



Report to: Development Services Committee

Meeting Date: June 11, 2018

SUBJECT: Geothermal-Based Community Energy System Pilot Project
(Wards 2 and 6)

PREPARED BY: Catherine Jay, Development Manager, North District,
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RECOMMENDATION:

- 1) That the report entitled “Geothermal-Based Community Energy System Pilot Project (Wards 2 and 6)”, dated June 11, 2018, be received;
- 2) And That Staff be directed to continue to negotiate with Mattamy and Enwave to address outstanding issues;
- 3) And That Staff report back on the result of the negotiation, resolution of issues identified by Staff, and provide comments on the implementation of community energy system pilot project at a future Development Services Committee meeting;
- 4) And That the Mayor and Clerk be authorized to enter into agreements, as necessary, to the satisfaction of the Chief Administrative Office and the City Solicitor, to implement the Pilot Project;
- 5) And That Staff be authorized and directed to do all things necessary to give effect to this resolution.

PURPOSE:

The purpose of this report is to inform Development Services Committee that Mattamy Homes (“Mattamy”), in partnership with Enwave Energy Corporation (“Enwave”), has proposed a Geothermal-Based Community Energy System Pilot Project (“Pilot Project”) in a proposed residential subdivision in the Berczy Glen Secondary Plan area in North District (Future Urban Area). This Pilot Project is proposing a network of geothermal wells and horizontal system connected by a distribution system to all the homes in the subdivision. This report also highlights the benefit of a community energy system and identifies the staff comments, including related risks, received to date on such a system. Additionally, this Pilot Project has received a grant to fund front end engineering and design costs from The Atmospheric Fund (TAF), formerly the Toronto Atmospheric Fund.

BACKGROUND:

Pilot Project to Reduce Emissions & Increase Energy Efficiency

As part of its Sustainable Development innovation agenda, Mattamy has partnered with Enwave to develop the Pilot Project for the western portion of their development in the Berczy Glen Community at Elgin Mills and Victoria Square Boulevard area.

This Pilot Project represents an important advancement of low carbon energy at a community scale in Canada and will reinforce Markham as a leader in sustainable development. All stakeholders involved in this initiative are proactively pursuing a low carbon community, through a Community Energy Plan (as required by Markham's and York Region's Official Plans), to achieve a global objective of lowering greenhouse gas emissions. Currently, there are a number of individual private and City buildings in Markham that are utilizing geothermal energy system, but such a system has not been tested at a community level. Fire Station 93 and the Museum both have ground source heat pump (geothermal) systems to provide heating and cooling, and they are among the City's most energy efficient and low emissions facilities.

The Pilot Project will provide a model for the City to begin transition to net zero emissions new development, and therefore, supporting the *Greenprint, Markham's Community Sustainability Plan's* goal of net zero energy, water, waste and emissions by 2050, and the principles and parameters for the planning of the North Markham Future Urban Area. Additionally this initiative supports the recently endorsed Municipal Energy Plan goal of net zero emissions 2050, as all heating and cooling will be provided by electrically driven heat pumps. The Pilot Project is being tested for approximately 400 homes. If this Pilot Project proves viable, the community-based geothermal energy system may be scaled within the Future Urban Area, the Greater Toronto and Hamilton Area, Provincially or Nationally.

As this Pilot Project will be the first residential subdivision development with a community-based geothermal energy system in the Greater Toronto and Hamilton Area, Staff will continue to work with Mattamy, Enwave and other approval authorities and stakeholders to measure the benefits and address issues related to such a system, and monitor its performance post start-up and commissioning.

The Pilot Project is proposing a series of geothermal wells and horizontal system strategically placed throughout the subdivision that are then connected via distribution pipe network that will serve each home in the community. Within each home will be an independent heat pump that will use the supplied geothermal water to heat or cool the home to the occupants desired comfort level. Enwave is proposing to construct and own the geothermal wells, distribution network and heat pumps in return for fixed and variable fees payable by the homeowner. This is very similar to Markham District Energy's service model.

Recently, The Atmospheric Fund (TAF), as part of their new regional mandate, awarded the City of Markham, Enwave and Mattamy a grant of \$225,100 in support of the engineering and design of the Pilot Project. This is a vote of confidence for this project and staff hope this help will attract additional funding and partners. An agreement or agreements between the City, Mattamy and Enwave are required to define the share of any grants each party will receive as well as respective roles, responsibilities, timelines

and other issues needed to move the Pilot Project to full implementation. In addition, agreements with other parties may be required in order to implement the project.

