THE OGA'S RESPONSE

to

ONTARIO'S LONG TERM ENERGY PLAN

January 2011

Ontario Geothermal Association

Executive Summary
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"A brief market-deregulation scheme saw electricity prices spike an average of over 30 per cent in just seven months. The government of the day was forced to cap prices for residential and small business owners — an unsustainable policy. The cap just masked the underlying problem of rising cost pressures in an electricity system in need of renewal and additional supply.

Ontario was also heavily reliant on coal-fired generation. About 25 per cent of electricity generation came from polluting coal-fired plants. In addition, Ontario imported coal power from neighbouring American states. Ontario, a province with ample power resources, had become a net importer of power.

The priorities that the government sets and the investments the government makes today are laying the groundwork for an Ontario of tomorrow that will feature a modern, clean and globally competitive economy; healthy, vibrant and livable communities; and an exceptional quality of life for all Ontarians. The government has a responsibility to ensure a clean, modern and reliable system for the health and well-being of Ontario families and businesses.

***All of this means that Ontario needs a more modern energy system and a diverse supply mix. Clean, reliable energy is the fuel that will power Ontario's future economic prosperity. Ontario must take steps today to ensure that the right kind of energy will continue to be there for us tomorrow"*- excerpt from the Long Term Energy Plan for Ontario.**

The Emergence of Geothermal Energy in the Province of Ontario.

The Federal Government of Canada has signed the Kyoto Protocol binding it to significantly reduce the amount of C02 Canada releases into the atmosphere every year. The Ontario government is currently formulating a long term energy plan that will look to reduce the overall burden on the power supply and will lessen electrical demand at peak intervals in summer and in winter. From that Kyoto federal agreement came the provincial mandate for Ontario to eliminate coal-fired electric generating plants by 2009. The one-tonne challenge was created for Canadian homeowners to contribute to the goals of Kyoto. From the provincial LTEP we hope that alternative green sources of energy will emerge to even out the demand on electricity supplies over the next 30 years.

The Ontario government recently stated; ***"While we are proud of our collective efforts so far, we must continue to develop cleaner forms of electricity and foster a conservation-oriented culture. We need to have a balanced low-carbon supply mix to meet energy needs cleanly and reliably — Ontario will be ready for when North America moves to greenhouse gas regulation. We also need to maximize the electricity assets we have"*** The Ontario Geothermal Association (OGA) would like to ensure that this means more geothermal energy in the mix of renewable energy sources.

In addition, the Ontario Power Generation (OPG) is required to meet strict government-mandated greenhouse gas emission targets, including ensuring that between 2011 and 2014 annual emissions are two-thirds lower than 2003 levels. While Ontario is the only jurisdiction in North America that is phasing out coal-fired plants, it has ignored the huge benefits of geothermal energy in the renewable energy mix.

The OGA believes that we can offer a unique opportunity to heat and cool nearly every building in the province by means of geothermal energy. This form of energy can be recovered from the earth beneath every building site, without any need for energy transmission lines. The use of geothermal energy offers benefits to the users, to the local and provincial economy, to utilities, and to society. It can use competitive market forces to develop a self-sustaining market.

Geothermal energy is recovered from the upper 200 metres of the earth beneath each building. It is then upgraded by the use of heat pumps to provide heating and cooling of the building , as well as a supply of hot water for domestic use.

The importance of geothermal energy is that every Ontarian has access to this energy source in their own backyard. A geothermal energy system recovers the thermal energy that is stored in the soil and rock of the earth. By using a system of pipes buried in the ground, a mixture of water and environmentally friendly anti-freeze is circulated to recover or dissipate heat. These systems are highly energy-efficient, quiet, and clean.

A geothermal energy system is a unique technology. Every Ontario property owner has access to geothermal energy in their own back yard. It increases the comfort of users while reducing their energy bills. It provides local employment opportunities while reducing the trade deficit. It reduces the cost at which electric utilities provide service. It reduces the burning of fossil fuels, thus improving the environment. The sealed components of geothermal energy systems (pipes in the ground and the heat pumps)

make them highly reliable, with low operating costs. Finally, they provide local employment for system installation and maintenance.

