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Item No. 12.1.1
Environment and Sustainability Standing Committee
February 2, 2017

TO: Chair and Members of Environment and Sustainability Standing Committee

SUBMITTED BY: Original signed

Bob Bjerke, Chief Planner and Director, Planning and Development

DATE: January 18, 2017

SUBJECT: **Cogswell Redevelopment Area District Energy System**

ORIGIN

May 13, 2014 — Executive Standing Committee passed a Motion that Halifax Regional Council:

1. Approve the Cogswell Lands Plan as the guiding document for the next stage of work for the removal and re-design of the Cogswell Interchange.
2. Approve the functional road network as proposed in the Cogswell Lands Plan.
3. Direct staff to initiate the following work and return to Council as required:
   a. Communicate the Cogswell Lands Plan, as approved, to the public, adjacent landowners and future developers through the municipal website, individual meetings and a public open house held in conjunction with the Strategic Urban Partnership.
   b. Proceed with the Detailed Design for the demolition and redevelopment of the Cogswell Interchange including issuing Requests for Proposals to retain necessary expertise.
   c. Enter into negotiations for land acquisitions required to advance the Cogswell redevelopment.
   d. Prepare a financial plan for the demolition and redevelopment of the Cogswell Interchange.
   e. Commence preparations for Municipal Planning Strategy/Land Use By-law amendments and necessary street closures as per the HRM Charter.

February 5, 2015 — Environment Sustainability Standing Committee (ESSC) passed motion 12.1 directing staff to prepare an information report outlining the process they are taking to ensure that opportunity for District Energy is explored as part of the Cogswell Interchange Land Redevelopment Plan.

April 2, 2015 — Report made to Environment Sustainability Standing Committee (ESSC) describing meetings which have been held with Halifax Water (HW) specific to their interest and role in District Energy. HW expressed an interest in participating in a District Energy project and is open to continuing discussions on the project.

RECOMMENDATION ON PAGE 3

October 6, 2016 Environment and Sustainability Standing Committee (ESSC) – THAT the Environment and Sustainability Standing Committee request a staff report on the implications of and mechanisms for mandatory connections to the district energy system within the Cogswell redevelopment area that would provide exclusive right to provide thermal energy;
Further, that staff provide information on potential mechanisms for voluntary connection to the district energy system by buildings outside the Cogswell redevelopment area.

LEGISLATIVE AUTHORITY

Halifax Regional Municipality Charter (HRM Charter):

79(1) The Council may expend money required by the Municipality for
(ac) placing underground the wiring and other parts of a system for the supply or distribution of electricity, gas, steam or other source of energy or a telecommunications system;
(ad) a system for the supply or distribution of electricity, gas, steam or other source of energy;

229(1) A municipal planning strategy may include statements of policy with respect to any or all of the following:
(i) The provision of municipal services and facilities,
(m) The use and conservation of energy, including the height and siting of developments,

235(5)(j) Where a municipal planning strategy so provides, a land-use by-law may…. (j) set out conditions, including performance standards, to be met by a development before a development permit may be issued;

281(3) A subdivision by-law may include (g) requirements for part of a system for the supply or distribution of electricity or other source of energy or a telecommunications system to be placed underground.

Halifax Regional Municipal Planning Strategy:

Policy E-26 The Community Energy Plan (CEP), approved by HRM in 2007 and as updated, shall provide guidance to HRM actions and programs with the goal of embedding considerations of energy security, energy conservation, energy distribution and energy consumption into all aspects of HRM activities. Updates to the CEP will seek proven, integrated and systematic approaches to energy planning in collaboration with community stakeholders with the goal of reducing corporate and community energy consumption with particular emphasis on using renewable energy (geothermal, solar, wind) and district energy.

Policy E-27 Where deemed advisable to implement or further an action or program of the Community Energy Plan or the Economic Strategy under Section 5.2, HRM shall consider amendments to Secondary Planning Strategies and Land Use By-laws or any other by-laws of the Municipality.

Policy E-29 HRM shall co-operate with Nova Scotia Environment and other government agencies in developing policies and programs to protect air quality and reduce greenhouse gas emissions and, where deemed advisable by HRM, shall consider adopting or amending by-laws to achieve these objectives.

Downtown Halifax Secondary Municipal Planning Strategy:

Policy 23 It shall be the intention of HRM to negotiate an agreement with provincial and federal levels of government and agencies including the Waterfront Development Corporation Limited, to establish LEED standards for the development of public lands throughout downtown Halifax pursuant to Policy 49 of this Plan.

Policy 49 HRM shall work in cooperation with other levels of government to encourage the strategic redevelopment of public lands and investment in public amenities and support the implementation of this Plan. It shall be the intention of HRM to pursue agreements with the federal and provincial governments as appropriate to further goals related to sustainable building design and housing affordability in the tendering of projects for public lands pursuant to Policies 8 and 23 of this Plan.

RECOMMENDATION

That ESSC recommend that Regional Council:

1. Endorse pursuing the requirement that new development within the Cogswell redevelopment area connect to a district energy system if one exists; and
2. Seek amendments to the HRM Charter and other amendments as required to provide the authority to implement the Cogswell District Energy System; and
3. Direct staff to develop the options and mechanisms to effectively implement the requirement for mandatory connection.

BACKGROUND

The Halifax Regional Plan guides the Municipality's planning and development until 2031. It sets the foundation for implementing a number of objectives and policy directions focussed on sustainable growth and development including implementation of HRM's Community Energy Plan which aims to reduce energy consumption and maximise the use of renewable and alternative energy sources. The last Regional Plan review introduced several directions to strengthen HRM's commitment to environmental, economic and social sustainability and resiliency including expanding "the use of tools that increase housing affordability……control of overall resource and energy consumption, and reduction of greenhouse gas emissions". As a guiding principle HRM will "manage development to make the most effective use of land, energy, infrastructure, public services and facilities, and foster healthy lifestyles". This principle is reflected in current planning efforts including the Centre Plan, Halifax Green Network Plan, and the proposed Cogswell Redevelopment Project (the Cogswell Project).

