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CORPORATE REPORT

NO: R109 COUNCIL DATE: May 17, 2010

REGULAR COUNCIL

TO:	**Mayor & Council**	DATE:	**May 3, 2010**
FROM:	**General Manager, Engineering**	FILE:	**5500-15**
SUBJECT:	**District Energy Heating System – Surrey City Centre**		

RECOMMENDATION

The Engineering Department recommends that Council receive this report as information.

INTENT

The purpose of this report is to advise Council on the work that has been completed to date and an intended course of action for further work toward the implementation of a district energy heating system in the Surrey City Centre area.

BACKGROUND

Under the Surrey Economic Investment Action Plan the City committed to a number of incentives and initiatives to encourage new investment in two Economic Investment Zones. One Economic Investment Zone covers the City Centre area while the other covers the South Westminster/ Bridgeview area. One of the initiatives to which the City committed in the City Centre Economic Investment Zone was to explore the potential to establish a district energy system in the Surrey City Centre area.

A district energy system distributes thermal energy (e.g., heated water) to buildings in a specified neighbourhood and can be an efficient and effective means of reducing green house gas emissions by utilizing low GHG emission energy sources.

District energy systems have been used in the core areas of several cities in Canada historically but fell out of favour over time. More recently, due to the energy efficiency of district energy and their effectiveness in reducing GHGs they are experiencing a resurgence in western Canada. These systems have a long history in Western Europe. Approximately half of all residential dwelling units in Sweden are served by a district energy system.

As a result of increasing energy prices, a stronger focus on preserving electrical energy sources for higher grade demands such as commercial and industrial uses and a strong interest in reducing green house gas emissions, district energy systems are attracting significant attention in British Columbia.

Almost all of the new high density (high rise) residential development in Surrey City Centre is heated by electric resistance (baseboard) heaters. This type of heating system has a low capital

cost, but has a relatively high operating cost in comparison to a heating system (i.e., hot water) that is part of a district energy system.

District energy heating systems can use energy from a variety of sources to create hot water for circulation to customers. These include wastewater heat recovery, heat exchange from ground water, solar heat, biomass digestion, waste to energy facilities, and natural gas. The thermal energy is used to heat water that is then distributed to customers through a dedicated pipe network at either a low temperature (15 to 20 degrees Celsius) or a high temperature (above 60 degrees Celsius). The heat from water is then used directly to heat dwellings or other spaces through heat exchangers or is transferred to the local building heating/cooling system through a heat pump. Information about potential thermal energy sources and the difference between low temperature and high temperature distributions systems is contained in Appendix I to this report.

DISCUSSION

In partnership with BC Hydro, Terasen Energy Services and the Fraser Basin Council, the City has recently completed a preliminary feasibility study with respect to District Energy Systems for the Surrey City Centre area.

Within this study, district energy system potential demand in the City Centre area was calculated based on expected floor area of current and future buildings, current and future land use scenarios, peak and annual energy intensity factors and estimated district energy participation rates. The City Centre area was divided into three service areas around central anchors or hubs in each service area. The service areas are centred on the three SkyTrain stations, Gateway, Surrey Central, and King George, which already act as the transportation hubs for these service areas and are higher density.

Based on the energy demands of each hub, energy supply options were developed based on the following strategic objectives:

- Minimize total cost (capital, and long term operating, and maintenance costs);
- Maximize efficiency in the delivery of energy; and
- Minimize green house gas (GHG) production.

A preliminary economic review was completed to identify which options are able to provide a thermal energy price comparable to current electricity rates, which is estimated at $81/MWh. Based on preliminary estimates, that total capital cost for providing a district energy heating system in a hub area ranges from $9.1 million to as high as $66 million. Combining the capital costs with operations and maintenance costs, fuel costs and applicable carbon taxes, the total costs range from as low as $60 per MWh to as high as $125 per MWh over 40-years based on a capitalization rate of 5.5%, which is considered reasonable for this type of investment.

Hydronic-based heating systems are more expensive to install in buildings in comparison to electric resistance (baseboard) heaters. It is estimated that the initial capital cost premium for a hydronic heating system in comparison to baseboard heaters is approximately $1,400 to $2,100 per dwelling unit. Based on this premium, it is estimated that with a district energy system the premium would be recoverable over a 10 to 20-year timeframe.

