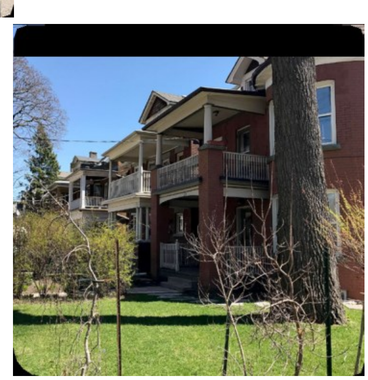
IMPLEMENTING DISTRICT GEOEXCHANGE SYSTEMS IN CANADA

An Examination of Opportunities and Constraints



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About the Authors

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About the Public Good Initiative

PGI is a student-led pro bono consultancy at the University of Toronto's School of Public Policy and Governance. PGI's mission is to make a positive contribution to the policy capacity of the not-for-profit sector. We match our student consultants with community organizations looking to benefit from our policy-based consulting services.

Executive Summary

Climate change is a pressing issue that all levels of the Canadian government are struggling to address. While numerous policies have been implemented to curb greenhouse gas emissions (GHG) from transportation, industrial processes and electricity production, less has been done to target emissions produced from residential heating and cooling. One of the most promising technologies are geoexchange heating and cooling systems, which are reported to reduce GHG by as much as 90% when compared to conventional heating systems. However, development of these systems has been slow in comparison to other renewable technologies despite their promising potential. This is especially true in the case of large-scale development, where wind and solar energy farms have seen significant investment through both the private and public sector, while geoexchange technology remains largely implemented at the level of individual homeowners.

Green 13 is a community group based out of Toronto's Ward 13. Their goals are largely to generate public awareness about the concerns of climate change and other environmental issues, and encourage members of their community to take action against them. Green 13 is working with Junction residents to develop an approach to eliminate carbon emissions from homes; together they are looking for an approach that can be replicated in the three million households in urban neighbourhoods across Ontario. They are currently exploring the possibility of developing a district-based geoexchange system to provide heating and cooling services to numerous homes in the community. They have sought the advice of the Public Good Initiative to identify barriers to the development of such a system in old urban neighbourhoods, and propose potential solutions to overcome these barriers.

This report seeks to characterize the current geoexchange landscape in Canada by exploring opportunities and challenges concerning politics, policy, technology, and financing. We have found that the political landscape is favorable for the development of geoexchange systems, especially in Ontario. Technical concerns do not appear to be a major impediment to the development of such systems. We identified notable concerns with respect to both financing and policy. In old neighbourhoods especially, the costs of adapting homes to use the technology can be high, which has limited the growth of district-based geoexchange systems to new developments. We also identified challenges within the current policy framework, namely the apparent lack of a coherent and concerted strategy at all three levels of government for the development of the geoexchange energy. Current policies tend to promote individuals' use of the technology rather than large-scale development, and there remain numerous specific examples of legislations that are not conducive to the development of geoexchange systems.

Recommendations

This report puts forward the following recommendations regarding the development of district energy in Ward 13, as well as across the country.

Technical

1. Green13 and other communities looking to install district-based geoexchange systems will likely need to launch a technical feasibility study to better understand its options and challenges with respect to finding an adequate source, delivery network, and connections

Political

1. Green 13 should work to gain support from political leaders for geoexchange developments within the neighbourhood
2. Green 13 should develop a mobilization strategy to target key political stakeholders in order to garner vocal support for the project
3. Green 13 continue to engage local residents by hosting consultation and information sessions with local residents

Policy

General

1. All three levels of government engage with local utilities, private developers, and community organization to develop a strategy for the large-scale development of these systems
2. Implement a procurement policy at government departments that changes the operational versus capital budget structure so as to reward high-efficiency investments by provincial institutions, and which promote the use of geo-exchange technology
3. Adopt policies that encourage large-scale development of district systems, rather than single-home systems

Municipal

4. Impose renewable energy requirements specific to geo-exchange at the community-level, which developers would be required to follow when moving ahead with new community projects
5. Utilize existing billing and collection resources (i.e., hydro and property tax bills) to disseminate information about geo-exchange technology, clearly communicating its benefits

Provincial

6. Develop programs to support larger scale development of geoexchange resources, like the FIT program
7. Assess which ministries and departments are the most appropriate for managing geoexchange energy production
8. Take steps to make electricity prices more competitive with natural gas

Federal

1. The federal government should take a more active role in encouraging large scale development of geoexchange systems by consolidating existing financial incentives and/or creating new ones

Financial

1. Green 13 should work with city planning staff and Sarah Doucette to capture sustainability benefits from the increasing development occurring within the neighbourhood
2. Medium density homes should then be connected to neighborhood geoexchange energy systems that are installed in higher density developments

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Background

Climate Change: The End of Business as Usual

“Climate change is one of the greatest threats of our generation. Ontario’s climate is changing because Earth’s climate is changing. The weather has always fluctuated, and it will continue to do so. But the long-term average, the climate, is getting warmer and the weather is getting wilder.

Effects on the natural environment, human health and the economy are accelerating. Human activity is causing climate change (sometimes called global warming) by putting more GHGs into the atmosphere.”[i]

The City of Toronto is already experiencing more extreme weather events in recent years. Studies predict that the city will experience more extreme rainfall events, warmer summers and more frequent heat waves.

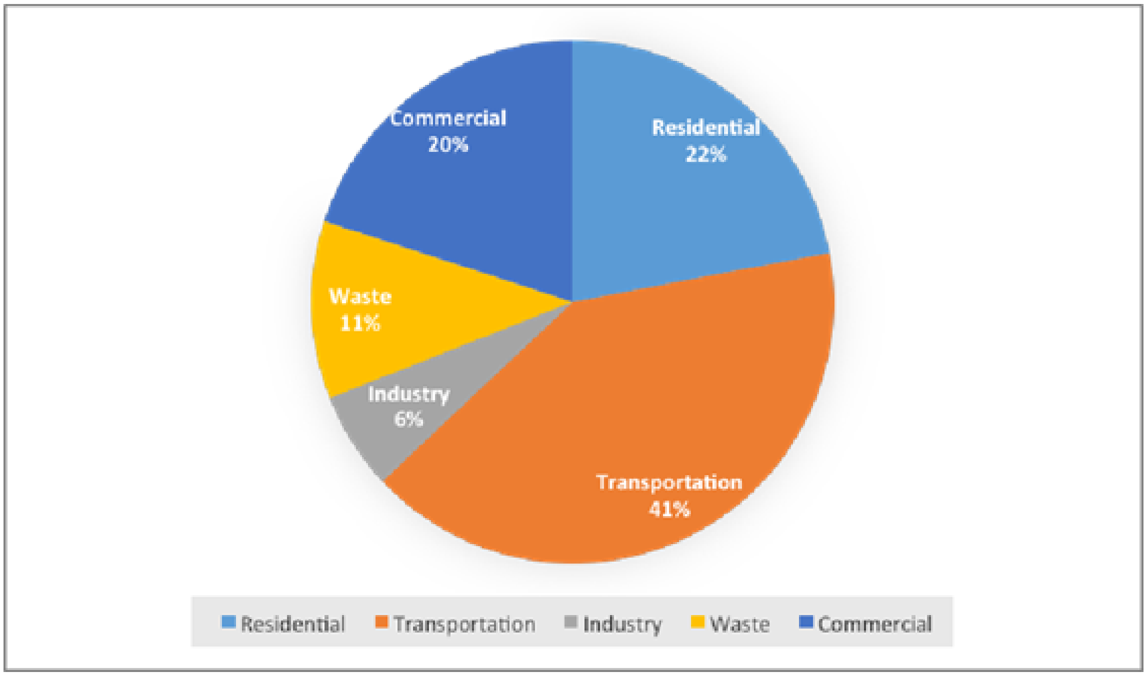
“Climate change is one of the greatest threats of our generation”

In addition, Toronto’s Future Weather and Climate Drivers Study also predicts that by 2040 residents will use air conditioning systems six times more frequently as compared to current usage. And, the number of heat days – a measure of demand for heating requirements – will go down by 31%, or almost one third.[ii] Without some offsetting growth in the number of Natural Gas users climate change will cause a decline in demand for gas utilities. Together these two trends indicate business as usual scenarios for energy utilities will be another casualty of climate change.

