SAPPERTON RENEWABLE DISTRICT ENERGY SYSTEM

DEVELOPING A CLEAN, LOW-CARBON NEIGHBOURHOOD ENERGY SYSTEM IN SAPPERTON
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1.0 UNDERSTANDING DISTRICT ENERGY
WHAT IS DISTRICT ENERGY?

District Energy Systems, also known as Community Energy, Neighbourhood Energy, or District Heating systems, are networks that distribute thermal energy to buildings. District energy is one of the most efficient and cost-effective ways to distribute heating or cooling energy to many buildings within a defined geographic area. Some of these systems have been around for a century or more, starting as high temperature steam heating networks serving the downtown areas of large cities. Today, district energy systems can include legacy steam heat, but also feature a wide range of hot water and ambient temperature systems for space heating, as well as low temperature systems that also provide space cooling. Modern district energy systems can also incorporate electrical power generation (“combined heat and power”), as well as large-scale thermal storage to buffer start-up cycles and quick changes in demand.

System size and configuration vary, but they can be found across the globe, in very small communities right up to the largest global cities, often times integrating more than one fuel source into a common delivery system. By connecting many buildings into a single heating or cooling network, district energy systems have the advantage of being able to provide clean, renewable sources of energy across an entire neighbourhood. These low-carbon “fuel switches” result in simultaneous reduction of greenhouse gas emissions across an entire network of connected buildings, thus dropping emissions faster and with less cost than if each building had to accomplish this on its own. In New Westminster, the top priority for the new district energy system in Sapperton is to utilize renewable sources of thermal energy.
ESSENTIAL ELEMENTS

District heating (or cooling) energy is typically conveyed from an energy centre through water circulated in underground pipes to individual buildings connected to the system. The district energy system interfaces with a building’s space heating and domestic hot water systems via heat exchangers, which are placed in the building’s mechanical room. Buildings connected to a district energy system do not require their own heating equipment, thus reducing their capital costs and eliminating any associated equipment maintenance expenditures. This means that buildings connected to neighbourhood energy systems can avoid costs associated with purchasing and maintaining their own space heating and domestic hot water equipment, since this is provided directly by the district energy utility.

MODERN DISTRICT ENERGY SYSTEMS CONSIST OF 4 ESSENTIAL COMPONENTS:

- **RENEWABLE ENERGY CENTRE**: A central plant where continuous low-carbon heating and/or cooling energy is produced. Note that some systems may have more than one source of renewable energy that may not necessarily be centralized into a single location.
- **PEAK HEATING SYSTEM**: Additional capacity (typically natural gas boilers) that supply intermittent, top-up heating to the system on the coldest days of the year; Peak heating may be distributed (‘mini plants’) or centralized at the Renewable Energy Centre.
- **DISTRIBUTION PIPING**: A network of underground infrastructure (supply and return pipes) connecting the Renewable Energy Centre to buildings within the service area. Water is an ideal means of distributing thermal energy to buildings.
- **ENERGY TRANSFER STATIONS**: Heat exchangers installed within each building and provided by the thermal utility, provide the mechanical interface between the building’s internal heating distribution system and the neighbourhood energy system.
Communities around the world have realized significant reductions in greenhouse gas (GHG) emissions associated with heating or cooling of buildings through the use of district energy systems that mainly use renewable and low-carbon sources of energy. These systems typically utilize one or more low-carbon and renewable energy sources and technologies, such as biomass, solar hot water, waste heat recovery, or geo-exchange systems. By drawing from renewable sources of energy, district energy systems reduce the overall consumption of fossil fuels and help communities reach their GHG reduction targets while providing local residents and businesses a reliable source of energy.