Among the benefits that geothermal energy systems offer to the consumer are:

- comfort (an even flow of warmth or cooling throughout the building)
- reliability (long system life, low repair costs)
- no outdoor unit (reduced noise, no exposure of system to weathering, aesthetics)
- lowest operating cost of any space conditioning system (according to NRCAN)
- less demand for energy at peak intervals in summer and winter

Geothermal energy systems reduce electric utility costs to provide service during both summer and winter peak periods. They increase customer satisfaction and they help to alleviate the need for fossil fuels during peak loads in the winter.

A coalition of OGA and government agencies can be instrumental in transforming traditional space heating and cooling technology to renewable geothermal energy. It can help create a new competitive standard for space conditioning and provide encouragement for efficiency improvement in the design of geothermal energy systems and the system components.

The Benefits of Geothermal Energy

By installing a geothermal energy system, an average 2000 sq. ft. home will eliminate nearly 10 tonnes of C02 every year. The house used in this calculation utilizes a 4 tonne geothermal unit; therefore, for each tonne of geothermal energy installed in a home, 2.45 tonnes of C02 are saved every year. This calculation is set against the use of natural gas as the primary heating source. If other types of fuel are used, such as propane or oil, the tonnage savings increase.

Geothermal technology is the only technology that is practically capable of significantly reducing electricity demand immediately. The wide-ranging acceptance of geothermal energy systems will create a long-term, proven solution for electricity conservation and peak load management. This technology is not new, and investment in its development is unnecessary.

Geothermal technology can operate in the majority of buildings in Ontario regardless of size, structure, or location. The advantages of geothermal energy systems go far beyond electricity conservation. Geothermal energy systems positively impact local economies, significantly reduce fossil fuel emissions, achieve the most comfortable indoor space conditioning available, and save money. Currently, Ontario has become Canada's leader

in the use of geothermal energy. Agencies such as the Ontario Reality Corporation are mandating geothermal energy systems in newly constructed government buildings.

Geothermal systems will continue to compete effectively in Ontario's heating and cooling market without the benefit of government investment in the future. However, organizations such as the OPA have the ability to increase awareness and acceptance of geothermal energy systems province-wide to ensure that the benefits of geothermal energy are experienced by everyone.

Geothermal energy systems offer electric utilities increased customer satisfaction and business stability. Once the ground loop is installed, it is likely that a customer will continue to use it indefinitely, creating a satisfied customer willing to purchase service from the electric utility for an extended time. Geothermal energy systems offer a flatter load profile, reducing the need for electric system construction while more efficiently utilizing existing facilities, and thus potentially lowering the cost of electricity sold. They can eliminate the need for fossil fuels — particularly natural gas in urban areas and oil and propane in rural areas — during the winter period. According to various industry handouts, when geothermal technology is coupled with high-quality construction techniques and other forms of renewable energy, the various benefits are compounded, to lower energy consumption in cooling by approximately 80%.

Of the 15,400 MWt (4,400,000tonnes) global installed base of geothermal energy systems, about 56 percent of this capacity is installed in the U.S.. Europe follows, with about 39 percent of the installed capacity, and Asia has about 5%. In Europe, Sweden is the dominant player in the geothermal energy systems market, with almost 2500 MWt (711,000 tons) installed—more than double any other European country. The U.S. geothermal energy market is split evenly between residential and commercial applications, with a very small market for industrial applications. Geothermal energy systems can provide energy savings of up to 60 percent, compared to typical fossil fuel furnaces with air conditioners. The purpose of this report is to explore and explain how geothermal technology can be an integral part of managing Ontario's power supply issues.

