:** District energy providers should be engaged in municipal servicing and land use planning decision-making in order to take advantage of opportunities to coordinate infrastructure development.
- **Recommendation 4:** Municipalities and district energy managers should work together to ensure that the benefits provided by district energy systems are incorporated into municipal climate change mitigation and adaptation plans.
- **Recommendation 5:** Municipalities should continue to explore opportunities for utilizing alternative fuel sources, including renewables, in district energy applications.



Figure 4 Hamilton Community Energy Centre. (Source: City of Hamilton)



Figure 5 Markham District Energy plant. (Source: Town of Markham)

### Acknowledgements

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