Around the world, municipalities are key players in encouraging the development of district energy within their jurisdictions. This holds true in British Columbia, where 188 local governments have made a commitment to reduce community-wide GHG emissions, and move toward climate-resilient and resource-efficient pathways. Low-carbon district heating is one of the strategies that a number of communities, are utilizing to achieve greenhouse gas reduction targets, as expressed in their Official Community Plans. The Local Government Act also provides municipalities with authority to establish an energy utility within its jurisdiction, with a number district energy systems in BC established as a result.
2.0
NEW WESTMINSTER POLICY CONTEXT
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City policy supports district energy as a way to significantly reduce community greenhouse gas (GHG) emissions, through the introduction of renewable sources of heating for buildings, as a long-range investment in sustainable infrastructure. Identifying viable district energy opportunities and establishing a supportive policy and regulatory framework is strongly supported by the city’s Emission 2032 sustainability framework, and is one of the top implementation priorities from New Westminster’s Community Energy and Emissions Plan (CEEP).

“CITIES HAVE A CENTRAL ROLE TO PLAY IN THE TRANSITION TO SUSTAINABLE ENERGY, AS MANAGERS OF INTERDEPENDENT SERVICES AND UTILITIES, THEY ARE UNIQUELY PLACED TO ENABLE THE INTEGRATED SOLUTIONS NECESSARY TO RAPIDLY ADVANCE BOTH ENERGY EFFICIENCY AND RENEWABLE ENERGY. ONE SUCH INTEGRATED SOLUTION IS THE DEVELOPMENT OF MODERN DISTRICT ENERGY SYSTEMS.”

UNEP UN Habitat and ICLEI
GREENHOUSE GAS REDUCTION

With an estimated greenhouse gas reduction of 8,600 tonnes per year at full build-out of the system, the Sapperton District Energy System represents a major step forward in achieving emission reduction targets expressed in New Westminster’s Official Community Plan (OCP). This GHG emission drop is equivalent to removing 1,700 vehicles from our roads each year. New Westminster’s OCP community greenhouse gas emissions targets are shown below:

- **2020 TARGET**: Reduce Annual GHG Emissions by 15%
- **2030 TARGET**: Reduce Annual GHG Emissions by 30%
- **2050 TARGET**: Reduce Annual GHG Emissions by 80%

NEW WESTMINSTER GHG EMISSIONS BY CATEGORY (2010)

NEW WESTMINSTER ELECTRICAL UTILITY

Although it may not be widely known outside of New Westminster, but the City is already in the energy business, and has been so for decades, supplying electricity to local residential and commercial customers. District energy provides an opportunity for the City’s Electrical Utility to broaden and diversify its services to the community through the provision of renewable thermal energy to existing and future customers. This direction is strongly supported by the Utility Commission Strategic Plan, which sets a goal to embrace opportunities offered by clean energy micro grids, digital infrastructure and the green economy.

City policy also seeks higher levels of energy efficiency and reduced GHG emissions in new and existing buildings. Energy Save New West is our community program to help achieve these objectives.

To find out more, visit: www.energysavenewwest.ca
3.0 SAPPERTON NEIGHBOURHOOD
The overall context for district energy is favourable in the Sapperton area. In conjunction with planned expansion of the Royal Columbian Hospital, the City of New Westminster has been investigating the technical and economic feasibility of a neighbourhood-scale system that would supply clean, renewable heating at a competitive price to customers in the Sapperton area. The City views this system as a long term investment in sustainable, low-impact community infrastructure.

This system would serve new, larger private residential, commercial and mixed-use buildings in proximity to Braid and Sapperton Skytrain Stations, as well as new development along East Columbia Street. Over time and as the distribution piping for the system expands in the neighbourhood, it may be possible to connect existing commercial and apartment buildings in the area when existing boilers and heating equipment reach the end of their lifecycle – an ideal time to connect to renewable heat.

The district energy service area also includes the Royal Columbian Hospital (RCH) campus, which represents a very large customer for the system, because it has a significant annual heating requirement. From a district energy perspective, the hospital functions as the ‘anchor load’ for our system, supporting the overall feasibility of system, particularly during the initial stage of the project’s lifecycle.
Sapperton District Energy System also supports the sustainability objectives of the IDEA Centre (Innovation, Discovery, Education, and Advancement) by providing green infrastructure that supports the emergence of a low-carbon neighbourhood in Sapperton and the Brunette Industrial Area.