Adding Geothermal Energy to Ontario's Energy Supply Mix

Geothermal technology has the potential to be the single greatest impact on the demand for electricity in Ontario. Geothermal energy systems can provide heating and cooling 24 hours a day, 365 days a year. Geothermal systems can be designed for single family homes, multiple housing projects, apartment complexes, farm and rural buildings, commercial buildings and industrial blocks. As the price of fossil fuels for heating and

electricity increases, geothermal installations will increase, as users seek lower cost alternatives. Incentives and promotion will also encourage consumers to seek better, more efficient and sustainable alternatives.

In a speech to the Canwell conference in Manitoba in May 2010, former Governor General Edward Schreyer stated that geothermal energy technology is not usually even counted in global statistics, yet it already produces more energy than solar panels and has the potential to be the third most important renewable energy source in the world, behind wood and hydro-electric energy.

Since geothermal energy systems use the energy in the earth to heat and cool buildings, they are capable of replacing fossil fuel furnaces and conventional air conditioners in every building in the world, from the tropics to the frozen tundra. They are the most efficient technology known for these purposes, typically replacing 40-60 percent of a building's conventional energy supply. If a geothermal energy system is installed in a new building, the increased capital cost over conventional systems will immediately be more than offset by the reduction in your energy bill. It pays from day one.

Geothermal energy systems use the same technology as the other heat pumps in our lives - refrigerators, freezers, and air conditioners, all of which move heat from one place to another. Fridges move heat from inside the fridge into the kitchen. Air conditioners move heat from inside the building into the outdoors. Geothermal energy systems move heat from the earth into buildings, for winter heating. In summer, the heat pump can be reversed and move heat from the building into domestic hot water tanks, with any excess heat returned to the earth.

The geothermal heat pump is a proven technology capable of significantly reducing winter fossil fuel use and summer peak electrical demand in buildings. The current residential share is about 56% and commercial share is about 44 %. In Ontario, residential, commercial, and institutional buildings account for about 40% of primary energy consumption and carbon emissions, 72 percent of electricity consumption, 55 percent of natural gas consumption, and significant oil consumption.

Over the long term, buildings are expected to continue to be a significant component of increasing energy demand and a major source of carbon emissions, driven in large part by the continuing trends of urbanization, population and GDP growth, as well as the longevity of building stocks. However, because building equipment and many structural features are frequently upgraded, the short term potential for improving the energy integrity of the existing building stock is substantial. Over the past several decades.

geothermal energy systems have gradually improved and energy savings have been demonstrated at the individual project level.

Types of Geothermal Energy Systems

Geothermal energy systems are generally classified by the type of ground loop **(see appendix #1).** The key types of ground loop systems are described below:

Open loop or well systems are the oldest type of geothermal energy systems, and can be installed wherever there is a productive ground water aquifer. Open loop systems have been in common use since the 1970's and currently represent approximately 5% of the Ontario market. In such systems, groundwater is used as the heat carrier and is brought directly from the water well to the heat pump. The water is discharged either back into the well or into a body of surface water.

Closed loop systems use a loop containing water or an anti-freeze solution through the ground loop and use a refrigerant loop to transfer the heat to the heat pump. They currently account for about 80% of the installations in Ontario. The ground loop can be laid vertically in deep boreholes or horizontally in shallow trenches in the ground, or occasionally laid in a pond or lake.

The vertical configuration involves a borehole drilled to a depth of 150 to 200 ft per tonne of energy. The vertical loop has a smaller ground surface area requirement, which makes it more feasible for small properties. Vertical boreholes currently account for 30-35% of the residential market and over 90% of the commercial market in Ontario.

The horizontal loop is usually a less expensive option, because it only involves digging a 4 to5 ft deep trench. However, it requires much longer piping since the ground temperature is subject to seasonal fluctuation at shallow depths. The length of pipe necessary is a function of system size, climate, soil/rock thermal characteristics and loop type. The ground surface area necessary for a typical horizontal loop ranges from 2000 ft2 to 3500 ft2 per tonne (50 to 90 m2/kW). In a pond loop, the ground loop is submerged in a lake or a pond. If a suitable body of water is available, this design is an economical option, because it involves minimal digging.