The Challenge: Older Urban Neighbourhoods

In Toronto, buildings represent 44% of the total GHG emissions within the city. In order to mitigate the negative impacts of rising GHG emissions, it is essential that neighbourhoods look to new strategies in order to reduce overall GHG emissions.

Figure 1: City-Wide Greenhouse Gas Emissions by Source for year 2013 (City of Toronto)

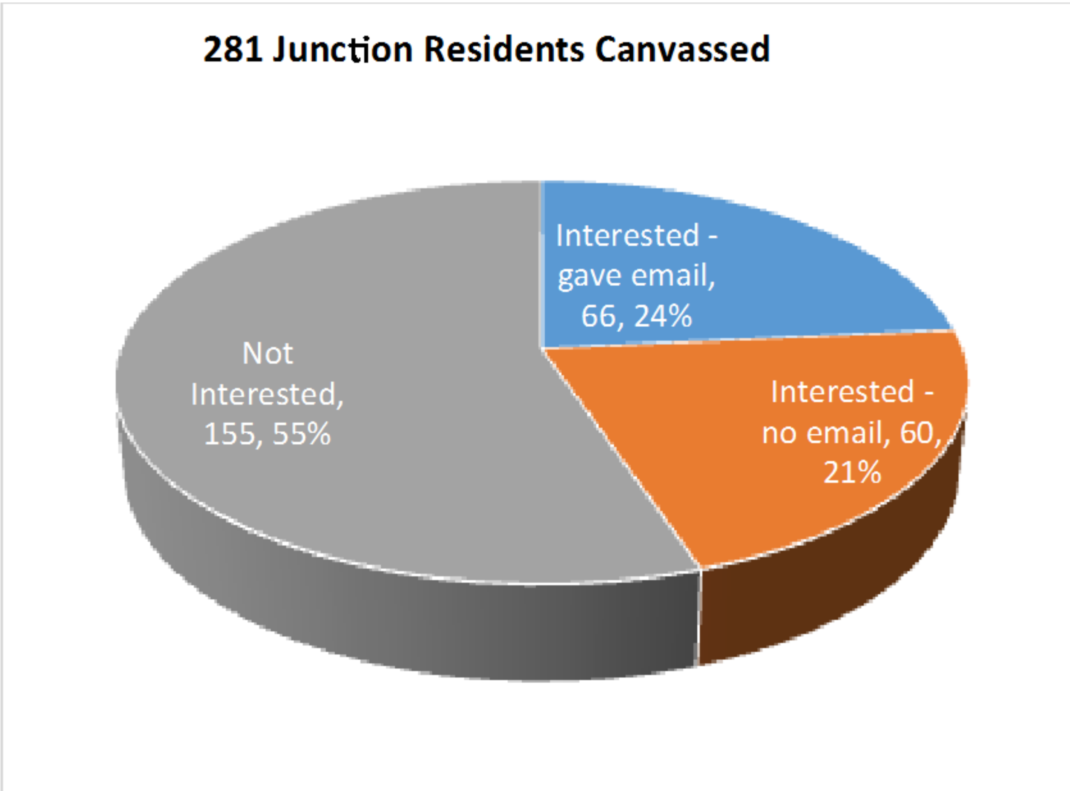


Geothermal energy is one of the most efficient means of reducing GHG emissions associated with heating and cooling of buildings. District-based geothermal heating and cooling systems are being built in some new neighbourhood developments in Canada as a solution to reducing local GHG emissions. These developments are supported by provincial rules and municipal by-laws that provide utilities with a regulatory environment to operate within.

Green 13 is working to develop an approach to creating neighbourhood-based geoechange heating and cooling systems in older urban neighbourhoods. Green 13 has secured PGI to look into district based geothermal energy systems and the potential for developing similar systems within the Ward 13 area; as well as providing additional resources to distribute to other interested jurisdictions. Recent canvassing in the Junction area within Ward 13 demonstrates that there exists significant interest in the development of a geoexchange district energy system.

In March 2017, Green 13 canvassed 883 homes in this area, resulting in 281 conversations with homeowners regarding the idea of developing a district-based geoexchange system; 126 of these homeowners expressed interest in the project and 66 provided contact information to stay up to date with work related to the development of a system in the neighbourhood. The breakdown of results is seen below in Figure 2.

Figure 2. Junction Canvassing Results



Even though geoexchange systems are a promising way to increase energy supply while decreasing GHG emissions, there has not been significant uptake in the development of geoexchange systems within the City of Toronto or throughout the province. Previous Federal and Provincial programs offering subsidies of close to $10,000 per household led to no more than 10,000 Ontario homeowners converting per year. In order for Ontario to achieve its emissions reduction target of 80% by 2050, 100,000 homes per year, each year for the next 30 years, will need to be retrofitted to reduce their emissions by 80%. This clearly indicates a different approach is required—one that requires homeowners, governments and utility companies working together. Green 13, and the Junction Geo project, are poised to contribute to developing this new approach.

"Recent canvassing in the Junction area demonstrates that there exists significant interest in the development of a geoexchange district energy system"

This report will address some of the technical, financial, political and regulatory barriers facing Green13 in implementing a geoexchange system in the neighbourhood, as well as providing case studies and recommendations outlining the best way forward to achieving energy sustainability at the neighbourhood level and identifying areas that will need further research and work.

The Solution: Older Urban Neighbourhoods

What is Geoexchange?

Geoexchange systems (also: ground-source heat pumps, earth energy systems) are central heating and/or cooling systems that transfer heat to and from the ground. While above-ground temperatures vary significantly with the seasons, temperatures only a few feet underground remain relatively constant year-round. In Toronto, the average ground temperature is 10.1°C, whether it's mid-July or mid-January[iii].

Geo-exchange systems take advantage of the relatively stable ground temperatures and use the energy stored in the ground to heat or cool a home, and a typical residential lot contains more than enough energy to service a home.

Geoexchange systems typically consist of three components: A loop, a heat pump, and a distribution system. The loop is the section of the system that is stored underground and which allows energy to be transferred to and from the surrounding earth. Loops are usually made up of plastic pipes (usually polyethylene) that are buried a few meters underground, and are used to circulate the heat-transfer liquid through the system. A heat pump located inside the building is used to extract heat from the liquid, and the heat can then be distributed throughout the home using typically forced-air systems. Meanwhile, the chilled heat-transfer liquid is pumped back below the surface where it can draw further heat from the ground to be distributed into the home. In the summer, this process can be reversed to act as an air conditioning system, with excess heat being drawn from the home and stored underground for the winter[iv]. This property allows geoexchange systems to act as renewable energy sources as warm temperatures from the summer months can be stored underground as heat for winter, and vice versa.

Environmental Benefits

Geoexchange systems contribute to reducing GHG emissions in two ways: They are a renewable energy source, and they are highly efficient heating and cooling technologies. Numerous studies have demonstrated the energy-saving and emissions-reducing potential of this technology. A report by Natural Resources Canada states that typical geo-exchange systems reduce energy consumption by 30 to 70 percent while heating, and by 20 to 95 percent while cooling[v]. The National Renewable Energy Laboratory in the US similarly cites decreases in energy consumption by 72 percent compared to conventional electric heating and cooling systems[vi]. Accordingly, decreases in GHG emissions can be as high as 90%, according to work performed by the Toronto Atmospheric Fund (TAF)[vii].

District Energy Systems

District energy systems are heating and cooling systems that operate from central plants and distribute heating and cooling services across a network of attached residential and/or commercial buildings. These systems typically utilize only a few central heating and refrigeration plants and conserve energy by eliminating the need for each individual building to have its own heating and cooling unit, thereby improving the efficiency of the system. They also offer users the convenience of not having to run their own heating and cooling units and worry about maintenance and repairs, as these services are managed by the utility company operating the district system.

District energy systems have traditionally operated by burning fossil fuels or biomass to generate the heat that is distributed to users connected to the system. However, more recently utility companies have been exploring the use of geoexchange energy on a district level. Canadian companies like Corix Utilities[viii], Geotility[ix] and FortisBC[x], as well as numerous municipalities, are currently operating award-winning district-based geoexchange systems in different regions of Canada to provide a green source of heating and cooling services to a wide customer base.

Technical Challenges

Interviews with industry experts, geoexchange system developers, and drillers allowed us to identify the primary technical concerns for the installation and maintenance of geoexchange energy systems. Broadly, concerns were divided into three sections: Source, Delivery, and Connection.