Public Consultation

The preliminary feasibility study included a stakeholder workshop, which included representatives of BC Hydro, Terasen, Surrey City Development Corporation, developers, engineers and architects. The session was designed to get feedback regarding district energy initiatives from those who have some interest in the City Centre Economic Investment Zone. From this workshop a number of opportunities and challenges were identified. The more significant of these were:

- Consumers (customers) need to be made aware of the benefits of connecting to a district energy system;
- Commercial buildings and building owners (and operators) will have less maintenance responsibilities when connected to a district energy system as boilers and chillers contained within individual buildings can be eliminated;
- Developers need to develop a sense of confidence with the new central heating technologies and may potentially require financial incentives to provide for hydronic heating as opposed to the "business as usual" approach of electric resistance (baseboard) heaters;
- The financial viability of a district energy system is increased proportionately to the number of customers connected to the system; and
- Developers could leverage the reduction in energy costs by virtue of the efficiency of district energy as a selling feature.

Local District Energy Systems

The City of Vancouver and the City of North Vancouver each operate a district energy system. A description of each of these district energy systems is provided in Appendix II.

The Olympic Athletes Village in the Resort Municipality of Whistler and a private commercial and residential development in Victoria (Dockside Green) are heated by district energy systems. There are a number of district energy systems under development across the Province, such as in the City of Langford.

Next Steps

As the preliminary economic review indicates that a district energy system in the City Centre area is viable, the Engineering Department will be undertaking the following activities toward the implementation of an appropriate system in City Centre:

- Work with design staff from the Surrey City Development Corporation to ensure that all new civic facilities in the City Centre (e.g., new library, new City Hall, etc.) have the necessary infrastructure to allow connection to a district energy system;
- Undertake further planning to develop and refine a specific district energy system for each of the Gateway, Surrey Central, and King George service areas;
- Work with City staff and with the Development Advisory Committee to address the obstacles (real or perceived) that act to inhibit the implementation of a district energy system in the City Centre area;

- Work with the Sustainability Office to complete a triple bottom line accounting process to ensure that the economic, social, and environmental objectives are addressed by the approach taken to the implementation of a district energy system;
- Pending the outcome of Metro Vancouver's Public Consultation process with respect to in-region "waste-to-energy" options and the subsequent decisions on this approach to waste management, City staff will work with Metro Vancouver staff to forecast future biomass and waste-to-energy fuel streams from the region and their potential to be used for thermal energy or combined heat and power (CHP) facilities in the City of Surrey;
- Consult with private sector interests, including existing energy providers, on ownership or operating partnership options for the implementation of a district energy system in the City Centre;
- Investigate Provincial and Federal funding potential for a district energy system. It is noted that grant funding (federal government) was provided to the City of Vancouver, City of North Vancouver and the Resort Municipality of Whistler for their systems; and
- Hire a Community Energy Manager in cooperation with the Sustainability Office and in partnership with BC Hydro. The Engineering Department is actively recruiting a Community Energy Manager to lead district energy system development, among other energy initiatives.

Staff will provide further reports to Council as information evolves, including specific recommendations as to how the City should proceed with implementing a district energy system in City Centre.

SUSTAINABILITY CONSIDERATIONS

The implementation of a District Energy System in the City Centre will support the Economic and Environmental Pillars of the City's Sustainability Charter under the following specific elements of the Charter:

- ***EC8: Energy Security:*** by promoting the use of low-impact, renewable energy sources and promoting community energy solutions;
- ***EN1: Energy Efficiency:*** by incorporating alternative energy systems such as geo-exchange and solar heating systems for city facilities;
- ***EN2: Waste Reduction:*** by potentially introducing waste to energy conversion opportunities;
- ***EN10: Integrated Community Energy Master Plans:*** by developing an Integrated Community Energy Master Plan for the City Centre and by working with private property owners to promote upgrades and retrofits that increase building energy efficiency such as through the connection to a district energy system;
- ***EC8: Increase Energy Security***: by the provision of a district energy system that is potentially fuelled from a sustainable fuel source such as waste.

CONCLUSION

The implementation of a district energy system in the Surrey City Centre will satisfy many of the City's environmental and economic development goals as identified in the Surrey Economic Investment Action Plan and the Surrey Sustainability Charter. City Staff are continuing actions toward implementing a district energy system in the City Centre area and will provide further reports to Council including specific recommendations as information is available.

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Appendix I - Thermal energy sources suitable for a District Energy System
Appendix II - Summary of North Vancouver's District Energy Systems

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APPENDIX I

Thermal energy sources suitable for a District Energy System

Wastewater Heat Recovery

Wastewater has an average temperature of 15 to 20 degrees Celsius. This thermal energy can be extracted from the wastewater stream through a heat exchanger and supplied to a district energy system for distribution.

Geo-exchange Heat Recovery

A vertical open-loop geo-exchange (GHX) system draws groundwater from an aquifer for heating or cooling. Groundwater passes directly through a heat exchanger which transfers thermal energy between the district energy system and the groundwater. The groundwater is then re-injected into the groundwater aquifer.