Besides changing the source of heating and cooling energy, Mattamy and Enwave are working to design the houses to a higher standard of energy efficiency and reduced energy consumption. The Pilot Project is targeting insulation levels and air tightness that exceed the current Ontario Building Code.

Mattamy and Enwave Have Previous Experience with Innovative Design

Mattamy is a major builder in North America and has a significant presence in Markham. Enwave operates intelligent thermal energy systems that generate, store, distribute and share energy in its different forms. Enwave received global recognition for the design and construction of the Deep Lake Water Cooling system (DLWC) which uses cold water from the bottom of Lake Ontario as a source of chilled water for air conditioning of over 70 buildings in Toronto. Enwave also recently signed a partnership agreement with the City of Toronto to develop low-carbon thermal energy networks in Toronto. These new systems are community-based and will be similar to the Pilot Project.

OPTIONS/ DISCUSSION:

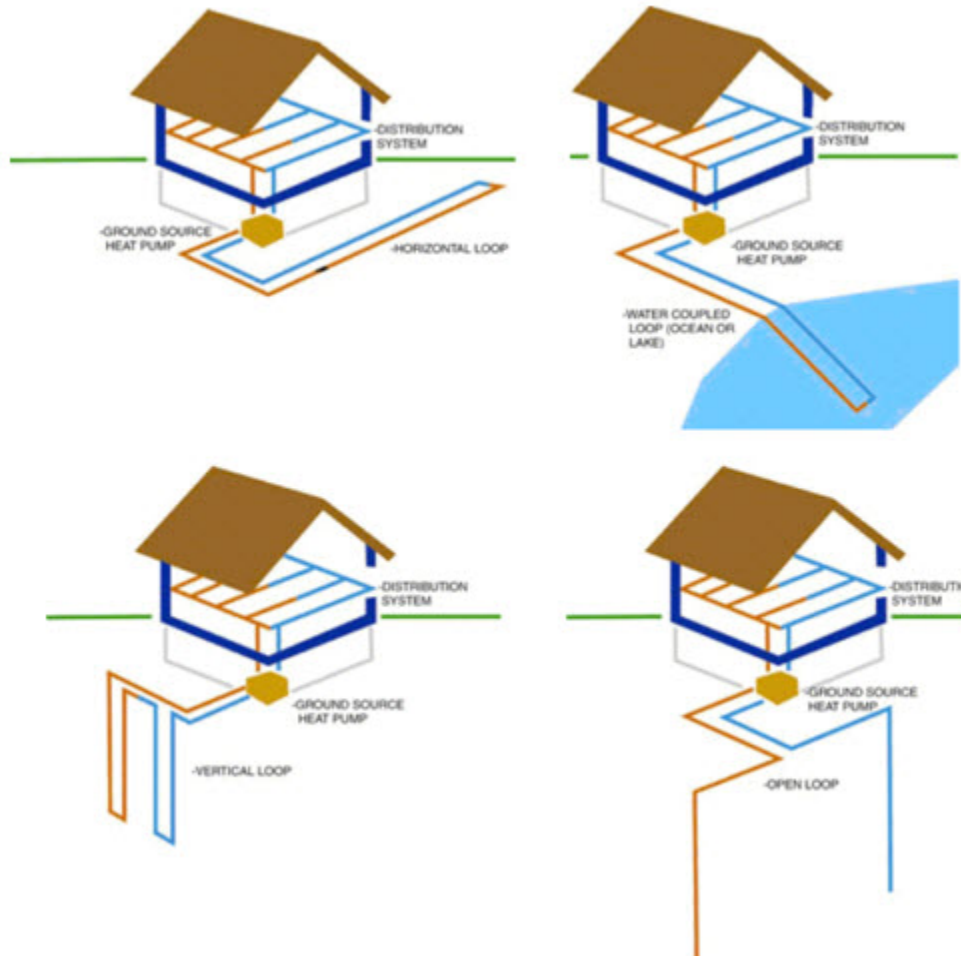
An Innovative Community-based Energy System

The Pilot Project consists of the following major components:

- 1) **Ground source modules** are where the thermal energy is extracted from the ground (heat source) or dissipated back to the ground (heat sink). The Pilot Project is proposed to include both closed loops and open loops (see Figure 1 below). There will be both vertical wells drilled deep into the ground (approximately 100m down) and horizontal system modules that are buried below the frost line in open spaces. Part of the system may also be an open-loop, which is typically two wells drilled into the same aquifer, to provide an efficient means of extracting or dissipating energy directly from or into the aquifers. An open-loop system, since it is comprised of ground water wells, is governed by Ontario's Ministry of the Environment and Climate Change. A closed loop system is not subject to the approval process;
- 2) **A distribution system** where the energy is transmitted through a fluid medium from the geothermal modules to the private homes. This fluid is in a closed loop and will not be mixed with the groundwater;
- 3) **A heat pump** is installed inside each house on the distribution loop. This is where the energy (heating or cooling) from the distribution system is transferred to the house.

Figure 1 Types of Geothermal Energy Exchange Systems

(The figure shows a single house while the Pilot Project will be community based)



Business Model of a Private Community-based Energy System

Currently, all energy utilities (e.g. Enbridge, Alectra) are regulated by the Ontario Energy Board. Enwave is a private corporation owned by Brookfield Asset Management. Mattamy and Enwave have been asked by the City to provide a legal opinion on whether and how Enwave is regulated.

The Use of Geothermal Power is Consistent with Markham's *Greenprint and the Municipal Energy Plan*

Ground source heat pump systems do not burn fossil fuels to create thermal energy, and they use electricity very efficiently.

These systems are similar to a standard air conditioner only they can generate heating or cooling by reversing the process. Typically a standard home air conditioner that cools

air passing by the furnace fan will reject waste heat from the refrigeration process through the outdoor condenser unit. Similarly the back of a kitchen fridge is typically warm. By reversing the flow of refrigerant in the heat pump, hot or cold thermal energy can be created and delivered into the building.

Not only do ground source heat pumps not burn fossil fuels, they use electricity and are extremely energy efficiently compared to a standard electric baseboard heaters.

Community-Based Geothermal Energy Systems in Other Jurisdictions

Enwave has provided examples of a number of similar systems in North America. The ownership of these systems range from municipalities to private sector. These systems include the Town of Gibsons (British Columbia), Drake Landing Solar Community (Okotoks, Alberta), Alexandra District Energy Utility (Richmond, British Columbia), Sun Rivers Golf Course Community (Kamloops, British Columbia), and Île-des-Chênes District Geothermal Energy (Ritchot, Manitoba). In the USA, other notable community scale district geothermal systems are Ball State University (for institutional use) and the Whisper Valley residential community located in Austin, Texas. The Whisper Valley system is a similar model to the proposed Markham pilot, with an ultimate built-out of 7,500 dwelling units. Staff is contacting the owners of these systems to understand how they operate and what impacts they have to the municipalities and their assets when it is a private system.

Benefits of Community-based Geothermal Energy to Markham and/or the Community

Mattamy and Enwave identify the following benefits with the Pilot Project:

a. Markham:

- **Innovation:** Markham will be the first municipality in Ontario to support the development of a green community that utilizes high-efficiency building design, low-carbon community energy for a grade-related residential community.
- **Precedent:** Provides a framework for public-private collaboration in reducing carbon footprint and addressing climate change.
- **Sustainability:** Access to low-carbon energy for Berczy Glen municipal assets and creation of a new model for net zero emissions development to support Markham's sustainability mandate.

b. Community:

- High efficiency buildings which incorporate low-carbon energy systems as a new build.
- Contributes to the City achieving its net zero emissions target by 2050.
- The benefits of a utility model:
 1. **Sustainability:** Avoid upfront cost of high efficiency/low-carbon energy systems, allowing for the operational savings to be experienced on day one with the capital cost being paid back over time.
 2. **Simplified Experience:** The homeowner does not have to worry about the dwelling's energy system, Enwave will provide each home with a full-service solution; the homeowner only sets their thermostat to the preferred setting, all else is taken care of.

