SUBJECT: Integrated Community Energy System Phase 2

TO: Committee of the Whole

FROM: Capital Works

Report Number: CW-08-17

Wards Affected: all

File Numbers: 210-09

Date to Committee: February 27, 2017

Date to Council: March 27, 2017

Recommendation:

Direct the Executive Director of Capital Works to report back to the Committee of the Whole with an analysis of options for a business structure and financing to oversee, manage and develop a community energy system in Burlington by the fourth quarter of 2017.

Purpose:

This report presents a high level business case for the development of a community energy (district energy) system in Burlington. The city's strategic plan states under Section 3.2 Environmental and Energy Leadership:

3.2 e) The city will work with community stakeholders to implement the Community Energy Plan and achieve the goals and objectives related to energy conservation, generation and availability.

3.2 g) The city recognizes that climate change is a significant issue and is working with the community and all levels of government towards the goal of the Burlington community being net carbon neutral.

This project is directly related to an action in the strategic plan:

> The city will work with Burlington Hydro to explore district energy, micro generation, and new storage technologies.

Heating for conditioned air and water for buildings is a significant contribution to greenhouse gas emissions. Development of a district energy system including the

system of pipes to distribute heat to buildings is a proven and viable technology to bridge to a low carbon system.

Generating local energy (thermal and electricity) can support local economic development, efficient land use development, improve local resiliency and reduce greenhouse gas emissions, supporting the strategic plan:

A City that Grows

- Promoting Economic Growth
- Intensification
- Focused Population Growth

A Healthy and Greener City

- Healthy Lifestyles
- Environmental and Energy Leadership

An Engaging City

- Good Governance

Background and Discussion:

In 2016, staff reported to council on the results of the Community Energy Study – Phase One (CW-01-16), with the following direction:

> Direct the Executive Director of Capital Works to proceed with phase two of the Community Energy Feasibility Study and to report back to the Development and Infrastructure Committee with the results by the fourth quarter of 2016.

The phase 2 study report is found in Appendix A – Integrated Community Energy System for the City of Burlington, Phase 2 Study.

Characteristics of a District Energy System

District heating provides heat for multiple buildings from a single heating plant. There are three main components for a district energy system: the energy centre to produce the heat and power; the distribution system of buried piping to circulate the hot water for thermal energy; and the energy transfer station in each building. This is an efficient source of energy as district heating systems operate at higher efficiencies than individual heating systems in buildings. The added benefit is the ability to produce electric power from the engines or turbines (combined heat and power or CHP).

As the system expands and connects new facilities, additional components and sources of energy can be incorporated into the ‘integrated’ system, including renewables, use of bio-fuels, waste heat from industrial and domestic sources, and energy storage.

The technology for district energy systems is mature and has been around for over a century. While the technology is proven and mature, careful planning and a sound investment strategy is required to transition from traditional heating systems to a district energy system. Systems need to be designed based on a sound business plan and be flexible to expand as additional buildings (customers) are added. Most district energy systems in Canada are owned by municipalities or large institutions like universities as the public sector in general is in a better position to provide the long-term operational commitments that mitigate the financial risks associated with such systems. However, once a system has expanded and becomes profitable, there is demand by private sector entities to subscribe to and or invest in these systems. Development of a district energy system is a long term investment.

Study Process

A request for proposals (RFP) was issued and FVB Energy Inc. was hired to complete phase two of the study to develop a business case for a community energy system. The RFP also required a review of the city's planning policies to make policy recommendations to support the future development of a Community Energy System (CES) within the mobility hub areas. A summary of the planning policy work is provided in the phase 2 study report (Appendix A).

The Downtown Coordinator, the Manager of Realty Services, and planning staff were consulted on potential existing buildings and development sites which might connect to a district energy system in the downtown core. A request was emailed to certain building owners for building and energy data. Meetings were held with a select group of developers and building owners, while some discussions took place by email.

A workshop was held at the Art Gallery of Burlington for city staff, council members and property owners and developers, which included a presentation from Bruce Ander about the Markham District Energy system. In November, FVB made a presentation to the Community Stakeholder Advisory Committee for the Community Energy Plan on the work completed to date. Upon completion of the study, follow-up meetings were held with a select group of developers to discuss next steps.

Community Energy Scenarios for Consideration:

FVB provided four scenarios for the city to consider in developing a community energy system in downtown Burlington:

1. District Energy System embedded in a new development – heating only
    - This scenario includes the generation of heat only from an energy centre embedded in a downtown development and distributed to five buildings, including City Hall, which would be connected over a five year period.

2. District Energy System embedded in a new development – heating with a CHP system to produce electricity
   - This scenario is similar to #1 but also includes the generation of power (electricity) from a small CHP (combined heat and power) generator.
3. District Energy System with heating, cooling and a CHP system to produce electricity
   - This scenario builds on 1 and 2 but also includes the generation of cooling thermal energy.
4. A CHP system to produce electricity for three buildings on electric heat.
   - This scenario is a standalone system which is not integral to the proposed downtown system. A CHP system would produce electricity for three multi residential towers which are electrically heated, where the waste heat from the CHP engine is sold as thermal energy to adjacent buildings.