Source

The source describes the area that is required to draw sufficient heat from the surrounding ground to service all of the units connected to the energy system. Finding an adequate source to provide energy for the many homes that would be connected to the system presents a unique challenge in older urban neighbourhoods, which are typically medium density, have relatively little space to work within, and have already significant underground infrastructure developed. Drilling professionals suggested that new technologies are likely able to work around these issues, however. Options exist to drill vertical boreholes, which occupy comparably less underground space than horizontal geoexchange fields. Alternatively, drilling equipment is now capable of drilling on an angle, and geo-exchange fields can now be installed underneath sidewalks or the buildings that they are intended to service[xi].

"Finding an adequate source to provide energy presents a unique challenge in older urban neighbourhoods "

Other consultants in the geoexchange industry suggested that finding an adequate source would be of minimal concern to Green13's proposed project. Even without access to advanced drilling technologies, these systems are often installed under public green spaces, in laneways, or underneath parking garages. These sites are plentiful in Toronto's Ward 13, and in most urban neighbourhoods, and therefore a reasonable source will almost always be accessible.

Delivery

Delivery is the process by which the heat-transfer liquid is moved from the central plant to the various units that are serviced by the geoexchange system. Similar to the source, finding an appropriate space to install the delivery system is significantly more challenging in urban neighbourhoods than in rural or suburban areas. There can be problems with installing the piping in areas with a high-density of other underground utilities, as well as issues with obtaining permission to have the delivery infrastructure cross property lines. To circumvent these problems, developers have successfully installed delivery pipes underneath sidewalks and city laneways. With municipal support, developers can avoid the risk of private property ownership blocking access to development.

There are numerous examples of innovative solutions to addressing the source and delivery problems associated with geoexchange systems in high-density urban areas. A particularly relevant example for Green13 is the Planet Traveler hostel, located in downtown Toronto. This project, designed to be the greenest hostel in the world, was successfully able to install the geoexchange loop infrastructure below a public laneway after obtaining permission from the City of Toronto[xii]. Despite having no property of their own to drill under, the owners were able to find adequate space to install a geoexchange system with the capacity to heat and cool a 4-storey hostel.

Similar efforts to access public lands for geoexchange installation have been observed in Montreal, where a community group is seeking permission to use a public alleyway to act as both the source and delivery channel for heating and cooling services. While this project has yet to be built, the group is in the process of undertaking a feasibility study with the backing of their local mayor[xiii]. Finally, the civic centre Port Hawkesbury, Nova Scotia, operates a geoexchange system that has access to the area beneath public sidewalks. Not only is the system able to use this area for delivery, but it also actively heats the sidewalks during the winter to melt away snow and ice[xiv].

Connection

Insights from interviews with industry professionals suggested that connection posed the most significant technical challenge. In a district energy system, connection is the ability of users to access the heating and cooling service that is being delivered. Unlike electricity services, which are standardized across all homes, individual homes often operate different heating systems. Gas-heated forced-air systems are some of the easiest to convert, as geoexchange systems use similar ductwork to deliver heat throughout the unit (in many cases, duct capacity must be expanded due to the lower temperature of geoexchange systems). Converting electric-based heating systems are more complicated as these homes are often lacking the necessary ductwork entirely. Hot water radiators pose similar problems, as they are designed to operate above the temperatures that are typically provided by geoexchange systems[xv].

In all of the above cases, homes can be retrofitted to accommodate the geoexchange system, but costs may be prohibitively high (this issue is explored further in the financial challenges section of this report).

Our Recommendation

Green 13 and other communities looking to install district-based geoexchange systems will likely need to launch a technical feasibility study to better understand their options and challenges with respect to finding an adequate source, delivery network, and connections. However, our preliminary research suggests that the source and delivery are lesser concerns than the issue of connection. At this point, we do not have sufficient knowledge of the current heating sources of the residents of Ward 13 to estimate the scale of the connection challenge.

The Target: Medium Density Older Urban Neighbourhoods

Old Neighbourhoods

While numerous district-based geoexchange systems have been developed in Canada, they have been exclusively installed in new neighbourhoods and are built along with the units to be serviced. For Canada to meet its climate change emission targets, however, it will require that older neighbourhoods also transition towards renewable heating and cooling services. This report will hope to identify some of the opportunities and challenges to developing district-based geoexchange systems in older urban neighbourhoods, and present options for how to overcome these limitations.

Ward 13 Neighbourhood Demographics

Ward 13 consists of the western portion of the Parkdale-High Park riding, encompassing ten square kilometers.[xvi] The ward borders Keele/Parkside to the east, Lake Ontario to the south, the Humber River to the west and the Canadian Pacific rail lines to the north. The area is made up of parkland, housing and small businesses and includes the neighbourhoods: Baby Point, Bloor West Village, High Park, The Junction, Swansea and Warren Park.[xvii] Ward 13 has a population density of 5.18 thousand per square kilometer. The density of the neighbourhood is relatively low, with an average of 2.21 persons per household and 35.9% of the neighbourhood is occupied by single person households.

Housing

Housing makeup of the neighbourhood is predominantly single family homes, comprising 42.8% of the housing available in Ward 13. The remaining housing includes: 32.9% apartment buildings of 5 of more stories, 20.8% apartment building less than 5 stories and 3.5% of the population resides in row or townhomes. Out of the total population, 56.2% of the population owns their home while 43.8% of the population rents.

The housing infrastructure in Ward 13 is predominately old, with 63.7% of total housing infrastructure constructed before 1960, largely single family homes and low rise apartment buildings. Newer construction from 2006 to 2011 resulted in the development of apartment buildings that were five stories or higher. Table 1 provides additional insight into the makeup of housing infrastructure within Ward 13, with Total Population and Total denoting the number of buildings per construction type completed.

Table 1: Period of Construction and Structure Type (NPHS Survey)

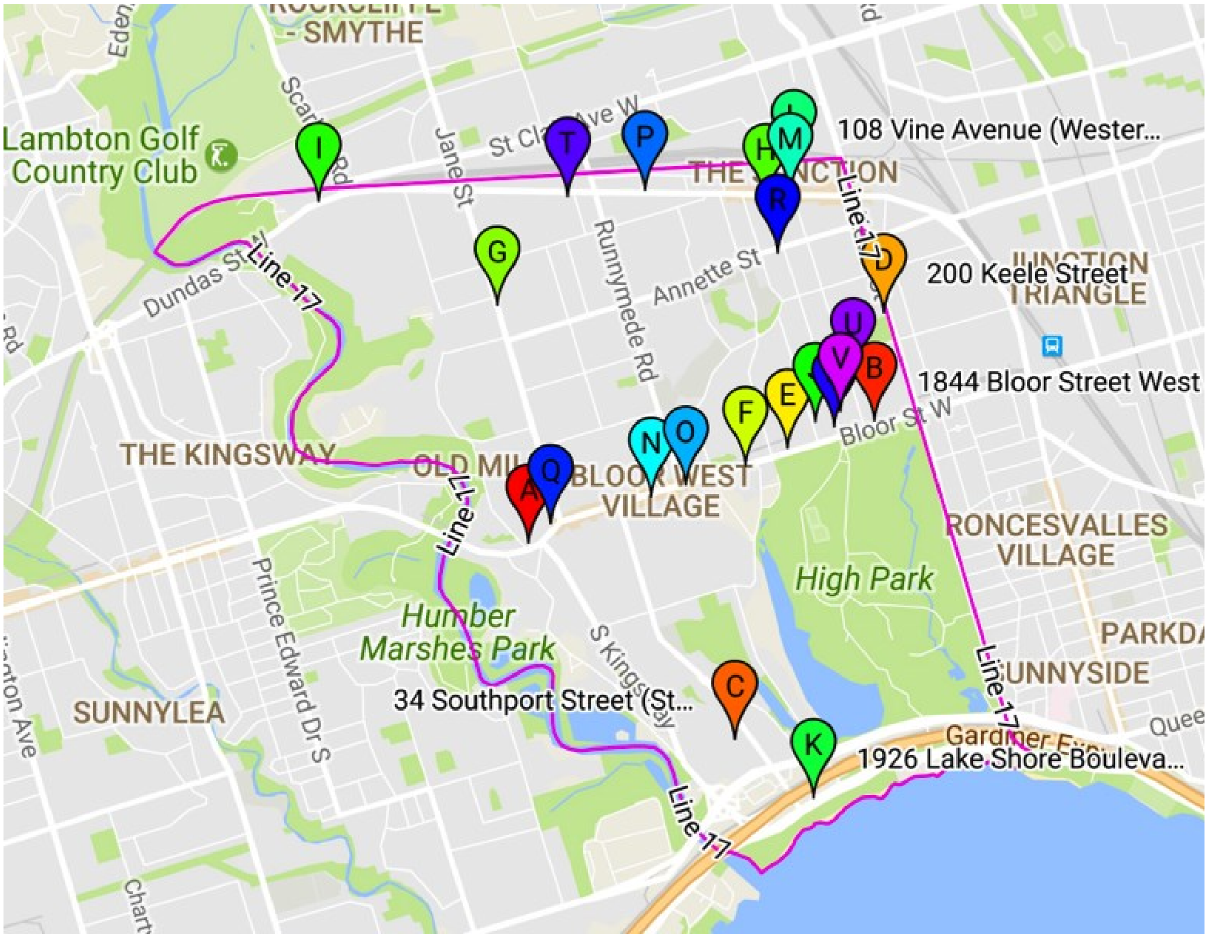
Ward 13								
	Single-detached house	Semi-detached house	Row house	Apartment or flat in a duplex	Apartment building <5 storeys	Apartment building 5+ storeys	Other single-attached house	Total
1960 or before	17,800	5,125	970	2,395	6,080	1,195	0	33,565
1961 to 1970	350	125	45	150	860	4,005	0	5,535
1971 to 1980	470	125	525	35	890	4,135	0	6,180
1981 to 1990	210	160	280	0	640	1,655	0	2,945
1991 to 2000	70	10	20	85	365	555	0	1,105
2001 to 2005	115	30	190	55	75	555	0	1,020
2006 to 2011	235	25	365	0	70	1,590	0	2,285
Total Population	**19,250**	**5,600**	**2,395**	**2,720**	**8,980**	**13,690**	**0**	**52,635**