The Cogswell Project falls largely within Precinct 8 under the Downtown Halifax Secondary Municipal Planning Strategy (Downtown Plan) and a small portion falls under the Halifax MPS (Attachment A). It will demolish the old interchange and rebuild the surrounding area, helping to further grow the Regional Centre and downtown core. The Cogswell Project will better connect surrounding communities, and release six acres of land for re-development for a compact mixed-use development. Since the inception of the Cogswell initiative, the opportunity for incorporating a district energy system (DES) into the new development has been expressed by various interests including the public and Regional Council.

Following public consultation through HRMbyDesign, the Downtown Plan, and the "Cogswell Shakeup", a vision for the area was developed through the Cogswell Lands Plan focusing on high-quality, mixed-use, pedestrian, transit, and active transportation-friendly development. The Cogswell Lands Plan was approved by Regional Council through the Executive Standing Committee on May 13, 2014 (http://www.halifax.ca/council/agendasc/140513rc-agenda.php). It highlights objectives for an

environmentally sustainable development including LEED certified building, storm water re-use, community heating and cooling, district energy, net zero impact, and greenhouse gas reduction targets.

In December 2015 the Halifax Water Commission (HW) solicited proposals for the provision of engineering consulting services relating to a business case feasibility and technical study for a potential DES to capture the waste heat from the existing water and waste water treatment plant and to develop an Ambient Temperature District Energy System (ATDES). The final report indicated that the proposed DES could deliver energy more affordably than a conventional system while lowering greenhouse gas emissions and reducing dependence on fossil fuels. (Attachment B).

A presentation was made to the ESSC on October 6, 2016 by HW on the technical, environmental and financial feasibility of implementing a DES. That presentation can be viewed at: www.halifax.ca/boardscom/SCenv/documents/CogswellDESESSCPresentationOct62016FinalR1.pdf. HW informed Council that the waste water treatment facility has sufficient thermal energy to meet the heating and cooling requirements of the proposed DES loads and more. However, the business case for a DES depends on mandatory connection to the system within the Cogswell development area. This report outlines the enabling mechanisms available to provide for mandatory hook-up and their implications as well as some considerations for facilitating voluntary hook-up of buildings outside of the Cogswell redevelopment.

DISCUSSION

A DES is designed to supply thermal energy (and possibly electricity) to multiple buildings from a central plant or from several interconnected but distributed plants. Across Canada, DES's have a multitude of ownership models that range from municipally owned and operated to private corporations or a mix of both. A jurisdictional scan of DES's in Canada is provided as Attachment C.

Those which are in operation in Halifax are owned and operated by both public and private institutions. Currently, HRM does not have any requirements in place mandating district energy.

DES Operation

Halifax Water (HW) would own and operate their proposed DES installation as per the powers under the Halifax Regional Water Commission Act. Any further distribution rights would be addressed through local utility providers. The DES operator will be responsible to determine what regulations and requirements are necessary to operate as a utility and if they meet the requirements of the Public Utilities Act. HW, Heritage Gas, Nova Scotia Power, and the municipalities of Antigonish, Berwick, Canso, Lunenburg, Riverport and Mahone Bay are examples of utilities that currently report to the Utility and Review Board (UARB). Reporting to the UARB could guide the cost of energy from the DES and provide confidence to the property owners that they are receiving fair market value for the purchased energy.

Further details of the operation of the proposed DES would be determined if Council supports mandatory hookup giving HW further confidence of the feasibility of designing infrastructure for the DES. The opportunity to install the thermal grid (the piping system that distributes the energy) during the demolition and preparation of the lands for development will avoid significant costs. Future buildings connecting to a DES would significantly improve the achievement of LEED (Leadership in Energy and Environmental Design) certification.

Legislative Authority

Explicit powers are not currently identified under the Charter to direct mandatory hook up to a DES, continued participation with a DES, and the related purchase of energy source through land-use policy and regulation.

The current powers respecting district energy in the HRM Charter are limited and are summarized as follows:

- Council may expend money for placing underground wiring and other parts of a system for the supply or distribution of electricity, gas, steam or other source of energy, 79(1)(ac);
- Council may expend money on a system for the supply or distribution of electricity, gas, steam or other source of energy, 79(1)(ad) and may install such systems outside the boundaries of the Municipality, 104(5).
- A municipal planning strategy may include statements of policy respecting the use and conservation of energy, including the height and siting of developments, 229(1)(m); and
- a subdivision by-law may include requirements for part of a system for the supply or distribution of electricity or other source of energy or a telecommunications system to be placed underground, 281(3)(g);

These powers do not specify the explicit power to require a mandatory hook-up or to enforce such a requirement. To this end, more explicit legislative authority including clearer powers to require connection to the proposed DES and prohibiting the connection to other energy sources within the boundaries of the Cogswell District are likely needed. Even with mandatory hook-up the specifics of the purchase of that energy source and enforcement of its use would need further consideration by HW.

Mandatory Mechanisms

The following potential mechanisms for mandatory connection to a DES are discussed through this report:

- Sale of Land Condition
- Land Use Regulation
- DES By-law

Sale of Land Condition

The majority of lands within the Cogswell District are owned by HRM and will be released to the market for private development. The majority of surrounding properties are privately owned, except for an area owned by the Department of National Defence. The Municipality, as the land developer, could require the installation of the DES infrastructure and mandatory hook-up through the land sale and use of a buy back agreement. When HRM places the lands for sale, a condition could be included in the agreement of purchase and sale to require that the buildings connect to the DES. The standard mechanism to enforce such a condition would be through a buy-back agreement which is typically enforceable only for a specific period of time. This requirement would survive the property closing and continue to bind the purchaser but would not apply to subsequent purchasers of the property.