Geothermal energy systems offer an opportunity to supply hot water, providing additional energy cost savings. More than any other heating and cooling system, a geothermal energy system relies on local value-added services. A substantial portion of the installed cost goes to local economies. Geothermal energy systems offer electric utilities increased customer satisfaction and business stability. Once the ground loop is installed, it can be used indefinitely. Geothermal energy systems offer a flatter load profile, reducing the

need for electric system construction while more efficiently utilizing existing facilities and this lowers the cost of electricity sold and assists in alleviating the need for imported fossil fuels.

Geothermal energy is a proven technology with accelerated growth in Ontario during the past decade. But one of the problems is that all renewable energy sources (eg - wind, solar and geothermal) require significant capital investment. Ontario has made significant public investment in wind and solar but has ignored geothermal energy. As a result, there is a lack of information concerning the benefits and advantages of geothermal energy systems in the general public and among business and political leaders.

The Ontario government has stated its desire to take the first steps in ensuring that a reliable, cost-effective energy market will exist for many years. The importance placed on alternative energy sources and demand-side management strategies are key decisions in ensuring this occurs. Geothermal energy must be a large part of this solution. The OGA is anxious to partner with the OPA/Ontario government to determine what the best course of action will be. The OGA appreciates the appointment of a full time renewable staff person in December 2010 to review the renewables portfolio and to communicate with the renewable partners in Ontario.

The remainder of this proposal will focus on demonstrating how geothermal energy systems will be a critical part of any future decisions made.

Conservation and Demand Management

The LTEP Overview discussion states that;

''Public conservation programs were reintroduced to Ontario in 2005 to encourage and provide incentives for families, businesses and industry to consume less energy. Conservation is now a cornerstone of long-term electricity planning, recognizing that all Ontarians — for generations to come — will benefit from cleaner air and a lower carbon foot print." Geothermal plays a big role in lowering the carbon footprint by reducing the use of electricity and fossil fuels.

For the past few years, Ontario has encountered a growing demand for electricity usage throughout the year along with a growing summer peak demand. At the same time, power-generating facilities are aging and the phase out coal-fired generators will continue to put an importance on demand reduction/management strategies. Geothermal energy systems provide the single greatest opportunity for the Ontario government to effectively manage the demand side of electricity usage.

David Suzuki writes in his 2005 report, Powering Ontario with Renewable Energy Smart Generation:

- Geothermal energy systems are "the most cost effective option to provide space conditioning (heating and cooling) in Ontario."
- Since 1990, Ontario has become a summer energy peak region due to the increased use of air conditioners and hotter weather during that period geothermal energy systems use approximately 50% less energy than traditional air conditioners during peak times. Air conditioners deteriorate in condition rapidly and are least efficient during the highest demand periods, when it is hottest outside. The geothermal energy system remains constant in its efficiency regardless of the outside conditions.
- According to the Independent Electricity System Operators (IESO), 13 of the top 20 kW usage days on record occurred in the summer months of 2005, and if the summer energy demand growth of 1.3% per year continues apace, we can expect record- setting summers such as that of 2005 and 2010 to continue. Assuming a growth rate of 1.3% per year, the peak demand load in the year 2015 will be 26,900 MW, with an extreme weather peak of approximately 30,000 MW.v
- Currently, the available production of electricity, including 6,500 MW from four coal plants, is 29,663 MW.
- This means that the province will be incapable of providing enough energy by the year 2015. It also assumes that all power-generating facilities continue to run at current levels, which is not guaranteed to happen, and takes into account the provincial mandate to phase out coal fired generation by 2007 or 2009. When this is completed, new forms of generation will certainly be needed. The easiest way to make the inevitable transition period as seamless as possible is to lower the demand for energy.
- Combined use applications –community centres, ice rinks, schools, grocery stores, apartments buildings and housing complexes/subdivisions – systems that are really just getting going in other provinces may work well in Ontario especially with regard to lowering demand at peak times.