In comparison, the city as a whole comprises of 53% of residents living in houses or other low rise living units, 6% of resident living in row or townhomes, and 41% of residents living in high rise apartments. On average, there are 2.46 people per household.[xviii]

Development

Much like the rest of the City, Ward 13 is facing increasing development pressures throughout the neighbourhood. Below, a map outlines the new proposed development projects within the Ward. As of March 2017, there are 22 proposed developments in the neighbourhood. [xix]

Figure 2: Proposed Developments for Ward 13



Role of Community

Vocal support from the community is vital in order to achieve the political objectives outlined above. NIMBYism ('not in my backyard'), or negative reactions from local neighbours from development of a geoexchange energy system in the neighbourhood could be hugely detrimental to the project. Therefore, it is important that Green 13 continue to engage local residents by hosting consultation and information sessions with local residents to ensure that the project has continued support throughout its implementation.

This presents a unique opportunity for Green 13 to act as the voice of residents in the development of geoexchange energy system development. Previously, governments have led consultations with respect to geoexchange development with installers and utility operators, however, the voices of residents and homeowners have not been highlighted in these previous consultations and discussions.

Given the residential nature of many geoexchange energy systems, the local resident and homeowner is an important voice that needs to be considered in the future development of geoexchange energy systems. In the future, Green 13 hopes to act as a resource for industry and government to provide insight into the challenges priorities for homeowners in the development of geoexchange energy systems.

Political Challenges and Opportunities

Political support and cooperation is an essential element of the success of geoexchange expansion across the city and the province. Political support for geoexchange and geothermal systems have been expressed through statements by political leaders at all level of government as well as the provision of financial support for the development of geoexchange systems in policy plans. Furthermore, political parties can indicate their support for the development of geoexchange systems through an inclusion of this energy source in environmental and sustainability plans, as explored below.

Municipal Government

General support from the City of Toronto Councilors and City Staff seems reasonably high. The city has demonstrated its support for the development of geoexchange systems by including geoexchange renewable energy production in several publicly owned buildings as well as the policy plans outlined below:

- In 2009, City council adopted the Toronto Sustainable Energy Strategy, which included recommendations for the development of district energy systems in existing and new neighbourhoods.[xx]

- In 2011, the Environment and Energy Division identified 27 brownfield locations for potential district energy development.[xxi]

- In 2013, the City adopted its 2013-2018 strategic actions which commits the City to integrate environmental and energy policies across municipal departments as well as develop business plans and implementation strategies to move forward with energy priorities.[xxii]

- In October of 2016, the City of Toronto has released design guidelines for district energy-ready buildings. The report identifies the key elements and technical guidelines for constructing buildings that would be able to support district energy.[xxiii]

- On November 19th, 2016, the City of Toronto announced a request for qualifications for organizations interested in partnering opportunities for large-scale development of district energy networks. The purpose of the RFQ is to establish a list of up to five pre-qualified respondents and to gain insight on the current market place on partnership approaches for developing new low carbon thermal energy networks in Toronto.

Climate Change Action Plan

The City of Toronto's Climate Change Action Plan establishes three greenhouse gas reduction targets for the city. All three targets are based on 1990 levels.

1. 6% reduction by 2012
2. 30% reduction by 2020
3. 80% reduction by 2050.

Funding allocations through the Action Plan included $22 million for renewable energy projects and $22 million for retrofitting City facilities.

TransformTO[1]

Led by the City of Toronto's Environment and Energy Division as well as the The Atmospheric Fund, TransformTO is a community engagement initiative to help inform the development of a new Climate Change Action Plan for the City.

TransformTO's initial report sets out several short term objectives related to the development of geoexchange systems, including[xxiv]:

- Leveraging innovative financing mechanisms to increase funding available to the private sector in order to make energy efficiency and clean energy investments. (1.2)
- Dedicating funding for community-based climate action for the development of sustainable energy plans and GHG reduction projects (1.3)
- Advancing low-carbon/Renewable thermal energy networks (2.3).

Toronto Green Development Standards

The Toronto Green Standard provides green building requirements for new developments across the city. Implementing district energy systems for neighbourhoods will allow developers of new projects in the neighbourhood to easily adhere to the green standards.[xxv] Updates in 2014 to the Standard now require buildings to be designed to achieve 15% energy efficiency

[1] It should be noted that in the 2017 Toronto Budget, Transform TO was only granted 1/5 of its funding request, totaling $330,000. This shortage of funding prevents TransformTO from completing its objectives, including working with local communities such as Ward 13 on necessary sustainability objectives.

improvement over the Ontario Building code for tier 1 certification, and 25% energy efficient improvement for tier 2 certification. It is estimated that through the Toronto Green Standard Program, Toronto will avoid over 115,000 annual tonnes of GHG emissions from new construction between the year 2010 and 2016.[xxvi]

Currently, there are no green standards for renovations of private residential homes aside from requirements established in the Ontario Building Code. This is a missed opportunity for the City of Toronto, given that there are significant renovations happening across the city. A recent study indicated that 37% of Canadians were planning on renovating their homes within 2016.[xxvii] Furthermore, studies of Toronto indicate that the baby boomer generation is choosing to stay put in their detached homes and renovate instead of moving.[xxviii] Rising renovation trends are a unique opportunity for the city to encourage energy efficiency in private residences to meet energy targets.

New Official Plan[xxix]

Changes to the City of Toronto's Official Plan include requirements for developers of larger sites to produce Energy Strategy reports including considerations for neighbourhood energy systems.[xxx]

Community Energy Planning

In 2014, the City began the development of community energy plans for the downtown Lower Yonge Precinct as well as updating the community energy plan on city-owned brownfields in the Westwood Theatre Lands that have been identified as an opportunity to implement a district energy system.[xxxi] Currently, there are no bylaws requiring a certain level of energy efficiency or carbon neutrality for these areas aside from the previously discussed Toronto Green Standard.

Provincial Government

Provincial political leaders have also indicated their support for the development of geoexchange systems throughout the province. Below, such support is explored:

- Energy Minister Glenn Thibeault stated publicly that the Ministry of Energy is currently working on creating grants from cap and trade revenues for homeowners to implement geoexchange systems on their property. [xxxii]

- The Minister of Environment, Glen Murray, presented at the 2017 Ontario Geothermal Association Annual Conference, reconfirming his support for the expansion of the geothermal industry.[xxxiii]

Climate Change Action Plan[xxxiv]

The Climate Change Action Plan released by the Ontario Government in the summer of 2016 outlines several commitments towards the expansion of geoexchange usage throughout the province. These commitments include:

- The establishment of a green bank to provide financing for low-carbon energy technologies to reduce carbon pollution from buildings, including geoexchange systems.