Solar Thermal

Solar radiation collectors act to collect solar energy that is used to heat water. Similar to wastewater and geoexchange systems, solar-generated thermal energy can be fed to a heat exchanger and transferred by way of a heat exchanger to a district energy system for distribution.

Biomass

Biomass thermal and cogeneration involves the combustion, gasification or pyrolysis of a biomass to produce heat and/or a fuel source. The heat is transferred through a heat exchanger to a district energy system or the fuel is used to power a gas turbine or reciprocating engine to produce heat or combined heat and power (CHP). Possible biomass sources include municipal green waste (yard clippings, kitchen organics), wood residues (construction waste, sawmill residues), wood briquettes and pellet fuels.

With any biomass system, maintaining a consistent and reliable fuel supply is one of the key challenges.

Waste to Energy (w2e)

Municipal solid waste can be converted to thermal energy by way of incineration (mass burning), which is the most common and well-established method, or using gasification or pyrolysis to generate synthetic gas for combustion. Metro Vancouver is currently considering the potential for waste-to-energy systems in its Solid Waste Management Plan update.

Natural Gas

Similar to a local boiler system in a home or office building, a district energy system can be supplied by one large community natural gas fuelled boiler or a series of smaller distributed natural gas boilers.

Electricity

Electricity can provide direct radiant heat.

Thermal Energy Distribution

Once energy has been extracted or generated at an energy plant, it must be transported to consumers for use in heating and cooling systems. In a district energy system, this is accomplished by circulating a carrier fluid through a piping system. The carrier fluid is typically steam, water or an aqueous refrigerant solution (e.g. glycol). The selection of the carrier fluid is based on the temperature of the system, which also dictates the type of piping required. Typical district energy system temperature ranges, fluids and piping materials are summarized below:

Distribution Temperatures	Distribution Fluid	Pipe Materials
> 100 ºC	Steam or hot water at pressure	Insulated steel
40 – 100 ºC	Hot water	Insulated steel
0 – 40 ºC	Warm or cold water	Uninsulated HDPE or PVC
< 0 ºC	Antifreeze	Insulated HDPE

APPENDIX II

City of Vancouver – Southeast False Creek Neighbourhood Energy Utility

The Southeast False Creek Neighbourhood district energy system has its thermal energy supplied from a wastewater heat recovery system, supplemented by natural gas boilers. The system is owned and operated by the City of Vancouver through a neighbourhood energy utility (NEU).

All developments within the Southeast False Creek Neighbourhood must connect to the NEU. The NEU rates for 2010 are approximately 10% above what BC Hydro would charge for same energy. From 2011 onward, rates are projected to increase on average by approximately 1.15% above inflation each year, which is lower than the rate of increase projected for electricity from BC Hydro.

The NEU owns and operates the centralized plant, the distribution pipe system and the heat exchanger within each connected building. All other infrastructure within each connected building is owned and operated by the building owner. Rates are set by City Council and include an allowance for the recovery of fixed costs (this charge is based on the square footage occupied by each customer) and an energy use charge for the recovery of variable costs.

The total cost of the project was approximately $36 million; the Government of Canada invested $9.47 million through the Federal Gas Tax Fund, and the Federation of Canadian Municipalities invested $5 million through the Green Municipal Fund. The remainder was financed by the City of Vancouver.

City of North Vancouver – Lonsdale Energy Corporation

The Lonsdale Energy Corporation (LEC) is a natural gas-powered district energy system operating in the City of North Vancouver. Through a network of underground piping and mini-plants, LEC circulates hot water to heat the buildings that are connected to the LEC system. In Lower Lonsdale, several mixed-use developments have natural gas boiler mini-plants contained within them. The mini-plants heat water that is circulated through a series of underground insulated pipes providing energy for heating buildings and for domestic hot water to residences and businesses within the supply area.

LEC has three service areas - Lower Lonsdale, Central Lonsdale and Harbourside – and two distinct distribution grids in Central Lonsdale and Lower Lonsdale. The service areas are covered by the *Hydronic Heat Energy Service Bylaw* (2004) which requires connection to the LEC system for certain classes of property within the designated service areas.

The LEC is a public utility that is wholly owned by the City of North Vancouver but operates as a separate company. The City's role is that of a rate regulator to ensure LEC customers receive clean, affordable district energy heating; the City also defines the service area boundaries. Corix Utilities is under contract to the LEC for building and operating the boilers in the Lower Lonsdale service area. Corix Utilities also provides other services, such as metering and maintenance in the Lower Lonsdale service area. While the lower grid is operated by Corix, LEC itself operates the upper grid in Central Lonsdale.

Start-up capital of $8 million for the Lower Lonsdale system included $2 million from the City of North Vancouver, $2 million from Corix Utility and a $2 million loan as well as a $2 million grant from the FCM Green Municipal Investment Fund.