Land-Use Regulation

In addition to planning for mixed-use and compact development HRM can integrate energy supply or energy efficiency requirements into land-use planning policy and regulation, including mandatory connection. This would help to reduce load uncertainty for HW by guaranteeing customer demand. Although the Regional Plan and Downtown Plan contain policy support to implement the objectives of a DES, the current Charter as discussed above, does not enable mandatory connection. With Council's direction staff will seek Charter amendments and, if received, incorporate any necessary MPS and LUB amendments into an implementation strategy for mandatory hook-up.

Time-lines for advancing and securing the necessary legislative amendments are not known however, with Council's approval to proceed, staff would expedite discussions with the Province to advance earliest possible approvals. The likely time-frame for cabinet decision would be the fall 2017 session of the

Legislature. Any subsequent MPS and LUB amendments would be advanced as per Council's direction and priority scheduling.

DES By-law

The current development of the Centre Plan indicates support for DES's along with solar energy and support for LEED. With more explicit DES policy support and regulation under the proposed Centre Plan, support for DES's could be applied at a broader scale throughout the Regional Centre. Staff are not recommending a stand-alone DES Bylaw for the Cogswell redevelopment but rather as a future consideration for the implementation of the Centre Plan. A DES By-law, if legislative amendments are received enabling the adoption of such a by-law, similar to Surrey BC, (https://www.surrey.ca/bylawsandcouncillibrary/BYL_reg_17667.pdf) could be explored at a later date for its potential application across Halifax.

Voluntary Mechanisms

In addition to mandatory hook-up for buildings within the Cogswell District, opportunities to extend the DES benefits to surrounding properties could be explored. As a municipal government HRM is in a favourable position to proactively advance community energy, energy efficiency, renewable and alternative energy objectives beyond its regulatory and planning role. Voluntary mechanisms and incentives that could be developed to optimize the DES network and maximize the distribution of the energy beyond Cogswell could include:

- Access to low-cost financing similar to HRM's Solar City program;
- Energy data and mapping provided to the public demonstrating current and potential energy consumption in surrounding neighbourhoods and opportunities for savings;
- Public awareness and education to build confidence and support for hook-up to the DES;
- Stakeholder coordination to bring together potential clients and to increase buy-in from potential residents, businesses and other end users outside of the Cogswell District.

DES Business Case

Halifax Water (HW) has expended significant resources to date in the form of pre-feasibility study and financial models in support of a DES on the Cogswell lands. However, at the ESSC meeting on October 6, 2016 they stated that in order to proceed, they need positive indications that all steps would be taken to advance the necessary approvals process. Without Council's approval to pursue mandatory connection and the necessary legislative amendments, HW will not proceed further with this initiative and district energy for the Cogswell Redevelopment area will likely not occur in any form.

If Council approves the recommendation in this report, HW will take it as a positive indicator of Council's first step in developing a mandatory hook-up strategy. This approval of the concept of mandatory connection and the legislation required to enable it, for any real estate developments within the newly created Cogswell corridor, would allow HW to proceed with their next phases to complete the fatal flaw due diligence analysis, final business case analysis, preliminary design, and final design of their proposed DES. This would happen in conjunction with HRM's efforts to seek legislative amendments for mandatory hookup to a DES. HW would only investigate their next steps with clear indications that the requirements for mandatory connection are under development with positive indicators that approvals will be forthcoming. At this stage, HW understands that HRM will need to approach the Province to obtain Charter authority and legislative approval in order to enact mandatory connection and understands the associated risk in the unknown. While HRM is optimistic that the Province will receive the request for mandatory connection in a positive light, it cannot guarantee the success of this approach as it will require the decision of the province which is beyond the control of HRM staff or Council.

Economic Impact

While a DES is known to provide many benefits to a community and its residents, very little information exists on how a DES increases the value of the developable lands. DES's can provide direct savings to both building developers/owners and tenants through reduced operating costs. Capital costs would also be lower since there is no need to install boilers and chillers in a building, which in turn results in lower operating, maintenance and labor costs. In newer DES developments, and especially those similar to what is being proposed for the Cogswell area, the DES and required building and residential construction is expected to be inherently energy efficient and would provide long term financial benefits to the developers/property owners through reduced capital, maintenance and energy costs.

Some of the principle benefits of community-scale district energy are widely recognized to be:

- Economic development: a vibrant downtown connected to district energy has an economic multiplier effect. The environmental and economic benefits will attract new businesses, creating a thriving district that, in turn, attracts new residents.
- Building owners connected to district energy typically benefit from capital avoidance, operational cost savings, and space savings.
- Externalizing management of complex equipment from internal building managers to qualified professional experts.
- District energy can help building owners achieve "green" certification (e.g. LEED, EcoLogo, Energystar), enabling them to meet their climate mitigation commitments, and valuable tools for attracting commercial and residential tenants.
- Building owners are able to offer "green" space on the rental and real estate markets.

Market studies done in Europe, and more recently the US, to assess the impact of DES's related to improved real estate values has to do with the value of the completed buildings or residences, including the developed land, since these are the end users and beneficiaries of the DES. The DE concept can bring uncertainty for developers until proposed system is fully scoped and understood, not unlike other variables such as market size, competitive advantage, interest rates, pending plan amendments to HRMbyDesign related to Cogswell. At this stage, the full details of mandatory connections, developer/building owner requirements, costs and risks are not at the stage to fully determine the impacts on the market value of the lands. Should the detailed DES business case support long term financial benefits to the developers/building owners through reduced capital, maintenance and energy costs, energy flexibility and rate stability, the real estate market value impacts are expected to be favourable.