FVB Recommended Options:

FVB has recommended that the city consider implementation of scenario 2 in the downtown core, a district energy system including heating with a CHP system to produce electricity. Although not related to scenario 2, the city should also consider the implementation of scenario 4 to develop a CHP system to provide electricity to a group of buildings with electric heat and provide the waste thermal energy (heat) from the engine to neighbouring buildings.

Recommended: Scenario 2

Combining both a 600 kWe CHP unit (behind the meter) with a 4.5 megawatt heating system would result in improved efficiencies for a district energy system. The electricity produced can be used to power the energy centre and the host building, and the waste heat recovered from the CHP unit can heat hot water that would be utilized in the district heating system.

It is proposed that this scenario would connect five buildings over a five year period, including City Hall. The estimated cost of this system is approximately $6.98 million, which includes the cost of the energy centre, the district piping system, and the individual energy transfer systems in each building. This cost estimate does not include upfront soft costs related to setting up an entity to manage a district energy system and all of the related legal, administrative, marketing and other necessary requirements, such as permitting fees.

Benefits

- Beachhead system - this small district energy system is considered a ‘beachhead’ where it can eventually be expanded to connect new buildings as

demand grows. Once it reaches a certain size, consideration can then be made to connect smaller buildings where the business case is not as strong.

- Bridge to renewables – a district energy system will help move the city towards becoming a carbon neutral (net zero) community over the long term, where a thermal grid will provide flexibility in the future for fuel switching to other sustainable sources of energy (i.e. biomass, renewables, waste heat, etc.), as well as implement energy storage systems.
- Resiliency – the city needs to consider measures to adapt to the impacts of climate change, particularly severe weather events such as flooding. During the 2013 Calgary flood, buildings connected to the Enwave district energy system were still operational compared to those buildings which were not connected.
- Economic development – creates jobs in Burlington (construction) and project management. The city can leverage the system for businesses which may be attracted to a community willing to take leadership on a sustainable and secure energy system.
- Sustainability and leadership – Burlington shows leadership as a sustainable community, working towards its energy and environmental objectives in the strategic plan.
- Premium energy – district energy provides a premium system of thermal energy to buildings, improving the comfort level of occupants.
- Real estate – developers benefit by gaining additional real estate in their buildings due to reduced mechanical demands, avoiding upfront capital costs.

Recommended: Scenario 4

FVB has also recommended that the city and Burlington Hydro consider a behind the meter CHP system to be built where electricity would be generated for a group of apartment buildings, which have electric heat, and the recovered heat from the CHP engine could be distributed to adjacent buildings for thermal energy. The estimated cost for this scenario is $2.9 million.

Benefits

- Avoided cost – as electricity rates continue to climb, implementation of a behind the meter CHP system would help mitigate the risk of increasing costs. Savings could be potentially passed onto the tenants where rent hikes could be reduced.
- Incentive – an application can be submitted to the IESO for an incentive to support this project.

- Efficiency – recovering the waste heat and selling as thermal energy to adjacent buildings improves the overall efficiency of the system.
- Resiliency – in the case of a prolonged power blackout, the CHP plant could operate to provide electricity to the building.
- Economic development – supports construction jobs for the implementation of the system.

Scenario 3

Although scenario 3 was not recommended by FVB, external stakeholders to the city's community energy plan have requested that the city continue to consider the option with cooling capacity. Since it has been forecasted by scientists that our climate will continue to warm in the future with a changing climate, the provision of cooling energy for buildings will become even more important. A district energy system that can provide reliable cooling energy during hot summers will help to improve the resilience of the building stock in Burlington.

Mobility Hubs

A review of the planning policies to support the development of community energy systems was completed by The Planning Partnership and shared with planning staff for consideration while writing the new Official Plan. A summary of the planning policy work is provided in the phase 2 study report (Appendix A). FVB did recommend that as the planning evolves for the Mobility Hubs, the city should consider possible opportunities for a future energy centre; either a stand alone site or embedded with another city facility, such as a fire station or community centre. The energy centre for Hamilton's system is attached to a high school in the downtown.

There are several positive reasons to develop a district energy system in Burlington and as FVB has shown, implementing a system in Burlington is technically viable. These systems have existed for a hundred years or more, so the technology is proven. However, there are also a number of measures which need to be put in place before proceeding with implementation.

Strategy/Process

If directed by council to proceed to the next stage of the project, the next steps for staff are to research options for a preferred governance/business structure and financial plan. Options to be considered include:

- Public ownership **–** the city creates a separate corporate entity but ownership is retained by the municipal corporation.

- Public sector partnership – the city creates an entity but partners with an existing district energy corporation or utility to develop and deliver the system.
- Public private partnership – the city partners with a private sector entity to develop and deliver a district energy system.