- To provide funding (400-800 million) for Ontario schools, hospitals and universities and colleges to install energy efficient systems, including geoexchange.

- To provide funding (500 to 600 million) for homeowners to make green energy retrofits and upgrades, including the installation of geoexchange systems.

Federal Government

The Federal Government has also expressed some support for the development of geoexchange systems across the country. Most notably, the federal government has paid particular attention to the growth of the geoexchange industry in Manitoba.

Jim Carr, the Federal Minister of Natural Resources has come out in support of the development of geothermal projects. At an address to the Bloomberg's Future of Energy Summit on April 4th, 2016 in New York, Carr noted that geothermal is the way forward, noting that major oil and gas companies have been making investments in solar, wind and geothermal projects.[xxxv]

Catherine McKenna, the Federal Minister of Environment and Climate Change has also voiced support for the development of geothermal expansion across the country. In the past, Minister McKenna has voiced support for Manitoba's geothermal expansion and has committed all government operations to be run on renewable energy by 2025.[xxxvi][xxxvii]

2017 Federal Budget

The annual federal budget commits funding to expand the accelerated capital cost allowance to a broader range of geothermal projects and expenses as well as expand the range of geothermal related expenses that are eligible for tax deductions.[xxxviii]

Paris Agreement

In December 2015, the federal government along with governments of another 195 countries signed the Paris Agreement. Canada's commitments include:

- Prevent global temperatures from rising more than 2 degrees Celsius
- 30% cut in emissions from 2005 levels by the year 2030
- $100 million annually (2020-2050) in sustainable development investments.

Main Challenges

While there has been indication from the City of Toronto that they are moving towards adopting more geoexchange friendly policies and programs, there has been little outward vocal support from municipal leaders. For instance, Mayor Tory has not come out to explicitly support the development of geoexchange systems. Furthermore, current areas that have been identified as key priorities for the development of district energy systems are not near the Ward 13 area. Given the importance of political support for the project, Green 13 should work to gain support from political leaders for geoexchange developments within the neighbourhood.

Case Study: Planet Traveler Hostel

Planet Traveler hostel installed eight geothermal loops 115 meters underground underneath an adjacent alleyway near the hostel. Headed by Anthony Aarts and Tom Rand, the 114 bed, four-story hostel will reduce energy consumption through geoexchange by 75%. In order to implement the project, Aarts and Rand had to go through 14 city departments to get approvals.[xxxix]

Source: Planet Traveler (2017)

When speaking to Tom Rand, codeveloper of the project, Rand mentioned the high level of support received from the city for the project. Furthermore, working with the city, the City was able to pass a motion in council that laid the groundwork for a standardized approval procedure to be implemented for geoexchange applications. Aarts and Rand successfully obtained access to city alleyways to install and operate a geoexchange heating and cooling system.

Our Recommendation

Local governments have a vital role to play in advocacy and coordination of geoexchange projects. In order to increase political support of the development of geoxchange projects throughout the City, Green 13 should develop a mobilization strategy to target key political stakeholders in order to garner vocal support for the project. Below, an outline mobilization plan details potential strategic initiatives Green13 could implement in order to garner increased political support of the geoexchange project in Ward 13.

Plan Details and Strategic Initiatives for Green 13

Main Goal

Political support for the development of a geoexchange system in Ward 13

Ward 13 identified as a pilot region for the development of trial geoexchange energy systems

Objectives

Vocal support for the development of geoexchange and district energy systems in the Ward 13 neighbourhood from key political stakeholders

Ward 13 neighbourhood identified as a priority area for the development of geoexchange systems by City of Toronto planning documents

Key Messaging

Build a neighbourhood that is sustainable for future generations

Take advantage of the increasing development (section 37 & CBAs) in the neighbourhood

Audience

Key municipal players

Geoexchange industry

Other neighborhood community groups

Tactics

Mobilize thought leader - David Miller – in support for the project

Lobby municipal leaders to voice their support

Continue to engage Ward 13 Councilor, Sarah Doucette to support Green 13 initiatives and events

Operational and Financial Considerations

There are many fiscal considerations to be made in creating a district based geoexchange network for an older neighbourhood such as ward 13. The operation of a geoexchange system is comparable in price to a natural gas system, but there are many pricing restrictions beyond the cost of operation[xlxli].

"Corix, a company that provides geoexchange services, had previously looked into developing geoexchange in Toronto but the estimated costs of retrofitting led the company away from the development"

Expert interviews have given pricing estimates for each house at $10,000 to install the loop and a further $15,00-$30,000 in retrofitting, depending on the presently existing heating system. If the house uses a heat pump it will be cheaper, around $15,000 but if duct work is necessary it can be as much as $30,000. This means that each house costs $25,000-$40,000 in retrofitting, before the price of operation. The price of operating a geoexchange system, though variable dependent on how the installation is financed could be cheaper than natural gas, especially as natural gas prices increase due to cap and trade rates increasing. Corix, a company which provides geoexchange services had previously looked into developing geoexchange in the city of Toronto but the estimated costs of retrofitting led the company away from the development.

Best Practices and Recommended Options

The most successful examples of district-based geoexchange systems observed in Canada are operated as utilities with significant private or public up-front investment. Examples of Private utility provision can be seen in the examples of Corix and FortisBC. Certain communities have had success using public provision in the case of Richmond and Gibson British Columbia.

The high upfront cost makes it more efficient for the establishment of these systems as a utility model allowing the costs to be paid down throughout the utilities life.

It is recommended that municipalities and governments keep this in mind when encouraging the development of this resource.

What has been seen in some cases of the development of geoexchange in residential neighbourhoods is a system predicated upon the requirement that: services provided through the system charge a market rate for heating and cooling, and all new developments in the area the system serves are hooked up to the district system.

These practises ensure that consumers use the system, and retrofit or construct accordingly. This mandated buy in rate allows the geoexchange provider and costumers to pay down the cost of installation in the long run, in a similar way to how natural gas systems pay down the cost of installation through monthly usage bills. Problems with this include the varying costs of installation, the lack of new developments to attach to the system, and the model's ability to cover the costs of retrofitting older homes. For example, if the entire cost of retrofitting were to be paid through monthly bills, for a house on the high side of retrofitting costs, bills would either be significantly more expensive or a longer contract period would be required to ensure that the system were paid down.

Alternatively, a utility company may insist that homeowners pay their respective retrofitting costs on their own. In this case, other sources of financial aid may be required to assist homeowners with these costs. There are programs run by the city of Toronto, which provide some degree of financial assistance for retrofitting houses to increase energy efficiency, like the Home Energy Loan Program (HELP), a low interest loan program.[xlii] Government assistance in retrofitting houses would significantly decrease the buy in cost associated with a large-scale transition to a geoexchange system.

A government loaning or funding program aimed at converting entire areas to geoexchange would help make a district geoexchange system in old neighbourhoods more feasible. Currently retrofitting programs in place are done on a residence-by-residence basis. If instead a coordinated retrofitting fund were created, which was aimed at retrofitting a larger area, in order to install a geoexchange system, private involvement would be more likely. The example of Corix choosing not to develop in Toronto due to the high retrofitting costs shows an example where decreasing the burden of capital investment may have incentivised the private sector to develop in the city. Some sort of public-private partnership, or consultation between the private utility providers, the provincial, municipal and federal government, and local community members on developing such a retrofitting fund in a way that is conducive to private development could make these systems feasible.

When discussing the development of geoexchange systems, the language used is important to foster its development. The narrative that geoexchange is a "free resource" should be avoided. Geoexchange resources should be treated as valuable under a utility model that utility companies can extract rents from in order to make profits off of their energy projects.

Case Study: Mirvish Village Neighbourhood Energy System

In Ontario, district energy systems have been implemented in new residential neighbourhoods as retrofitting costs are not a concern. The development planned for Mirvish Village is set to utilize a district energy system. This system is designed to allow new developments in the area to hook on to the utility[xliii].

Source: West Village Rezoning Application (2017).

The distribution system will be capped in all directions for the provision of future expansion throughout the neighbourhood. This will allow future developments in the area to join onto the neighbourhood energy system, managed by Creative Energy.

The energy system will rely on natural gas for operation in the short run; however, provisions during the construction phase will allow the use of geoexchange as the cost of fossil fuels increase with the implementation of carbon pricing schemes. Large district systems are financially feasible; however, the costs associated with retrofitting old neighbourhoods have created a barrier to entry.