Conclusion and Next Steps

If directed by Council, staff will collaborate with the Province to determine specific next steps and amendment process to enable the mandatory hookup to a Cogswell DES. As part of the authorization from Regional Council to proceed with the next phase of the Cogswell Redevelopment, it was agreed that staff would then return to Council for a go/no-go decision once the detailed design of the project was at 60% completion. The Cogswell Project team anticipates they will have a 60% final design completed in the summer of 2017. If Council endorses the requirement for mandatory hookup to the DES for the Cogswell Lands, HW would then initiate a request for proposal (RFP) to undertake preliminary design and business modelling. This process would start immediately after Council approval. If the DES business case remains positive, HW would then move forward with the detailed design for the DES. Detailed design for the linear components is expected to be complete by the fall of 2017. During this time, HW will engage with the UARB, Nova Scotia Department of Energy, HRM, the Public, and other key stakeholders as necessary.

While there are purchase and sale options available to enable mandatory hook-up to the proposed Cogswell DES as a condition of land sale, Charter amendments are required to fully achieve the objectives of a DES for the Cogswell lands. The long-standing work surrounding the Cogswell redevelopment and Council's desire to advance the project in a sustainable manner is reflected in the background work on the Cogswell Project. Furthermore, HW is prepared to accept the short-term risk

and expenditure by moving forward with the preliminary design for the DES provided Council directs staff to develop the mandatory hook-up strategy. Staff will then initiate amendment discussions with the Province, and return to Council with a detailed strategy for advancing mandatory hook-up in conjunction with the Cogswell Project. The Cogswell Project will be targeting high performance, energy efficient buildings and sustainable community options. The Nova Scotia Building Code currently references the Energy Code of Canada for 2011 and will soon reference the 2014 Energy Code of Canada. This will help to ensure that green building principles and energy efficiency requirements are advanced but further requirements to the built form could be considered so the area can be recognized as a leader in sustainable building design.

FINANCIAL IMPLICATIONS

There are no financial implications to this report for HRM. Staff will be able to develop the options and mechanisms for mandatory connection and seek the legislative amendments necessary to implement the Cogswell DES with existing resources. Halifax Water (HW) will however, have to expend resources to advance to the preliminary design and business modelling while legislative amendments are being pursued.

This investment from HW will further refine the design and cost implications of developing the DES and thermal grid, as well as options for cost recovery. HW will expend resources in the magnitude of $1.6 million to further assess the business case and complete the necessary preliminary and detailed design work. If legislative amendments do not pass, that investment would be absorbed by HW. If at any stage during the preliminary or detailed design and business case modelling the signs are no longer positive that HW will get mandatory connection, the DES project will not be pursued further by HW.

If Council rejects the recommendation in this report, HW will not proceed with the DES as part of the Cogswell Project. If, however, Council does approve the recommendation and HW proceeds with the design but subsequent legislation for mandatory hookup does not pass, there will be financial implications to HW.

RISK CONSIDERATION

In their presentation to ESSC on October 6, 2016, Halifax Water (HW) identified that a mandatory connection strategy is necessary for a positive business case for the Cogswell redevelopment project and that they could not proceed further to develop the final design or financial models for a DES without this assurance. Failure to approve the mandatory DES direction at this time would likely result in HW or any other possible proponent from abandoning the initiative. Without any acceptable alternative available and the shortening design window for Cogswell redevelopment, refusal to accept this recommendation could effectively preclude any DES being implemented within the Cogswell Interchange lands. HW agrees to accept the possible risk involved with proceeding with the next phase of financial and engineering development and the possibility that legislative amendments may not be approved. .

Performing a market analysis of the sale of the Cogswell lands was out of scope for this report. However, based on consultation with HRM Real Estate, mandatory hookup for the Cogswell Area Redevelopment is not expected to significantly affect the sale price of the lands. The planned update of the real estate assessment can more carefully consider the impacts of mandatory DE connection. The DES concept brings a level of uncertainty to developers until it is fully understood, not unlike market, interest rates, pending plan amendments to HRMbyDesign and overall Project Completion.

COMMUNITY ENGAGEMENT

Community engagement was not necessary for this report. Significant engagement has taken place through the Cogswell Project Team, HRMbyDesign, The Downtown Halifax Secondary Municipal Planning Strategy and The Cogswell Shakeup to shape the overall Cogswell Plan.

ENVIRONMENTAL IMPLICATIONS

From the report that was completed for Halifax Water (HW) in June 2016, the annual expected energy loads of the proposed and completed build out of Cogswell are as follows:

- Space Heating 14,016 MWh/year
- Domestic Hot Water Heating 3,944 MWh/year
- Space Cooling 5,469 MWh/year
- Total 23,429 MWh/year

The above energy demand numbers assume a full build out. Energy use will gradually increase as the buildings are built in the Cogswell Lands. The following tables show the greenhouse gas (GHG) emission intensity by conventional heating type and the avoided GHG emissions against the proposed DES by HW over 30 years.

Table 1: Total GHG Emission Intensities by Heating Type.

Heating Type	GHG Intensities (tCO2e/MWh)
Electric Baseboard (EBB)	0.652
Air Source Heat Pump (ASHP)	0.274
Gas Hydronic Heating (GHH)	0.212
Oil Hydronic Heating (OHH)	0.313
Ambient Temperature District Energy System (ATDES)	0.166

Table 2: Comparison of Cumulative Avoided GHG Emissions between Conventional Heating Systems to HW's Proposed DES (tCO2e).

	ATDES vs EBB	ATDES vs. OHH	ATDES vs. ASHP	ATDES vs. GHH
Total 1 Year	1,752	530	389	166
Total 5 Year	14,645	4,430	3,254	1,386
Total 10 Year	54,816	16,580	12,181	5,188
Total 20 Year	158,822	48,039	35,294	15,033
Total 30 Year	262,828	79,497	58,406	24,877

The above table demonstrates the magnitude of avoided GHG emissions if a DES is in operation for the Cogswell Interchange. If a DES, as proposed by HW, is not installed, approximately 262,000 tonnes of GHG emissions could be created over 30 years. This is equivalent to 55,000 passenger vehicles driven for one year or almost 1,400 railcars worth of coal burned.