Geothermal energy systems have the ability to reduce energy usage while raising the load percentage in homes and businesses. With the exception of buildings heated with electric resistance systems, geothermal energy systems will increase load usage by eliminating natural gas heating systems. With a COP of 4.0, the geothermal energy systems will allow reductions in energy usage during peak times of the day while still retaining the comfort of the building. This is achieved by allowing the majority of the heating and cooling to be done during the “off” times of the day where energy usage and costs are low.

When the peak energy demand occurs during the day (late afternoon in summer, and early morning in winter), the geothermal energy system in the building can ramp down and simply maintain current temperature levels, or if the controls of the home are set well enough, allow the temperature to change a few degrees either way. This loss in temperature can quickly and easily be made up by the efficiency of the geothermal energy system during a period of the day when electrical costs have fallen. Combined with the '***Smart Metre***" technology coming on line, controls on the geothermal heat pump can be designed to monitor electrical energy cost, and change usage accordingly.

In a 1994 report completed by the Geothermal Heat Pump Consortium in Washington, D.C., the impact of geothermal energy systems on peak load management is outlined as follows:

> *"One of the most attractive features of geothermal energy systems for utilities is that it reduces peak loads. Winter peak reductions can range from 5 to 12 kW per typical residential system. Summer peak reductions, including water heating, can range from 1.5 to 3 kW of peak."*

It is critical that peak load management is stressed when looking at Ontario's power issues. As the blackout of 2003 showed, North America's power grid can at times be fragile, especially during peak times of the year. Geothermal energy systems have the ability to lower peak demand usage while creating a higher base load during valley periods.

David Suzuki stated in his report in 2005 that if Ontario were to install 125,000 residential Geothermal heat pumps by 2010, it would result in a savings of 2,148,400 MWh per year (7.7 PJ). By 2020, Suzuki projected that the province could install 341,000 residential GHP systems that would save the equivalent of 5,777,200 MWh a year (20.8PJ). These numbers are for residential space heating only and do not reflect hot water generation or commercial/institutional buildings. In the same document, Suzuki stated that space and water-heating account for 58% and 21% respectively of total household energy costs. This means that geothermal energy systems have the potential to account for 79% of the total residential energy usage in Ontario.

Supply Technologies

Elimination of coal-fired generating plants will require the Ontario power supply to be diversified. The eliminated power will be replaced by a mix of sources as stated by the IESO, but the majority of power generation will come from natural gas-fired electrical generation plants. The introduction of geothermal energy systems to heat and cool

buildings in the province will significantly lessen the usage of fossil fuels. The natural gas saved from the installation of geothermal energy systems in a home could be used to produce electricity. Electricity produced from the natural gas savings can be used to power the installed geothermal energy systems, and provide surplus electricity production for sale to other markets, or to be used in other areas like the commercial/industrial sector.

Chapter 2 of the LTEP addresses the importance of a balanced cost effective supply of energy to support the Ontario economy. The LTEP also describes how the concept of "*Energy Storage*" could be employed to incorporate renewable generation in to a more sustainable mix of energy supply. **(Appendix# 2).**

The energy supply discussion in the LTEP ignores the capacity of Ontario's unique geology to provide:

1. a capacity to heat and cool most buildings in the province, and
2. an ability to store thermal energy in the earth

Ontario's massive and widespread geothermal energy capacity provides another major source of renewable energy to the supply mix. Utilization of geothermal energy for heating and cooling applications would extend the fossil fuel reserves for long term energy supply, transportation, electrical production and industrial applications.

To improve the performance of geothermal energy systems in heating and cooling applications, it should be coupled with the use of low heat-loss building envelopes. The current trend to constructing LEED-certified government and institutional buildings is demonstrating how low heat- loss buildings can be constructed. (Unfortunately, the recent trend in glass- encased apartment towers in Toronto, contributes to excessive building heat loss and wasted energy.)