Our Recommendation

In order to limit upfront costs of district energy and geoexchange, it is recommended that for new high residential development in Ward 13, a neighbourhood energy system be developed. Developers have the financial capacity for the high upfront construction costs related to the development of district geoexchange energy systems. Given the significant development occurring in the neighbourhood, Green 13, working with the planning staff and city councillor, has an opportunity to capture benefits from this increasing high and mid-rise development. Such benefits could be secured for the neighbourhood through either section 37 funding allocated to the development of energy systems or a community benefit agreement for the area with developers. Therefore, Green 13 should work with city planning staff and the City Councilor to capture sustainability benefits from the increasing development occurring within the neighbourhood.

For medium density development in the neighbourhood, such as the vast number of heritage single family homes that occupy Ward 13, it is recommended that these houses could be attached to the neighbourhood energy system for heating and cooling purposes. This would allow residents to not be responsible for the upkeep of the actual geoexchange system, and would only require the residents to have to pay the connection and retrofit costs for their individual homes. As the price of gas continues to rise due to increasing carbon pricing throughout the province, this option will become more financially appealing for homeowners as pricing should remain relatively stable as compared to rising gas energy prices.

Policy and Regulatory Considerations

Future Policy Directions for Government

While there exist many steps that local communities can take to implement geoexchange systems in their neighbourhood, there are important regulatory and legislative changes that need to take place in order to support the future proliferation of geoexchange energy usage. Currently, the incentives are misaligned for utility companies and other private enterprises to undertake the wide scale development of geoexchange systems. The large scale private development of other energy sources, such as oil, gas, solar and wind, are evidence that this can be accomplished, even for renewable energy sources. Below, various incentives and barriers to this development for geoexchange energy will be discussed as well as recommendations for government when moving forward.

Context and Need for Natural Gas Alternatives

At the centre of Ontario's five-year Climate Change Action Plan is the province's commitment to a low-carbon future. In October 2016, the federal government announced a nationwide carbon pricing policy that requires the provinces to adopt either a carbon tax or cap-and-trade system by 2018. Prime Minister Justin Trudeau informed the premiers that in the absence of implementing either one of the aforementioned climate policies, Ottawa would impose a mandatory levy on carbon, starting at $10 a ton[xliv].

"In order for Ontario to remain on track with its [GHG emission reduction] targets, natural gas use will have to decrease by 40% by 2030"

Prior to this announcement, Ontario was already in the planning stages of its provincial cap-and-trade program, which began its first trading period on January 1, 2017. In the future, the system will officially be linked with both Quebec and California's cap-and-trade schemes, which together comprise the Western Climate Initiative (WCI). In addition to pricing carbon, the Ontario government is affording the public more options, incentives, and tools to make better choices when it comes to energy consumption. As one example, the province aims to make it easier for homeowners and businesses to install or retrofit clean energy systems, including solar and advanced installation and heat pumps[xlv]. The province's plan aims to reduce GHG emissions by 15% by 2020, 37% by 2030, and 80% by 2050. In order for Ontario to remain on track with its targets, natural gas use will have to decrease by 40% by 2030, with steeper reductions until 2050[xlvi].

"There is a lack of policy support and incentives for the adoption of geoexchange, despite the complementary provincial government objectives"

Much of Ontario's electricity system has already been de-carbonized. However, natural gas is still widely used for heating and cooling buildings[xlvii]. This presents an opportunity for Ontario to embrace geoexchange as it's a low carbon alternative to natural gas. To put this into perspective, the proposed expansion by Union Gas and Enbridge are estimated to generate up to 4 Mt of carbon emissions by 2050. Replacing this with geo-exchange energy would reduce carbon emissions by 95 percent—producing approximately 0.2 Mt of carbon by 2050, and at a lower total cost.

Given the twin considerations of carbon emission reduction targets and the proposed expansion by Union and Enbridge, there is currently a high need for alternative sources of energy within Ontario. However, there is a lack of policy support and incentives for the adoption of geoexchange, despite the complementary provincial government objectives.

At a recent panel discussion led by members of the Ontario Geothermal Association, Vice President of Market Development and Public Government Affairs for Enbridge Gas Distribution, Malini Giridhar, emphasized that because 1.2 million Ontarians are currently without access to natural gas, major opportunities exist for the geoexchange industry[xlviii].

Current Geoexchange Policy Framework

Lack of Coherent and Concerted Policy Framework

An overarching barrier to the adoption of geoexchange systems is that they do not have the same public visibility as other renewable technologies, such as wind and solar energy. This appears to have resulted in the lack of a coherent, organized policy framework supporting the development of geoexchange energy by all three levels of government. This is demonstrated by the fact that the Federal Government, the Government of Ontario, and the City of Toronto all refer to the technology by different names (ground source heat pumps, earth energy systems, and geoexchange, respectively). Wind and Solar energy, however, are described using more consistent language. This suggests that the development of geoexchange systems may be hampered by the fact that it lacks the same visibility and concerted government support enjoyed by other renewable technologies.

This is also apparent at the provincial level in Ontario. Wind, solar, and hydro technologies are all under the jurisdiction of the Ministry of Energy where private development has been spurred by the Province's feed-in tariff (FIT) program. Geoexchange technology, however, remains under the jurisdiction of the Ministry of Environment and Climate Change, which has provided little economic incentives for its development.

This is despite the fact that from an environmental and cost perspective, geo-exchange represents a major tool for the provincial government to meet its objectives under its Climate Change Action Plan and Long-Term Energy Plan. Taken together, this points to a disconnect between policy objectives and current policy directions, as well as a need for clear linkages between policy directions and specific industry actions. It also suggests that the development of geoexchange systems may be accelerated if it were under the jurisdiction of a different Provincial ministry with a greater focus on public and private resource development.

Individual Use vs Large Scale Development

Another barrier to the development of district-based geoexchange systems in Canada that was identified while consulting the current policy framework is an apparent focus on policies that promote individual use of the technologies, rather than large-scale development. For example, the most prominent Federal program concerning geoexchange was the ecoENERGY Retrofit program, which provided homeowner with up to five thousand dollars to install and geoexchange system. However, these programs do little to encourage the development of geoexchange energy on a large scale that will be needed to attain both provincial and federal carbon targets.

Other renewable and nonrenewable energies have, however, been subject to programs aimed at encouraging their development on a large scale. In Ontario, the FIT program is an excellent example of such a policy. Launched in 2009, Ontario's feed-in tariff (FIT) program aims to promote the development and use of renewable energy sources and technology, attract investment, and ultimately improve air quality vis-à-vis shifting the province away from reliance on fossil fuels[xlix].

Ontario's FIT program is administered by the Independent Electricity System Operator (IESO) and allows homeowners, communities, business owners, and private developers to generate and sell renewable energy to the province at a guaranteed price and fixed contract. In order to qualify, projects must generate more than 10 kilowatts of electricity from onshore wind, waterpower, renewable biomass, biogas, landfill gas, or solar photovoltaic (PV) energy sources[l]. The FIT program has resulted in the development of a number of privately-owned and operated wind and solar farms across Ontario. If geoexchange energy were eligible for similar programs, we may expect to see greater development of the resource and its distribution through privately-owned and operated utilities.

Legislative Barriers

Our research also identified examples of specific policies that have directly or indirectly hindered the development of district-based geoexchange systems in Canada. For example, in 2012 the Ontario Provincial Government revoked and replaced O. Reg. 177/90 with O. Reg. 98/12, requiring anyone constructing new or altering existing vertical loop geothermal systems to obtain an Environmental Compliance Approval from the Ministry of Environment and Climate Change.

Those in the geoexchange industry argue that these new requirements place an unnecessary regulatory burden on Ontario geoexchange companies, and limits ability of the industry to expand throughout the province[li]. Furthermore, there are no provisions within the former City of Toronto Municipal Code, Chapter 313, Streets and Sidewalks, to allow for the installation and maintenance of the proposed geothermal heating/cooling systems within the public right of way, Community Council approval is required. The Canadian Geoexchange Coalition has identified numerous other examples of legislation that is inadvertently counterproductive to promoting the development of geoexchange energy, and this suggests that legislators may have to take this energy source into greater consideration when designing legislation in the future[lii].