The IDEA Centre is being developed in conjunction with redevelopment of Royal Columbian Hospital, a major tertiary care centre in metro Vancouver, in order to stimulate and support local as well as regional economic activity and medical-related research. The Centre has a mandate to advance innovation in all its forms, and to explore opportunities to strategically use clean technology and apply low-carbon energy systems to support the emerging economic cluster in Sapperton.
4.0 BENEFITS OF DISTRICT ENERGY
WHY WE ARE INTERESTED

From a strategic and long-range perspective, the City of New Westminster is interested in renewable district energy systems as a way to help “future proof” our community, leaving it in better shape to handle a changing global climate, but to also support multiple objectives associated with creating a more robust, sustainable and diversified economy.

MAJOR DROP IN COMMUNITY GREENHOUSE GAS EMISSIONS
At full buildout of the service area, Sapperton District Energy System will reduce greenhouse gas emissions by 7,500 to 8,600 tonnes per year, depending upon the type of renewable energy selected. This represents a significant step towards achieving the GHG emission reduction target in our Official Community Plan, thus helping to meet our climate change objectives.

DIVERSIFIES CITY ELECTRICAL UTILITY & RETAINS ENERGY DOLLARS WITHIN THE COMMUNITY
With an established presence in the local community, district energy provides an opportunity for our Electrical Utility to diversify its service offering through the provision of renewable heating (and potentially cooling) energy to future customers.

Prioritizes Reliability of Service
While the need to meet customer expectations of reliability is true for any utility, district energy systems are typically designed with additional redundancy so that operations account for regular maintenance cycles and replacement of equipment. Including backup power and potential thermal storage at the energy plant helps meet the objective of continuous operation by avoiding unforeseen downtime. In addition, the system is continuously monitored to ensure performance reliability.

PROVIDES THE INFRASTRUCTURE TO TRANSITION TOWARD A CARBON NEUTRAL COMMUNITY
District energy systems can be designed to integrate a variety of clean, renewable fuel sources as they become economically viable, such as bio-energy, solar thermal heating or capturing waste heat from commercial or industrial processes. This flexibility to “plug in” renewable energy sources provides a cost efficient way to significantly reduce the operational carbon footprint of buildings. Existing buildings that may be less energy efficient can also achieve this benefit simply by plugging into a low carbon district energy system.

ATTRACTIONS INNOVATIVE FIRMS AND A CREATIVE, SKILLED WORKFORCE
The City of New Westminster is working closely with Fraser Health Authority and other key sector organizations to develop a thriving health care, technology and innovation hub in the Sapperton area. Forward-thinking companies will want to locate in eco-districts, and may see strategic value in investing in locations that prioritize low-carbon and renewable sources of energy.

DELIVERS STABLE THERMAL RATES AND PREDICTABILITY
District energy systems take a long-range view in terms of capital investment, risk and financial return. Thermal utilities structure their rates with an eye to meet or beat 20- to 30-year projections of conventional energy prices (i.e., what their customers would pay for heating or cooling in the absence of district energy). District energy systems allow for easy fuel switching and cost effective implementation of the latest, most efficient energy conversion technologies.

HELPS BUILD A LOCAL GREEN ECONOMY
District energy systems can stimulate a local green economy and create new jobs associated with designing, constructing, operating and maintaining the system. In addition, the renewable energy centre (where the thermal energy is produced) can become a showcase of design innovation and learning, integrating other important sustainability objectives for the community.

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** Provides the Infrastructure to Transition Toward a Carbon Neutral Community **
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** Attracts Innovative Firms and a Creative, Skilled Workforce **
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** Delivers Stable Thermal Rates and Predictability **
District energy systems take a long-range view in terms of capital investment, risk and financial return. Thermal utilities structure their rates with an eye to meet or beat 20- to 30-year projections of conventional energy prices (i.e., what their customers would pay for heating or cooling in the absence of district energy). District energy systems allow for easy fuel switching and cost effective implementation of the latest, most efficient energy conversion technologies.