ALTERNATIVES

Council could choose to not support mandatory DES hookup on the Cogswell lands. However, the likelihood of advancing district energy without mandatory hookup is low as HW's business case requires confidence that mandatory hookup would be available in order to incorporate district energy into the detailed Cogswell redevelopment design.

ATTACHMENTS

Attachment A: MAP 1 Cogswell Lands
Attachment B: Halifax Water District Energy Report Executive Summary
Attachment C: Brief Jurisdictional DES Scan in Canada

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/index.php then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

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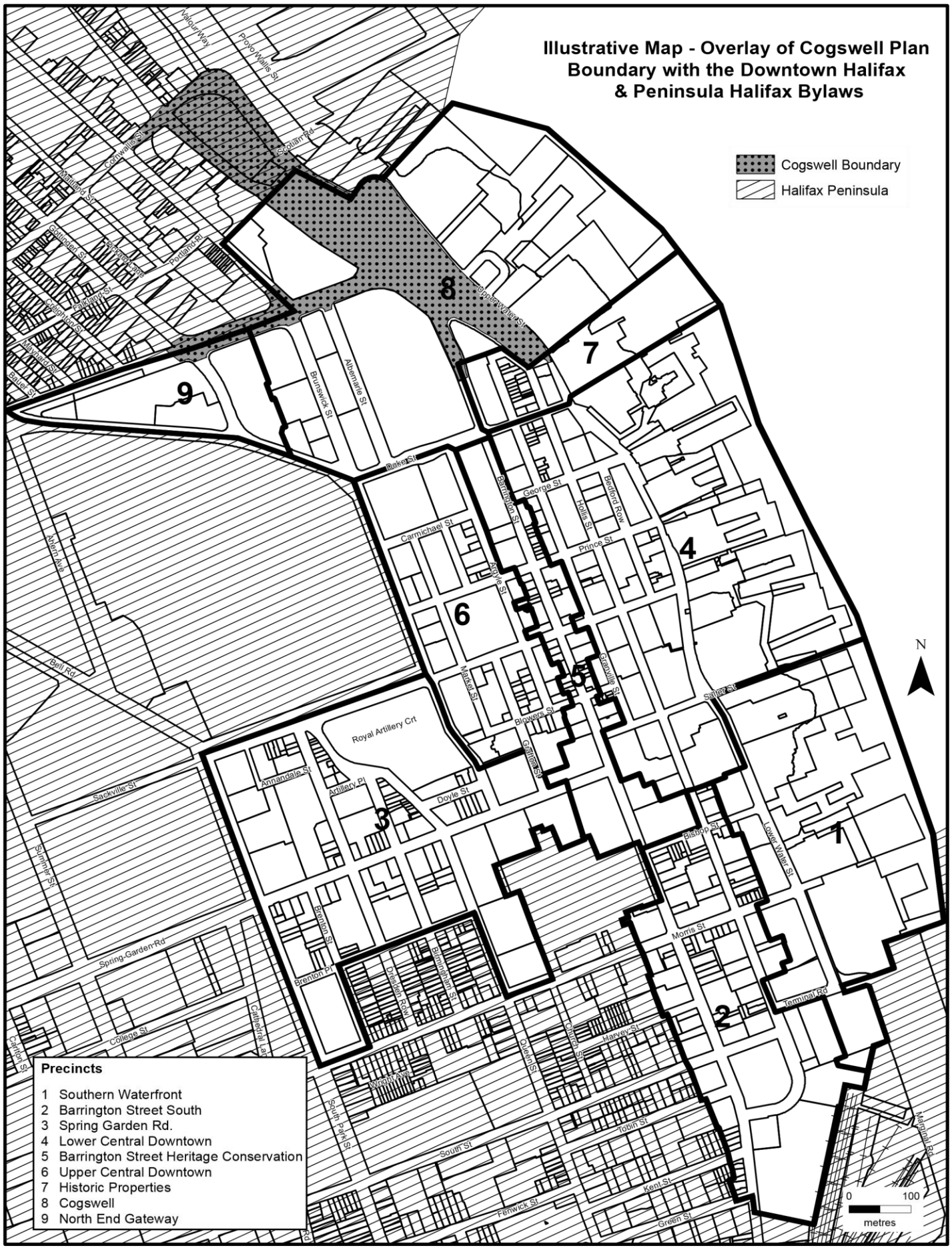
Original signed

Report Approved by: Holly Richardson, Acting Program Manager, Energy and Environment, 902.490.3665

Attachment A



COGSWELL DES FEASIBILITY STUDY

DEC PROJECT#: D16-009

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COP:	Coefficient of Performance
DES:	District Energy System
DHW:	Domestic Hot Water
DHS:	District Heating System
DND:	Department of National Defense
DPS:	Distribution Piping System
ETS:	Energy Transfer Station
EUI:	Energy use intensity
HDPE:	High-density Polyethylene
HRM:	Halifax Regional Municipality
HVAC:	Heating Ventilation and Air Conditioning
HW:	Halifax Water
NPV:	Net Present Value
PV:	Present Value
ROE:	Return on Equity
ROI:	Return on Investment
UARB:	Utility and Review Board
UV:	Ultraviolet
WACC:	Weighted Average Cost of Capital
WWTF:	Waste Water Treatment Facility

LIST OF REFERENCES

Ekistics Planning and Design. *Cogswell Transformed,* April 2014.

Province of Nova Scotia. *Public Utilities Act*. RS 1989 with amendments.