Our Recommendation

Given what was learned from our consultation of the current policy framework concerning the development of geoexchange systems in Canada, we make the following recommendations for each respective level of government:

General

We recommend that all three levels of government, local utilities, private developers and community groups develop a strategy for the large-scale development of these systems. This will likely require that all three levels of government agree on a consistent language to describe the technology and promote geoexchange energy in a similar manner that wind, solar and hydroelectric energy is currently promoted to increase public awareness of the technology.

Furthermore, as recommended by the Canadian GeoExchange Coalition (CGC)[liii], a good first step would be to implement a procurement policy at government departments that changes the operational versus capital budget structure so as to reward high-efficiency investments by provincial institutions, and which promote the use of geo-exchange technology.

Finally, in general, governments should consider implementing policies that encourage large-scale, private sector development of geoexchange systems. These policies may come in the form of direct subsidies for project development or tax breaks to encourage financial investment in geoexchange energy systems.

Federal

At the federal level, we recommend that the federal government play a more active role in encouraging the development of district-based geoexchange systems in Canada. This would likely have to come in the form of financial assistance to private developers interested in developing such systems. Funding once used to encourage individual homeowners' installation of geoexchange systems through the ecoENERGY program may be put to better use by providing financial assistance to significantly fewer, but larger, district-based geoexchange systems. Other financial incentive policies previously adopted by the federal government to encourage resource development, like accelerated capital cost allowance, may also be considered.

Provincial

We recommend that provincial governments, which are responsible for energy and resource management, reassess what the most appropriate departments or ministries are for the technology to be housed such that large-scale development is prioritized over individual use. In Ontario specifically, this may mean reassigning the responsibilities of geoexchange energy to the Ministry of Energy or the Ministry of Natural Resources and Forestry, where wind, solar and hydro energy are currently found.

Furthermore, to address the lack of policy promoting large-scale geoexchange resource development in Ontario we recommend adapting the provincial FIT program to include geoexchange technologies. One solution for Ontario could be to mimic the Renewable Heat Incentive (RHI) model in the UK, which has two schemes for the domestic and non-domestic sector, and prices heat rather than electricity. Eligible systems include: biomass boilers (that meet emission limits), wood pellet biomass stoves with back boilers (that meet emission limits), air source heat pumps (air to water only), ground (and water) source heat pumps, and solar thermal (flat plate or evacuated tube, supplying hot water only). Systems must be certified under the Microgeneration Certification Scheme (MSC) and accredited by Ofgem—Office of Gas and Electricity Markets—there is no output limit, and only space and water heating is eligible[liv][lv].

Finally, we recommend that provincial governments assess the current state of energy prices within their respective jurisdictions. In Ontario, for example, the low cost of natural gas relative to electricity makes investment in geoexchange technology unfavorable. Provinces may therefore need to consider taking steps to level the costs between energy sources. As an example, revenue from the provincial cap and trade system may be used to subsidize the cost of electricity to run heat pumps, thereby encouraging consumers to switch from natural gas to geoexchange systems.

Municipal

At the municipal level, we recommend imposing renewable energy requirements specific to geoexchange at the community-level, which developers would be required to follow when moving ahead with new community projects. The environmental and economic benefits need to be further communicated to all levels of government by the academic community, advocacy groups, and private actors. There is also a lack of public understanding, awareness, and support around the use of geo-exchange technology, pointing to a need for public education. The CGC suggests utilizing existing billing and collection resources to disseminate information about geoexchange technology, clearly communicating its benefits. Municipalities should consider operating geoexchange systems as a utility, either publicly or by providing private companies with access to do this themselves—an example of this is Alexandra District Utility in B.C.

Case Study: Alexandra District Utility

A district-based geoexchange system operated as a utility and owned by the municipality of Richmond, BC. It is a world-renowned and award-winning system, servicing nearly 1,200 units.

Source: City of Richmond (2017).

Conclusion

Addressing climate change in Canada will require significant reductions in both industrial and personal greenhouse gas emissions production. With strong leadership, an open-minded approach to alternative renewable technologies, and a concerted effort from all levels of government, Canada can make significant gains towards reducing its household emissions and meeting its climate target.

We believe that one of the most promising technologies that can be used to accomplish this are geoexchange heating and cooling systems, which are proven to be efficient, renewable and cost-effective. By developing these systems on a district level and offering them to consumers through a utility model, neighbourhoods and cities can make the shift to low-carbon heating and cooling solutions much more rapidly.

The Junction neighbourhood of Toronto's Ward 13 is an ideal candidate in which to launch such a project, with a dedicated and environmentally conscious community and a supportive local government. Ward 13 and other neighbourhoods can increase the odds of the project being successful by continuing to engage the local residents and key political actors and raise awareness about the many advantages of such a project.

There are many actions that can be taken by local, provincial and the federal government, too, to create a more favourable environment for the development of district-based geoexchange systems. In particular, we have identified that governments at all levels should pursue policies that encourage the development of geoexchange energy and not only its consumption, that address the financial issues associated with developing large-scale energy systems, and that encourage private investment in the energy resources. By adopting such policies, we expect to see geoexchange technology grow from a single-consumer product to a large-scale and widely used technology.

Based on the insights gained from this report, we make the following general recommendations regarding the development of geoexchange systems in Canada:

Recommendations for Action

1. Communities interested in developing a district-based geoexchange system should develop a **mobilization strategy** to target key political stakeholders at the municipal level in order to garner vocal support for the project

2. Communities interested in developing geoexchange energy systems should **maintain open lines of communications with residents** to prevent against NIMBY responses to the development

3. Communities interested in developing a district-based geoexchange system will have to **assess the availability of adequate source, delivery, and connection infrastructure** to understand the costs associated with installing the system

4. Governments and municipalities must consider the importance of providing **access to the funds to cover the high upfront costs** when developing a district-based geoexchange system when encouraging the development of this resource

5. Governments and municipalities should **consider operating the geoexchange system as a utility** either publicly or by providing private companies with access to do this themselves

6. To encourage the development of district-based systems, governments should **consider coordinating their current geoexchange retrofit funding programs** to fund a regional retrofitting program, rather than individual homes

7. We recommend that all three levels of government **engage with local utilities, private developers, and community organizations** of geoexchange systems to develop a strategy for the large-scale development of these systems

8. Implement a procurement policy at government departments that **changes the operational versus capital budget structure so** as to reward high-efficiency investments by provincial institutions, and which promote the use of geoexchange technology

9. Impose **renewable energy requirements specific to geoexchange at the community-level**, which developers would be required to follow when moving ahead with new community projects

10. **Adapt resource development programs** such as FIT to include geoexchange technologies and allow private developers to benefit from the development of these systems

Appendix A: Jurisdictional Scan

Focus of Research

This jurisdictional scan aims to generate a list of the examples of district-based geoexchange heating and cooling systems that exist in Canada and the USA. It will also identify other non-geoexchange district-based heating systems in Canada in hopes of identifying privately-operated systems that could act as a financial model for the current project. Similar regulations may apply to all district systems and similar incentives could be used to encourage private investment. From this research, recommendations will be made as to which jurisdictions warrant further research and how this information may be of use to this project. Finally, a list of key contacts has been assembled and we will be reaching out to these individuals and groups shortly.

General Trends

In developing this outline, a few trends were observed. Namely, there are very few examples of district geoexchange heating and cooling systems in Canada, and still limited examples around the world. Many examples in the USA and in Europe make use of hot springs or hot aquifers to source the heat from the ground, which are less applicable to the current project. It is also apparent that many district-based systems are installed as new neighbourhoods are being built and not installed in old neighbourhoods.

However, the research also uncovered some promising examples and revealed opportunities for further research and follow up.

- Further research has identified a number of utility companies operating in Canada and the USA that design, install, operate and maintain geoexchange systems. The companies maintain ownership of the systems and charge users a monthly fee for the utility. These systems vary in size, but the Sun Rivers Resort in Kamloops, BC, apparently services up to 2000 homes. The two identified companies working under this model are Corix and FortisBC (a natural gas company).

- There are a handful of examples of district geoexchange heating and cooling systems that have been successfully installed in Canada and the USA, such as the Alexandra District Utility, the Ile des Chenes District Geothermal Energy system, the West Union Geothermal Heating and Cooling System, the Gibsons geoexchange utility and the Creigthon street community geoexchange development. Although these are all owned by the municipalities, they are worth investigating further as many of them took advantage of generous government aid to fund their projects.

- There are also numerous examples of privately owned non-geoexchange district-based heating and cooling systems in Canada, including Enwave in Toronto and Creative Energy in Vancouver. These examples may provide insight into how district-based energy systems can be developed privately and made profitable to investors, and some of them have even been built in existing neighbourhoods.