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District energy systems can stimulate a local green economy and create new jobs associated with designing, constructing, operating and maintaining the system. In addition, the renewable energy centre (where the thermal energy is produced) can become a showcase of design innovation and learning, integrating other important sustainability objectives for the community.
5.0
COMMUNITY INVOLVEMENT
City Council and Utility Commission approved the business case to establish the Sapperton DES thermal utility and renewable energy service area on November 7, 2016, and instructed staff to proceed with securing a site for the new energy centre in Brunette Industrial area. With the business case settled, a final round of community engagement will occur in the second half of 2017 on the overall district energy concept and recommended renewable energy technology. During this time, there will be opportunities for local residents to review, comment and add value to the final concept plan, as well as assist in setting guidelines for the architectural design and public function of the renewable energy centre. The City is interested in maximizing the environmental, economic and community benefits from the new renewable energy centre.

For dates and times of 2017 community consultation, visit: www.newwestcity.ca/districtenergy

WHAT THE COMMUNITY TOLD US

To date, the City has consulted with the community twice during the initial concept development and refinement stages. A public open house and presentations were held in fall 2013 and again in spring 2014 to build awareness of the project and gain insight on community preferences regarding two feasible renewable energy options: sewage heat recovery and biomass wood chip combustion. Feedback was received from local residents attending the open houses or submitting comment forms. Members of the McBride Sapperton Residents Association also provided input during presentation by City staff on the project. Private developers active in the Sapperton area have also been kept up to date on the district energy system and evolution of the overall concept plan.

The Bullitt Centre in Seattle, Washington. Billed as the greenest commercial building in the world, the Bullitt Centre is designed to show what’s possible in advancing progress toward high-performance green buildings and energy resilient, low-carbon communities.

Since the early stages of this project, major stakeholders such as Fraser Health Authority have provided input to City staff and engineering consultants on mechanical, logistical and heating load considerations for the proposed neighbourhood heating system. Things kicked up a notch following the April 2015 announcement of funding from the Ministry of Health for Phase 1 of RCH expansion, with staff and consultants from Fraser Health and the City working closely to finalize technical integration aspects for delivery of renewable district heat to the new RCH energy centre (which is also included in Phase 1).

In winter 2015, staff from Fraser Health Authority held a public open house on the redevelopment of Royal Columbian Hospital (RCH). Information on the Sapperton District Energy System was also included with project information on the proposed RCH expansion phases.
6.0
PREFERRED RENEWABLE ENERGY SOURCE
VIABLE OPTIONS FOR SAPPERTON

There are two renewable energy sources are feasible for the Sapperton District Energy System:

Wood Chip (Biomass) Heating, where clean, urban-source waste wood chips are combusted in high-efficiency boilers to produce hot water heat for buildings; and,

Sewer Heat Recovery, where low-grade energy is recovered from Metro Vancouver’s nearby sanitary sewer trunk using electric heat pumps to heat water for distribution to buildings.

In fall 2016, City staff sought direction regarding the preferred renewable energy source for the Sapperton District Energy System, with the Electrical Utility Commission indicating that sewage heat recovery was preferred, with the second choice being biomass heating if sewage heat recovery proved to be unfeasible during detailed engineering design. Likewise, in November 2016, City Council endorsed sewage heat recovery as the preferred renewable energy source, and directed staff to proceed with detailed design and implementation of the system.
A significant amount of recoverable heat flows through the Metro Vancouver sanitary sewer network each day, representing a vast amount of low-grade energy that could be recovered through electric heat pumps. This trunk line serves the central and northeast sector of the region (New Westminster, Coquitlam, Port Coquitlam and Port Moody), and passes through the Sapperton area in a large underground pipe alongside the railway and SkyTrain lines. It is conveniently located close to Royal Columbian Hospital and Metro Vancouver’s Sapperton Pump Station, which screens and pumps sewer effluent to Annacis Island for treatment.