In addition, there are a number of actions which will need to be considered before getting to implementation, such as:

- Research financing mechanisms to develop system
- Develop a marketing/sales strategy to attract customers
- Develop energy service agreements to confirm customers
- Detailed design/engineering of system
- Permitting requirements (easements, environmental, etc.)

There will be upfront project management costs, which will require expertise in legal agreements, engineering and financing mechanisms. A knowledgeable project manager with district energy expertise will be crucial to get the project off the ground.

FVB is recommending that the city start small and develop the system (scenario 2) over a five year period. However, by starting small, there will not be the economy of scale to support a full time business entity in the beginning. Therefore, it will be important to look at all options for governance, especially partnership opportunities, to help manage the risks of a business start-up and the upfront costs.

Confirming sufficient energy customers and thermal demand will be critical before the city can proceed with implementation. If there are not enough customers, the project cannot proceed. Staff will not be recommending a 'build it and they will come' system. There will be challenges to coordinate implementation of a district energy project with the timing of development projects. The project manager will have to work in tandem with the city's planning staff, the downtown coordinator and the development community.

Staff will work with the Burlington Economic Development Corporation on the business development stage and will report back by the 4th quarter of 2017 with a recommended business and financial strategy to council.

Financial Matters:

The potential capital cost of the scenario 2 district energy system is $6.98 million and scenario 4 is $2.9 million (net after a potential funding incentive).

Total Financial Impact

The total financial impact for capital costs related to the two proposed scenarios is $9.89 million. However, these are based on best case estimates modeled using certain assumptions related to energy, implementation, construction, and infrastructure costs.

As modeled by FVB, Scenario 2 assumes a cost of capital of 4%. Higher costs of capital will reduce the net present value (NPV) of the project until the cost of capital is equal to the internal rate of return (IRR), at 8.0%, at which point the NPV will be zero. To account for risk associated with future cash flows a sensitivity analysis has been modeled that applies a higher discount rate and how that impacts the NPV of Scenario 2, which can be seen in the table below.

Weighted Average Cost of Capital (Discount Rate)	Capital ('000 k $)	Expenses ('000 k $)	Revenue ('000 k $)	Simple Payback (years)	Projected IRR, 20 years (%)	Projected IRR, 30 years (%)	20 Year NPV ('000 k $)
4%	$ 6,975	$ 834	$ 1,441	11.5	8.0%	10.3%	$ 2,404
6%	$ 6,975	$ 834	$ 1,441	11.5	8.0%	10.3%	$ 1,027
8%	$ 6,975	$ 834	$ 1,441	11.5	8.0%	10.3%	$ -

Additionally this scenario assumes that five buildings will be connected to the district energy system (DES) over a five year period. This is a conservative assumption to what is achievable with the project. There is potential to expand the system as new developments sign on as customers and there is a business case to do so.

Based on these assumptions modeled by FVB, Scenario 2 has a potential internal rate of return of 8.0 percent and a simple payback of 11.5 years.

Scenario 4 has a potential internal rate of return of 10.5 percent and a simple payback of 9.3 years (this scenario is also dependent on a current incentive program).

Source of Funding

As identified earlier in the report, the next step, having identified a viable technical basis for a district energy system, is to explore in more detail implementation options including financing strategies for the development of a district energy system.

Other Resource Impacts

Staff propose to research governance options along with financing scenarios and report back for council's consideration. The city will need to weigh the financial costs against the communities' long term environmental goals (reduced carbon emissions, resiliency and community sustainable development leadership). There is a nominal amount of funding remaining in the Community Energy Plan capital budget and staff will pursue external sources of funding that are available to support this next stage of work.

Study Funding

Funding for the 2nd phase of this district energy study was provided by Burlington Electrical Services Inc. (50%) and the Federation of Canadian Municipalities Green Municipal Fund (50%). The total cost of the study was $167,000.

Connections:

This study is directly related to the Community Energy Plan and the Strategic Plan. The implementation of a district energy system helps to meet the vision of the CEP:

> To achieve a community that is efficient and economically viable in how it uses energy through new development and retrofits, land use and transportation planning, energy generation (including the use of renewables), conservation and industrial processes to reduce its reliance on the use of energy, reduce its carbon footprint, and improve local energy security.

Development of a thermal grid in Burlington will provide future flexibility to build an integrated community energy system with renewable energy and energy storage, to meet the city's goal to become a net carbon zero community.

Public Engagement Matters:

Staff will continue to work with local building owners and developers as this study develops, as well as engage the Community Stakeholder Advisory Committee for the Community Energy Plan.

Conclusion:

The results of the Integrated Community Energy Study – phase two shows that it is technically feasible to implement a small district energy system in downtown Burlington to start. However, as noted in the report, a number of actions and measures are still necessary before the implementation stage. Staff propose to report back with options, including direct ownership and partnership scenarios to oversee the financing, implementation, development and management of a community energy system.

Respectfully submitted,

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Appendices:

a. Integrated Community Energy System – Phase 2 Study by FVB

Report Approval:

All reports are reviewed and/or approved by Department Director, Director of Finance and Director of Legal. Final approval is by the City Manager.