Insights from Paris

District geothermal projects in France are a promising lead due to the scope and potential government policies used to promote their development. These projects have expanded significantly in the past 10 years, mostly in Paris due to the presence of a hot aquifer (the Dogger aquifer) below the city (24). The technology used here is noticeably different from that being considered by Green13. These projects require drilling to depths of up to 2,000 meters to reach water at a temperature of up to 85ºC. In Paris, nearly 200,000 homes are heated using geothermal energy through a series of smaller projects which service up to 10,000 homes each (25, 26, 27).

Interesting policies have been identified in the French geothermal industry. There was a lack of private investment of the geothermal sources due to the risk associated with their development. Costs of development are very high, and it can be very difficult to know if the project will be successful until the 2,000 meter-deep well has been completed. The government therefore introduced a risk insurance program to spur investment, which sources state did increase the rate of geothermal heating system development in the region (28, 29).

Another French policy that warrants further research comes from a statement in reference (30) where the authors state: "The two plants has been built by DALKIA (VEOLIA Group) which has financed 100% of the investment secured by a 25 years contract exploit the geothermal district heating network and sell the heat to all the consumers connected." While this sounds like a royalties program, it is not elaborated on further in the article. We have therefore added the author of this paper as a key contact at the end of the scan.

Scan Overview

Name (Associated References)	Description	Where, When, Size	Ownership	Advantages for us	Disadvantages for us
Alexandra District Utility (1, 2, 8)	District-based geoexchange heating and cooling system servicing residential units.	Richmond, BC; 2011 – Present; 3100 Units	Owned and Operated by the City of Richmond	Award-winning geoexchange district heating and cooling system. It may have been partially funded by condo developers, but is now owned by the city.	Was developed and expanded as the neighborhood was being built and expanded.
Ile Des Chenes District Geothermal Energy (5, 7)	District-based geoexchange heating and cooling system servicing municipal buildings.	Ile Des Chene, Manitoba; 2010; Services multiple municipal buildings	Owned by municipality	Installed in existing community. Community considers this to be a great achievement and lists sources of funding acquired for project.	Does not service residential buildings.
West Union, Iowa District Geothermal Heating and Cooling System (10, 12)	District-based geoexchange heating and cooling system servicing municipal and private buildings.	West Union, Iowa, USA; 2012; ~ 30 buildings, both municipal and private.	The system is owned by the municipality, but operation rights have been leased to the patrons of the system.	This is a geoexchange heating and cooling system, installed in an existing community and servicing private and public buildings. It demonstrates the ability of the users of the system to control management themselves.	This is in the USA, in a very small town.
Drake Landing Solar Community (4, 13)	District-based solar heating system servicing residential units.	Okotoks, Alberta; 2007; 52 Residential homes	Uncertain	Set up in a residential area, using solar heat to provide district-based heating services. A detailed list of funding services is provided in their documentation, including significant funding from the Federal Government.	Different energy source (solar), but much of the heating delivery infrastructure is the same. System was built along with neighborhood, not in an old neighborhood.
Creative Energy (3, 14, 15)	District-based heating system seeking city's approval to expand to residential and other areas and switch to a low-carbon energy source.	Downtown Vancouver; Development currently in negotiations; 210 office buildings.	Privately owned and operated.	This is a private utility company looking to expand into existing neighborhoods and develop the infrastructure there to deliver low-carbon heating to commercial and residential buildings. System expansion is reliant upon an agreement with the city to pass a bylaw requiring all new developments to hook up to Creative Energy's system, and they are currently struggling to get this law passed. This may be an interesting case study for us to look into.	This is not geo-exchange heating, but a variety of other low-carbon alternatives instead (they are looking at biomass fuel and sewage heating, primarily).
Veresen District Energy (11, 16)	District-based heating systems servicing municipal and private buildings currently using biomass fuel.	London, ON & Charlottetown, PEI; 1980s – present; Many public, commercial and residential buildings throughout the cities.	Privately owned and operated by Veresen.	Privately operated district utility company in Canada that has expanded into existing neighborhoods.	Not geothermal energy. Many customers are not residential.
Enwave Deep Lake Water Cooling System (6, 9)	District-based cooling system using cold water from lake Ontario to service office buildings in downtown Toronto.	Toronto; 2004 – present; Many office buildings downtown.	Privately owned and operated by Brookfield Asset Management as of 2012.	Privately operated utility company using a green, renewable resource as a source of cooling power. How this resource is defined may have implications for how geothermal energy is defined.	Not in old residential neighborhood. Not geo-exchange heating and cooling source.
Creighton Street Community Geoexchange (17)	A small community-operated geoexchange heating and cooling system	Halfiax, NS; Built in 2006; Four townhouses connected.	Privately owned and operated by the homeowners.	This is a great example of a community-led initiative, developed in an old neighborhood.	This is relatively small in scale.
Corix Utilities (18, 19)	A private utilities company developing multiple district geoexchange projects.	Ottawa, ON and Kamloops, BC; Built in 2002 and 2012; Up to 2000 homes in size.	Privately owned and operated.	This is a great example of private investment into geoexchange systems. Homeowners are charged a monthly fee for the use of the utility which remains owned by Corix.	The systems are built in new neighborhoods as they are being developed.
FortisBC (20, 21)	A private utilities company developing multiple district geoexchange projects.	Various developments around BC, many in Victoria; Normally on the scale of condo buildings; Developments ongoing.	Privately owned and operated.	This is another great example of private investment into geoexchange systems. Homeowners are charged a monthly fee for the use of the utility which remains owned by FortisBC. FortisBC claims to fund "up to 100% of the development costs" of the systems.	Currently only operating in BC. The projects do not appear to be at the scale that Green13 would like.
Gibsons Geoexhchange Utility (22, 23)	Community-owned and operated geo-exchange system	Built in Gibson, BC in 2009. Initially built for 36 homes, planning to expand to up to 140 homes.	Owned and operated by the municipality.	This could be a model for Green13 pursue as a community-based initiative. It is considered very successful.	There is no private investment in this project. It was built in a subdivision, not a dense neighborhood.
Paris Geothermal Heating Systems (24 – 30)	Multiple privately-owned and operated hot-water geothermal heating services throughout the city.	Paris, France; Almost 200,000 homes in total; Most new development within the past 10 years.	Most systems appear to be privately owned and operated.	The primary value here may be in the government policies that are in place to spur development of these systems.	Most systems appear to be operating different technologies than those of interest to Green13.

Stakeholder Engagement Opportunities

A list of key contacts has been assembled for some of the more promising geoexchange projects. We will be reaching out to these groups shorty.

Alexandra District Utility: Alen Postolka, Manager of Sustainability Unit in Richmond

Alen.Postolka@richmond.ca

- Alen may be a great contact to put us in touch with the developers involved in this project. He may also offer insight into the competing models of private versus public ownership of geoexchange utility systems.

West Union District Geothermal Heating and Cooling System: Jeff Geerts, Iowa Economic Development Authority

jeff.geerts@iowa.gov

- Jeff may provide similar insight to Alen into the decision to choose public over private ownership of the system.

Creighton Street Community Geoexchange: Peter Blackie, Architect and project lead

petercblackie@hotmail.com

- There is little information about this project online, but it was completed many years ago and may have been expanded since the original construction. It would be great to have a better understanding of the financing of this project.

Corix Utilities

info.utilities@corix.com; information@sunrivers.com

- Corix utilities may discuss their business model and their willingness to work in an older neighbourhood. We may also be able to ask them about what types of government policies would make these projects more viable for them.

FortisBC

We can contact the clients for which FortisBC has built geoexchange systems (info@townline.ca), and to contact FortisBC we may have to use their customer contact lines (https://www.fortisbc.com/NaturalGas/BuildingProfessionsTrades/BuilderServices/Pages/Account-Managers.aspx?utm_source=CHBA%20directory&utm_medium=Print%20ad&utm_campaign=Energy%20Solutions)

- They will offer similar insights as Corix utilities. They can hopefully shed some light onto what would be required for them to develop a project on the scale of what Green13 is looking for.

Paris Geothermal Heating Systems: Christian Boissavy: **Christian.boissavy@orange.fr**

We can contact the author of the paper at reference (30). They may offer insight into their statement regarding French companies paying for access to sell the geothermal heat as a utility.

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