Province of Nova Scotia. *Municipal Government Act*. 1998 c. 18, s. 1.

Nova Scotia Utility and Review board. “Halifax Regional Municipality District Energy Systems.” Letter to Martin Ward, HRM. March 30, 2010.

ACKNOWLEDGEMENTS

Halifax Water would like to recognize the contributions of QUEST and the Nova Scotia Department of Energy for their contributions to the preparation of this report.

Nova Scotia Department of Energy

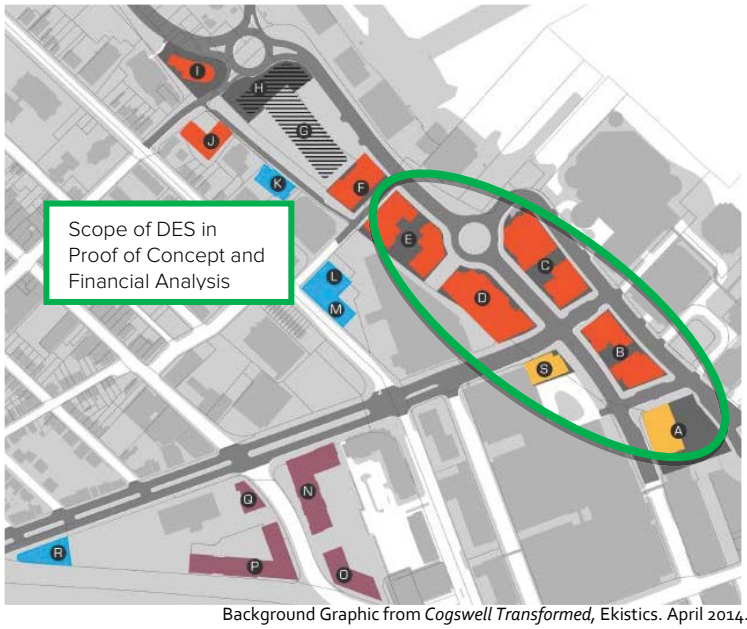
EXECUTIVE SUMMARY

This study has developed a concept design for a wastewater heat recovery based district energy system (DES) that recovers waste heat from the Halifax Wastewater Treatment Facility (WWTF) effluent stream and provides heating, cooling, and domestic hot water to six blocks of buildings in the Cogswell Redevelopment.

A number of technologies exist for extracting thermal energy from wastewater — both untreated sewage and effluent from treatment plants. This report has presented technology options for effluent heat recovery and has selected plate frame heat exchangers as the most cost effective, space conservative, and energy efficient heat exchange technology.

The proposed DES concept works by direct heat exchange between the effluent and ambient temperature water running through the DES piping. Ambient temperature water is piped to mechanical rooms in each building where heat pumps are used to extract heat from the water and provide high-grade thermal energy for building loads such as domestic hot water (DHW) pre-heating and make-up-air heating. Water source heat pumps in each residential or commercial unit provide space heating and cooling. In the winter, energy is transferred from the DES to the building water-source heat pump (WSHP) loop; in summer, excess energy from cooling is rejected to the DES from the WSHP loop through a heat exchanger.

A group of six blocks (green circle) in the Cogswell Redevelopment plan were selected for connection to the DES and development of a business case. The six blocks were chosen because of their central location, high density, and close proximity to the WWTF. As the largest blocks proposed for development under the Cogswell plan, these blocks present the greatest opportunity for a positive business case. A plan showing the proposed blocks and DES concept is provided at right.



Background Graphic from *Cogswell Transformed,* Ekistics. April 2014.

Figure 1: Cogswell DES Concept Service Area

The six identified buildings (blocks “A” through “E” and “S”) have a combined expected floor area of 162,000m^2 which is assumed to be 8% retail, 15% office, and 77% residential. Based on energy use intensities for Halifax, these buildings are expected to have a **peak heating demand of 12 MW** and a **peak space cooling demand of 7.8MW**.

The capacity of the WWTF effluent for heat exchange was assessed. The effluent 3-year average monthly temperature ranges from a low of 11.5°C in March to a high of 22.3°C in September. Minute by minute flow rate data was charted and a minimum night time dry-weather effluent flow rate of 2,000 m^3/h was observed. Average dry weather flow rates of 3,500 m^3/h were observed. The heat capacity of the effluent at various flow rates and temperatures is presented in Table 1.

Table 1: Effluent Heat Capacity

Effluent Temperature	Heat Capacity @ Flow	
	2,000 m3/h	3,500 m3/h
14 °C	17 MW	31 MW
12 °C	13 MW	22 MW
10 °C	8 MW	14 MW
8 °C	3 MW	6 MW

The effluent heat capacity table shows, even with below average effluent temperature of 10°C (a condition which typically occurs less than 5 days per year) and worst-case dry-weather flow, the effluent still contains **8 MW** of heating capacity, based on maintaining a minimum effluent temperature of 6.5°C. At the average January condition (12°C and 3,500 m3/h) the effluent contains **over 22 MW** of heating capacity. Based on this analysis, it is expected that the WWTF effluent would be sufficient to meet the proposed Cogswell DES thermal energy needs over 99% of the year. Under the proposed concept, the mechanical room in each building would be provided with a natural gas boiler for peaking and backup in order to meet the customer heating loads if the DES energy is not available.

A comparison of DES to other typical heating sources was provided. Table 2 shows that DES can provide a unit of heat with significantly lower fuel inputs and GHG emissions than other heating options.