If geothermal energy is coupled with other forms of renewable energy such as wind or solar, Ontario could achieve world recognition for true zero-emission buildings. One of the few zero-emission buildings in Canada is NextEnergy's National Headquarters in Elmira, Ontario. This is accomplished through the use of geothermal energy systems to heat and cool the building, the construction of a low heat-loss envelope, and the purchase of tagged, on-grid wind power from the SkyGeneration wind turbine located on the Bruce Peninsula. The extra cost of purchasing wind generated electricity is easily affordable due to the savings provided by geothermal energy system and the efficiency of the building (refer to **Appendix # 2** for more information). The entire system has resulted in heating

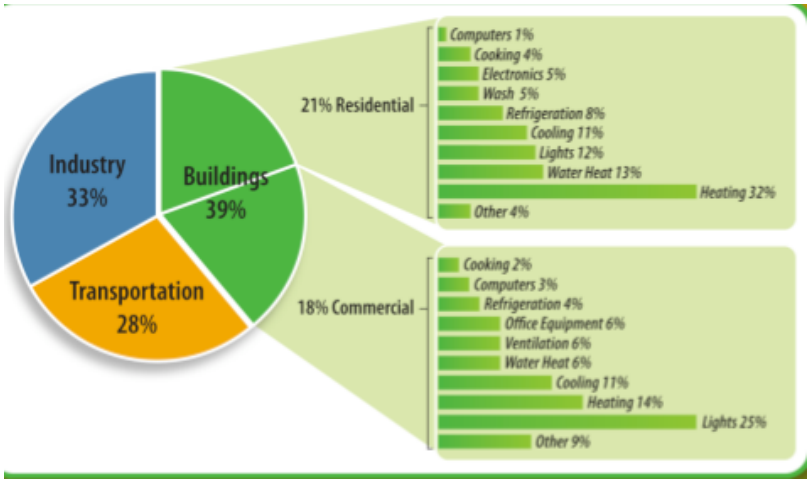
and cooling costs approximately 80% lower than the lowest-cost alternative (gas-fired furnaces and rooftop air conditioning units.)

The Ontario government is committed to significantly reduce the amount of greenhouse gasses released into the atmosphere every year. The provincial mandate is to eliminate coal-fired electric generating plants by 2015. Geothermal technology is the only form of renewable energy that is practically capable of significantly reducing electricity demand immediately. Geothermal energy systems will create a long-term, proven solution for electricity conservation and peak load management.

Job creation in the renewable energy industry is an important component of the geothermal energy systems. They require local labour, accounting for over 85% of the installed cost. (In comparison, solar and wind installation labour only account for approximately 20% of the installed cost.) In a typical $25,000 residential geothermal installation, approximately $21,000 in economic activity is construction that benefits the local community- excavation, ductwork, plumbing and electrical design. These jobs are generally mid - level trade based occupations. The energy generated is local, offsetting imported/transported fossil fuels, and the return on investment remains local.

Geothermal systems provide the opportunity for truly cost effective renewable energy resource deployment home- by- home, building- by- building. Life expectancy of the heat pump units approaches 25 years and the geothermal loop energy source has no degradation factor. The buried loops will outlive the structure. The loops can therefore be utilized by future generations of geothermal technologies. The systems also reduce peak demand for utilities and provide revenue to fill in valleys in the utility supply overall reducing utility generation costs.

There are about 900,000 geothermal energy systems now installed in the United States and nearly 100,000 in Canada. But this serves only 2-3 percent of the buildings in the two countries. By contrast, Sweden now has a 90 percent penetration of geothermal energy systems in new residential construction, and a growing number of retrofits in existing buildings. Switzerland has a 65 percent penetration of geothermal energy in new construction. A number of other European countries, Finland, Austria, Norway, Germany and France, are well ahead of the US and Canada.



Courtesy of Next Energy

In Canada, buildings are responsible for nearly 40 percent of energy consumption, if you consider fuels burned to heat the buildings and electricity consumed to cool, light and power the buildings. In Ontario, most of our heating energy is from fossil fuels which generate carbon emissions. Geothermal energy systems can replace most of the energy required to heat and cool buildings with clean, renewable energy generated on the building sites. Thus geothermal energy systems have the potential to generate a significant percentage of total energy use in Ontario. In fact, the geothermal energy capacity of Ontario's geological and aquifer formations greatly exceed the capacity of both wind and solar.