In the near term, Metro Vancouver will be improving the capacity of the sewer trunk line and upgrading the existing pump station. This work can be coordinated with implementation of our district energy system, including screening and diversion of sewage flow for purposes of heat recovery. Metro Vancouver has created policies that allow local municipalities or private developers to access their sewer lines for purposes of converting this energy to renewable heat. Metro Vancouver requires technical assurances that the heat recovered from their system does not compromise (drop temperatures below the levels needed for processing at the sewage treatment centres). Having access to this readily available and abundant heat source, as well as supportive policies by Metro Vancouver, are key factors as to why sewage heat recovery is feasible for our system.

Sewage heat recovery systems are relatively new for district heating applications, with some in Europe and the first example in North America being developed by the City of Vancouver to serve the Southeast False Creek and False Creek Flats area.
The City of Vancouver’s Neighbourhood Energy Utility (NEU) at Southeast False Creek began operation in 2010, initially serving the Athlete’s Village area, and then extended in stages to connect other new developments in the service area along 1st Avenue and 2nd Avenue. The energy centre itself is tucked under the Cambie Street Bridge, and currently includes two, 2 MW (megawatt) sewage heat chillers (pumps) that recover thermal energy that is used to heat hot water for distribution to buildings connected to the system.

At full build out, the NEU will deliver 8 MW of thermal energy, which is essentially the same energy load as Sapperton District Energy System, once our service area reaches full size.

Metro Vancouver has priced recovery of low-grade heat from their sanitary sewer system at zero dollars. However, the energy required to drive the heat pumps is provided by electricity from the grid, which the district energy utility pays for and is incorporated into the thermal rates charged to customers. British Columbia is fortunate to have a very clean (low GHG) electric grid, with approximately 93% of electricity provided by renewable energy sources.

Heat pumps work on a coefficient of performance basis, where the objective is to achieve at least a three-to-one ratio of energy efficiency, i.e., one unit of electricity yields three or more units of recovered heat. In this sense, sewage heat recovery system are similar to ground-source geo-exchange systems.

Metro Vancouver Sewer System

Both sewage heat and electricity (to power the heat pumps) are utilized as fuel sources for Sapperton District Energy System. As a result, this system will reduce GHG emissions by 8,600 tonnes annually.
7.0 DISTRICT ENERGY SERVICE AREA
The service area for the system encompasses 50+ hectares and includes the RCH campus as well as mixed-use redevelopment surrounding both Braid and Sapperton Skytrain stations. The service area also includes current and future buildings along East Columbia Street. Together these zones represent a balance of immediate and long-term demand for clean, renewable heating for the utility.

An essential component for overall viability and financial success of the Sapperton District Energy System is confidence that the City will be able to connect all forecasted heating demand in the business case. This includes existing thermal load from Royal Columbian Hospital (RCH) campus and future expansion phases, as well as new residential, commercial and institutional development within the Sapperton DES service area. For most district heating systems in BC, the preferred local government regulatory mechanism is a District Energy Connection Bylaw that specifies “hydronic” (hot water) heating compatibility requirements for buildings over a certain size and within a defined service area.

As distribution piping is extended into the neighbourhood, it may be possible to connect a number of existing multi-family residential and commercial buildings within the service area. For example, older apartment buildings that have existing natural gas boilers that are due to be replaced could connect to the system using much smaller heat exchanges, which would be installed by the district energy utility. This would allow older buildings to “fuel switch” to a low-carbon source of heating energy, reducing community greenhouse gas emissions even further. Note that it will not be mandatory for older buildings to connect to the system.
8.0 BUILDING CONNECTIVITY
BUILDING CONNECTION REQUIREMENTS

To connect a building to a district energy system, the mechanical systems within the building must be compatible. For most buildings, district energy is intended to supply all building heating needs. This includes domestic hot water, building ventilation and space heating. To be compatible, the means of conveying thermal energy throughout the building is through a piped water distribution system. This means that new buildings built within a district energy service area typically have a ‘hydronic system’ requirement, so they can be serviceable by the system.