Table 2: Halifax Heating Energy Sources Comparison

	Electric Baseboard	Air Source Heat Pump	Gas Hydronic Heating	Oil Hydronic Heating	DES Heating
Space Heating	1 MWh				
Fuel Source	Electricity	Electricity	Natural Gas	Heating Oil	Electricity/DES
Efficiency	100%	240%	85%	80%	420%
Fuel Use	1.00 MWh electricity	0.42 MWh electricity	1.18 MWh Nat. Gas	1.25 MWh Oil	0.24 MWh (electricity) 0.76 MWh (DES)
Fuel Rate ($/MWh)	$149.54	$149.54	$50.40	$69.70	$149.54 (electricity)
Fuel Cost ($/MWh delivered heat)	$149.54	$62.81	$59.47	$87.13	**$35.60**
Fuel GHG Intensity (tCO2e/MWh)	0.652	0.652	0.180	0.250	0.652 (electricity) 0.013 (DES)
GHG Emissions (tCO2e/MWh delivered heat)	0.652	0.274	0.212	0.313	**0.166**

Capital and operating costs of the DES concept were compared against three possible "business-as-usual" (BAU) systems for the six blocks. The BAU options considered were:

- Electric heat
- Water-source heat pump (WSHP) with natural gas heat
- WSHP with oil heat

The fuel costs of the three BAU cases were compared to the fuel costs of the DES option and are presented in Table 3.

Table 3: Fuel Input Costs for DES and 3 BAUs

Location	BAU 1 – Electric	BAU 2 – Nat. Gas	BAU 3 - Oil	DES
Energy Centre	-	-	-	$ 44,000
Bld. Mechanical Rooms	$ 640,000	$1,098,000	$1,495,000	$ 274,000
Customer HVAC System	$2,039,000	$ 579,000	$ 579,000	$ 601,000
Total	**$2,679,000**	**$1,677,000**	**$2,074,000**	**$919,000**

The DES option is shown to have significantly lower fuel use and fuel cost among the three options based on 2016 energy rates—**nearly 50% lower energy cost than the lowest cost BAU option** (natural gas boilers).

The fuel costs for the DES and BAU options are based on three year average natural gas and heating oil prices in Halifax and current Nova Scotia Power electricity prices as detailed in Table 4.

Table 4: Commodity Price Assumptions

Commodity	Rate
Electricity, Rate 2, Domestic	$149.54 /MWh
Electricity, Rate 11, General (blended rate)	$121.00 /MWh
Natural Gas, Rate Class 1 (DES)	$22.60 /GJ plus $22 /month
Natural Gas, Rate Class 2 (BAU)	$14.00 /GJ plus $563 /month
#2 Heating Oil	$0.75 /L

Class D capital cost estimates for the DES Concept are presented in Table 5 and compared to the cost of an equivalently sized BAU system (natural gas boilers) for the six Cogswell blocks. Capital costs presented include soft costs but exclude HST and contingency.

Table 5: Total Capital Cost for DES and BAU ($'000s)

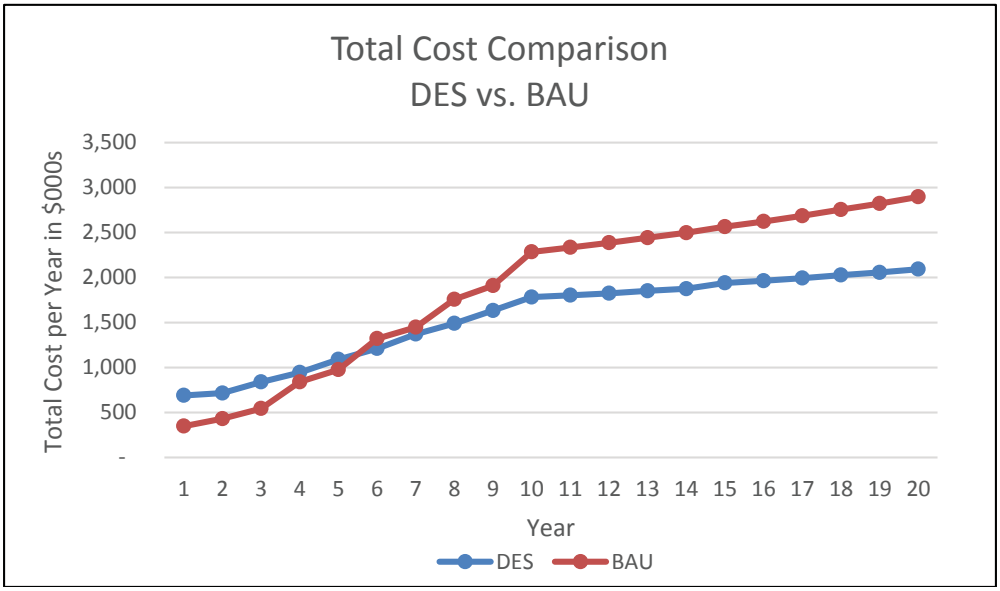
Systems / Components	DES	BAU 2
1. ENERGY CENTRE	$ 3,955	-
2. DISTRIBUTION PIPING SYSTEM	$ 1,326	-
3. ENERGY TRANSFER STATIONS IN (6) BLOCKS	$ 762	-
4. BUILDING MECHANICAL ROOMS IN (6) BLOCKS	$ 5,956	$ 5,489
5. CUSTOMER BUILDING HVAC SYSTEM	$ 27,763	$ 27,207
TOTALS	**$ 39,762**	**$ 32,696**

The DES option has a capital cost premium of **$7.1 million** over the natural gas boiler BAU scenario. The majority of this capital cost premium is due to the cost of the energy centre, distribution piping system (DPS), and energy transfer stations (ETSs) for the 6 Cogswell blocks. The estimated cost of the customer heating ventilation and air conditioning (HVAC) systems is similar under both DES and BAU options.

A 20 year financial analysis for the proposed DES concept has been created. It is assumed, initially, that the DES including the energy centre, distribution piping system, and building mechanical rooms in the six blocks would be owned and operated by Halifax Water as a regulated thermal energy utility. The utility sells thermal energy to the customer at a set rate ($/kWh).