Geothermal energy is clean, renewable. reliable 24 hours per day, cost-effective and helps Ontario to meet the mandated greenhouse emission targets. It is a sustainable source of clean energy that can continue to provide heating and cooling of buildings for generations to come. Ontarians deserve balanced, responsible long-term energy planning to ensure that Ontario has clean air, reliable energy and a strong economy for our children and grandchildren. Geothermal energy is available at every building site in Ontario which would result in large cost reductions due to reduced installation of gas pipelines and hydro transmission facilities. Widespread use of Ontario's geothermal energy capacity could cut energy costs, conserve fossil fuels, and reduce emissions.

Patrick Moore in a report issued in 2010 stated:

- "Ontario's progress in modernizing and upgrading electricity has not only benefited electricity users, it has strengthened the economy by attracting investment and creating jobs. Large infrastructure projects typically have high

GDP and employment impacts, and this is also true of the ongoing and planned investments in Ontario's electricity sector."

- "Geothermal in the renewable energy mix will help consumers have greater control over their energy usage — even when they're not at home. Geothermal as part of a smart grid can isolate outages allowing for faster or even automated repair. This will improve overall reliability for all electricity consumers and make it easier for consumers to produce their own power."

As stated in the Ontario Long Term Energy Plan (LTEP), ***"the Ontario government is moving Ontario from dirty coal dependency to a clean, modern and reliable energy economy that creates jobs."*** The geothermal energy industry currently employs more than 15,000 Ontarians. Continued growth and the widespread application of the industry will help to create and support jobs and opportunities for people and communities across the province.

The government commented in the LTEP; ***"We've accomplished a great deal in the past several years, but there is more to do. Ontario has sufficient electricity supply — but we will require more clean power for the future. As Ontario's energy infrastructure ages, we will need to rebuild or create another 15,000 MW of generating capacity over the next 20 years."*** *Continued expansion of the g*eothermal energy industry will help to accomplish this goal.

The LTEP indicates that the investments that Ontario has to make in our electricity system will result in increased pricing to residential and commercial consumers of 3.5 and 2.7 per cent per year for the next twenty years. European countries, led by Sweden, Switzerland and Germany have shown that properly designed and installed geothermal energy systems have less of a direct hit on a consumer's electricity bill and on the public purse because of the large decrease in fuel and electricity demand when geothermal energy systems are installed. Much of the electricity consumed comes at low rate off hours, making the situation even more positive for the consumer.

The LTEP states that: "***We are all paying for previous decades of neglect"*** In Ontario, geothermal energy can make a huge difference to provide a cleaner energy source at a reduced cost. With creative financing plans provided by the OPA and municipal and provincial levels of government and industry, there is an opportunity to lower costs to the consumer, as well. This would be good for the environment and good for all levels of government.

The LTEP states:" ***In 2009, the government introduced the groundbreaking Green Energy and Green Economy Act, 2009 (GEA). The GEA is sparking growth in clean and renewable sources of energy such as wind, solar, hydro, and bioenergy. A series of conservation measures in the GEA are providing incentives to lower energy use. In its first three years, the GEA will help create 50,000 clean energy jobs across the province. A clean-energy manufacturing base has been growing in the province and creating jobs for Ontarians."***

"The geothermal energy industry has not benefited from the FIT and microFIT programs that have promoted growth in the solar and wind based industries. By adding geothermal energy to the clean energy mix, the LTEP would create a uniformly distributed job market throughout the entire province" – Brian Beatty, president, Ontario Geothermal Association (OGA).