The other key mechanical element that is required to connect to a neighbourhood thermal grid is an energy transfer station (ETS) within the building’s mechanical room. The ETS is the interface between the building’s mechanical system and district energy supply and return pipes. For most buildings, two ETS units are required: one for space heating and the other to connect to the building’s domestic hot water heating system.

DISTRICT ENERGY SYSTEMS OFFER A NUMBER OF ADVANTAGES TO DEVELOPERS AND BUILDING OWNERS, SUCH AS:

- Buildings do not require their own heating plant (e.g. natural gas boilers), reducing capital costs and eliminating any associated equipment maintenance costs.
- The smaller footprint of the energy transfer stations (ETS) translates into a reduction in space requirements in the mechanical room, leaving more floor space available for other uses.
- No boiler stacks are required, streamlining design and improving building aesthetics.
- The elimination of heating plant equipment from the building eliminates any risks associated with the operation and maintenance of that equipment.
- Any risks associated with delivering heat are transferred to the district energy utility.
- Building owners benefit from the assured cost of a more reliable and resilient service than in-building or other forms of heating.

Sapperton District Energy System will provide low-carbon, renewable heating for connected buildings within the service area. The energy utility supplies heating energy for spaces within a building, as well as providing hot water heating for all domestic or commercial needs, such as washrooms, kitchens, laundry, and lab space.

The Government of Canada has set the future direction for energy efficiency in buildings through the Pan Canadian Framework on Clean Growth & Climate Change, which is to adopt increasingly stringent building codes starting in 2020, with the goal that all provinces and territories adopt ‘net zero energy ready’ building requirements by 2032. The Province of BC has also indicated through the Climate Leadership Plan that the BC Building Code will require a Net Zero Energy performance standard by 2032.

The City is encouraging the development of highly energy efficiency buildings throughout New Westminster while also supporting neighbourhood-scale renewable heating systems. If you are designing a new building in Sapperton constructed to an ultra-low energy standard like Net Zero Energy or Passive House, with annual thermal demand intensity below 45 kWh/m²/year then get in touch with us to customize connection requirements specific to your building.

DO ULTRA-LOW ENERGY BUILDINGS HAVE TO CONNECT TO THE SYSTEM?
9.0 MANAGING THE SYSTEM
THERMAL RATE SETTING PRINCIPLES

The capital costs of district energy systems are financed and recovered over the long term (typically 20-30 years) through a thermal energy rate charged to customers. Upon commencement of service, thermal energy charges are typically set so as to be competitive with conventional heating energy costs. In the medium and longer term, DES energy charges should be more stable and less sensitive than heating costs provided by conventional sources, such as electricity and natural gas.

In general, thermal rates will be set at a level that would cover all capital and operating costs while creating a reserve fund for contingencies and providing a reasonable rate of return on investment to the City. Thermal rates would be at or near the cost of conventional (business-as-usual) energy sources.

Proposed rate setting principles have been developed by the City of New Westminster to ensure an equitable assignment of system costs, while ensuring that there is an adequate revenue stream to finance the system.

GOVERNANCE AND DECISION-MAKING FOR THE UTILITY

Sapperton Renewable District Heating System would be regulated as a thermal utility that provides heating energy (and potentially cooling in the future) to buildings within a defined service area. It would be under the jurisdiction of the City of New Westminster’s Electrical Utility, which is governed by the Utilities Commission. This governance model has been successful one for the City, and provides a suitable platform for managing and setting strategic direction for the system.

While specifics on the Sapperton DES operating model are currently under study, City staff will bring forward recommendations to the Commission and Council in 2017. Daily operations and maintenance of the system would be under the authority of Electrical Utility.