The total cost of owning and operating the DES was compared to the total cost of owning and operating an equivalent BAU system (gas boiler and cooling tower) for the six Cogswell buildings over 20 years. The present value of the total costs of the DES is $19.8M which is less expensive than the present value of total cost of the BAU at $23.2M. The annual total costs for the first 20 years of the project are presented in Figure 2 for both DES and BAU.

Figure 2: Total Cost Comparison by Year



This demonstrates that, over the course of a 20 year analysis, the DES can be delivered more cost effectively than the BAU while also creating a valuable non-tax based, revenue-generating asset and also lowering GHG emissions of the community. An initial DES thermal energy rate set at $0.079/kWh of thermal energy would cover the DES utility costs and also be lower than the total cost per kWh for an equivalent BAU system at $0.092/kWh.

At these rates and based on initial assumptions, the DES utility could be created with a positive net present value (NPV) of $2.28M and in internal rate of return (IRR) of 5.7%. The financial modelling indicates that the utility would achieve positive cumulative cash flow in year 17 (5 years after the 6th Cogswell building is complete).

This is a very positive business case for a renewable energy utility. The proposed DES concept could be delivered successfully at Cogswell and HW could create a thermal energy utility that provides renewable energy to customers at lower cost than the BAU system.

The business case for the DES depends on developers connecting to the system. Connection to the DES should be made mandatory for buildings in the identified service area through use of restrictive covenants, developer agreements, or municipal by-laws put in place by Halifax Regional Municipality. Mandatory connection protects the business case for the utility and makes energy rates lower for all connected customers.

Attachment C

Brief Jurisdictional DES Scan in Canada

Jurisdictional Scan

District Energy Systems are not uncommon in Halifax or Canada. The first was developed in London, Ontario in the 1880's. Most are owned and operated by institutions such as Dalhousie University, Capital Health, and the Department of National Defence. District Energy Systems have been implemented across Canada and have a multitude of ownership models that range from municipally owned and operated to private corporations and a mix of both.

A study recently completed in March 2016 by the Canadian Industrial Energy End-use Data and Analysis Centre out of Simon Fraser University identified 159 operating District Energy Systems in Canada in 2014. Of the 159 operating District Energy Systems, three-quarters serve more than one customer type and these systems lend the best support with mixed use types of buildings. The same study highlights a surge in commissioned District Energy Systems. Half of the 159 District Energy Systems have been commissioned since 2000, with a quarter of all systems constructed in the five years prior to 2014. The 159 operating District Energy Systems serve a total of 2,863 buildings, where the average number of buildings connected is 37 and the largest number of buildings serviced by a single District Energy System is 302.

District Energy Systems that are in operation Halifax are owned and operated by public and private institutions. Currently, there isn't a specific mechanism that is in place to support the installation of a District Energy System unless a proponent sees the value in installing a system alongside the development of a new subdivision. Land use development tends to take place by the development of lands and builders purchase the land from a developer to build on a parcel of land. The unique opportunity for the Cogswell Interchange Redevelopment is the developer in this case is HRM.

City of Toronto

The City of Toronto has a By Law that states developers must consider connection if it is available and connect if it is competitive. It has had some positive influence on the continued expansion of the local DE Company, Enwave Energy Corporation, which is partly owned by the City. However, the qualifier "at a competitive price". The developer is part of that dialogue and naturally emphasize first-cost over long-term costs; long-term costs are often not their concern, e.g. in the case of condominiums.

City of Markham

In Markham, development of the DE system, Markham District Energy (MDE), which is wholly owned by the City, has been actively supported by the City. IBM, and was influential in supporting the marketing of the system to the original developers who agreed to connect their buildings. Development approval is subject to a number of requirements, one of which is sustainability, and the sustainability requirement is automatically deemed to be satisfied by connection to DE. The results have been that although there is no mandatory connection in Markham Centre, the connection rate of new development has been 100% and currently 27 buildings are connected.

Lonsdale Energy Corporation

Lonsdale Energy Corporation (LEC) is a district energy utility wholly owned by the City of North Vancouver. Initially, as part of its overall plan for DE, the City of North Vancouver established a Hydronic Heat Energy Service By Law that applied to the planned service area, known as Lower Lonsdale. It required new or retrofitted buildings to install hydronic systems, a pre-requisite for district heating. This By Law has been challenged in court under the Canadian Charter of Rights but the court has upheld the right of the municipality to enforce this By Law. In 2010, the City passed a new By Law (8086) that requires any new building in the entire City of more than 1,000 square meters gross floor area to connect to the

district heating system unless it is determined by the City's Director of Finance that the cost to the City would be excessive. By Law 8086 also allows LEC to provide cooling services, but connection of properties to a district cooling system (should LEC develop one) is optional.

Regent Park Energy

Regent Park Energy Inc. has a customer base created by development of a mixture of approximately 1/3 public and 2/3 private multi-unit residential building units on Toronto Community Housing Corporation owned land. The development by TCHC and real estate co-developer Daniels Corporation will take place in six phases and create approximately 5,000 new residential units. The market risk for this DES is mitigated by the commitment of TCHC and the co-developer to connect all of the new buildings (except about 500 townhomes). The co-developer agreed to connect their buildings under the co-development agreement with TCHC. This agreement was no doubt facilitated by the facts that TCHC owned the land and it is in an excellent location for development, close to downtown.

South East False Creek

The South East False Creek Neighborhood Energy Utility (anchored by the 2010 Olympic Athletes Village) is owned and operated by the City of Vancouver. It commenced operation towards the end of 2009. The City of Vancouver owned the land and entered an agreement with a real estate developer, which included connection of the new buildings to DE.

City of Victoria

The City of Victoria awarded development rights to City owned land at Dockside Green based on a competition. The resulting development agreement committed the developers to establish a DE utility, among other sustainability features, and connect the new buildings to it.