3. **Improved Layout:** The layout for a typical home are designed around the furnace and related ducts. The design of the houses using geothermal energy will not need a furnace and duct work, and the heat exchange takes up less space in the house.
4. **Reliability:** With Enwave providing heating and cooling as a utility service, they provide all dwellings with the support to address any mechanical issues to make sure the heating/cooling stays on and operates in a high efficiency manner to lower their energy bills.
5. **Energy Empowerment:** Mattamy and Enwave are working with EcoBee and Alectra to offer smart energy systems with apps that provide homeowners with advanced control and energy intelligence for their homes.

Issues Identified by City Departments

This section provides a high level summary of the issues/concerns raised by various City Departments. The main areas of concerns which need to be addressed are:

- 1) Use of Municipal rights-of-way (“ROW”) and impact to City’s infrastructure:
Legal Department has requested a legal opinion on whether Enwave has statutory authority to locate its infrastructure within the ROW, in the same way as the other regulated public utilities such as Alectra, Enbridge, Bell and Rogers. Enwave’s model requires its utility infrastructure to be located in both the roadway and the boulevard while the other regulated public utilities only occupy the boulevard within the ROW. Some of the proposed infrastructure (such as vertical wells) is anticipated to be abandoned within the City’s ROW at the end of its service life. Staff has raised questions about the design of private infrastructure within an already constrained ROW. The additional private infrastructure will likely impact the City’s future operations, maintenance and capital replacement cost of City’s infrastructure. The operations and maintenance of additional private infrastructure will be an additional inconvenience to the residents and businesses.
- 2) Use of City-owned open space: Staff expressed the same types of concern as the above (i.e. private infrastructure within City’s land.) If the energy modules are placed in City-owned land besides the ROW, will this affect the use of the land, the implementation of Low Impact Development (LID) initiatives, property lease and other financial implication?
- 3) Service Levels to Consumers – Although it is not the City’s responsibility to ensure that home owners receive a standard of service from Mattamy and Enwave, Mattamy and Enwave have been asked to provide a legal opinion on whether any consumer protection legislation applies to regulate its service to its customers. If Mattamy and Enwave are not regulated by consumer protection legislation that may apply to more traditional utility providers, customers will need to deal with cost and service issues directly with Enwave without regulatory protection.
- 4) Environmental Impact of Open Loop, temperature change to surface and ground water which may impact the environment. The impact to the environment will need to be mitigated based on current legislation or other best practices that have been developed for other geothermal thermal systems.

- 5) Operations and maintenance, design life of system, redundancy or factor of safety of system for the City of Markham and its residents.
- 6) How is Enwave regulated and how will future home owners be informed.

Staff will continue to work with Mattamy and Enwave to understand the technical, financial and legal implication of the system, carry out independent research into these areas, and will report back to Development Services Committee. Staff will assess this pilot project in order to build consistent and robust communities in Markham.

FINANCIAL CONSIDERATIONS

There are no current financial impacts in receiving the information in this report. As identified in the previous section (Issues Identified by City Departments), Staff will report back on the future impacts if and when this Pilot Project is executed and what the near, medium and long term future financial impacts might be for:

- Operations and maintenance of the ROW (both above ground and underground assets)
- Capital replacement of those same City assets in the ROW (listed above)
- Lease or other revenue from hosting private infrastructure in the ROW

HUMAN RESOURCES CONSIDERATIONS

Not Applicable

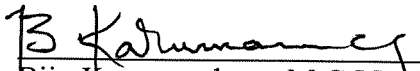
ALIGNMENT WITH STRATEGIC PRIORITIES:


The Pilot Project proposed in partnership with Mattamy, Enwave and the City is innovative and ambitious. It is directly aligned with Building Markham's Future Together: Safe and Sustainable Goal, the Greenprint and the Municipal Energy Plan as it seeks to achieve a near zero emissions community now in support of our net zero emissions 2050 goal.

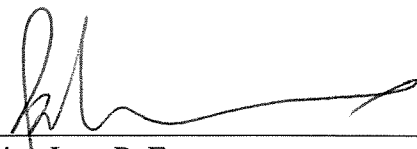
BUSINESS UNITS CONSULTED AND AFFECTED:

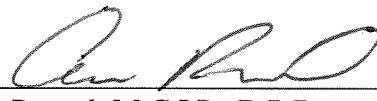
Legal, Operations, Environmental Services, Finance and Real Property have been involved in the preparation of this report and their input and comments have been incorporated in this report.

RECOMMENDED BY:


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