THE POTENTIAL FOR DISTRICT ENERGY SYSTEMS TO CONTRIBUTE TO MUNICIPAL CLIMATE CHANGE MITIGATION AND ADAPTATION PLANNING

Lessons from Ontario Municipalities

By
Sarah J. Brown

A report submitted to the School of Urban and Regional Planning in partial fulfillment of the requirements for the degree of Master of Urban and Regional Planning (M.PL.)

Queen's University
Kingston, Ontario, Canada
September 2010

EXECUTIVE SUMMARY

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 as part of land use and other decisions. Traditional systems for 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 in order to mitigate and adapt to climate change. A largely untapped opportunity lies at the hands of municipalities to develop local energy solutions that serve business development goals, contribute to greenhouse gas emission reductions, increase energy security, and enhance 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 climate change mitigation and adaptation planning in Canadian municipalities.

The concept of district energy is not a generation process or fuel source in itself, but rather 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 the form of hot water, chilled water or steam 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. 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. District energy systems are most financially successful when located in areas where there is a concentration of urban form, in particular the high-density mixing of residential, commercial and institutional buildings. These are also favourable elements of urban form that are encouraged through current planning principles and models.

District energy systems in the City of Hamilton and the Town of Markham are examined as case studies for this research. The primary aims of this research are: 1) to investigate the characteristics of district energy systems that may allow them to contribute to climate change

mitigation and adaptation, and 2) to examine the ways in which district energy systems are applied in the case study municipalities and identify factors that influence the ability of these municipalities to utilize district energy as a climate change mitigation and adaptation tool.

This research was conducted using qualitative research methods through a multiple-case study approach. The methods of literature review, document review and semi-structured interviews were utilized. Focused interviews were conducted with key players who are involved in the planning and implementation of the district energy systems as well as sustainability and climate change planning for the municipalities. In total, seven interviews were conducted: four with professionals associated with the Markham case study and three from Hamilton.

The literature review and the case studies illustrated that district energy systems do have characteristics that can contribute to climate change mitigation and adaptation planning in municipalities, including:

1) *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.

2) *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.

3) *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.

4) *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.

Despite the potential benefits provided by district energy, very real challenges still exist for the development of these systems including: the need for long-term investment, an

inconsistent regulatory environment, and legal, financial and logistical challenges associated with the difficulty of coordinating among many stakeholders and across jurisdictions. To date, a number of handbooks and case studies have been prepared to assist with assessing the feasibility of district energy and to provide lessons for overcoming challenges (e.g. CanmetENERGY Community Energy Case Studies, 2009; Gilmour & Warren, 2008). The following recommendations are meant to create the conditions necessary for municipalities to utilize district energy as a tool for climate change mitigation and adaptation.

Recommendation 1: *High level plans and policies related to growth and land use planning should identify areas that may be appropriate for use of district energy to open possibilities for future development of district energy systems.*

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: *Municipal staff and district energy managers should work together to ensure that the benefits provided by district energy systems are captured in municipal climate change action plans.*

Recommendation 5: *Municipalities should continue to explore opportunities for utilizing alternative fuel sources, including renewables, in district energy applications.*

In conclusion, given the need for Canadian communities to explore opportunities to develop local energy infrastructure that is adaptive and sustainable in nature, there is rationale for considering district energy as a valuable climate change mitigation and adaptation strategy. Establishing case studies which illustrate the benefits of district energy is a valuable tool for increasing the acceptance of this concept. The findings of this research will provide municipal leaders and staff with ideas and examples that they might use to contribute towards dialogue in their communities on planning for energy and climate change.