The LTEP also commented***: " By 2030, Ontario's population is expected to rise about 28 per cent — a gain of almost 3.7 million people. Ontario's population will become more urbanized with population growth taking place in primarily urban areas. The Greater Toronto Area (GTA) population will increase by almost 38 per cent over the same period".***

Currently, commercial geothermal installations are being installed in the GTA and in government buildings across Ontario, to heat and cool apartment buildings, office buildings, fire halls, shopping malls, schools, detention centres, *GO* stations and many other efficient applications. Major cities, school boards and government agencies are examining the use of geothermal energy systems to provide clean efficient energy to neighbourhoods that surround the central geothermal energy systems.

The LTEP states that: ***"All of this means that Ontario needs a more modern energy system and a diverse supply mix. Clean, reliable energy is the fuel that will power Ontario's future economic prosperity. Ontario must take steps today to ensure that the right kind of energy will continue to be there for us tomorrow."***

Geothermal energy systems can heat and cool the buildings in a much more efficient manner and is more cost-effective than any other energy technology. The energy source is the earth and rock right under the building. No transportation costs. No grid costs. Nothing but an efficient system. all contained on the property that is occupied by the energy user. Safe, efficient, effective.

The LTEP further states:

"To meet these needs Ontario will need a diverse supply mix. Each type of generation has a role in meeting overall system needs. Ontario requires the right combination of assets to ensure a balanced supply mix that is reliable, modern, clean and cost-effective. Ontario will also, first and foremost, make the best use of its existing assets to upgrade, expand or convert facilities. As part of a reliable network, the system needs both small and large generators"

Geothermal energy systems can complement other forms of energy, both renewable and non-renewable. In fact, combined solar and geothermal may present some viable options for larger users of energy in Ontario. Geothermal energy does not emit air pollutants or emissions during production - producing clean energy by tapping into a renewable and free energy source in the earth.

Ontario is also planning for future energy generation that will focus on efficient, localized generation from smaller, cleaner sources of electricity rather than exclusively from large, centralized power plants, which require transmitting power over long distances. This strategy is known as "distributed generation". Distributed generation also opens up opportunities for localized geothermal energy, allowing individuals, Aboriginal communities and small co-operatives or partnerships to become generators.

Renewable energy is an important part of the supply mix. Once the initial investment is made in equipment and infrastructure, fuel cost and greenhouse gas emissions are zero or very low. Renewable energy makes it possible to generate electricity in urban and rural areas where it was not feasible before. There are several million people in rural Ontario that are not on the natural gas grid and who could immediately benefit from geothermal energy installations. Others that are on the grid would add to the overall efficiency of the energy supply system by evolving toward geothermal energy systems as part of a long term, multi- year plan.

- Over the next 20 years, geothermal energy installations should be included as part of the estimated capital investments totalling $87 billion.
- The addition of geothermal energy to the energy supply mix will help create and sustain jobs and investments across the province and make a major contribution to Ontario's growing clean energy economy.

Ontario Electricity Demand (See Appendix 4)

The LTEP states in Chapter 1 that:

"***System planning requires a complex forecast of the total amount of electricity that will be used over the course of a year, as well as the amount required to meet peak demand. The next step is to match these requirements with available generation and transmission capacity. Demand fluctuates with the time of day, weather, and time of year and the structure of the economy. Ontario's demand can fluctuate between 11,000 MW on an early Sunday morning in spring to 25,000 MW on a hot Thursday afternoon in summer."***

"***Electricity cannot be easily stored. Under solar, wind and nuclear, Ontario's electricity system must be able to produce and move enough electricity to meet the changing demand for it instantaneously — all day and all night, every day and every night"***

. Geothermal is different. It can be harnessed to reduce electricity use at peak times. Since it is THERMAL energy and not electricity, both hot and cold energy can be stored for use at peak times.

Geothermal energy can offset approximately 40% of the energy consumed at point of use on demand. PVs, wind and solar cannot approach this kind of delivery of thermal energy and cannot do it on demand. The costs of deploying those technologies (per unit of energy delivery is much more expensive and is not available when it is cold, dark or calm (no wind). Geothermal energy systems do not need the transmission lines and all of the public capital costs associated with the transmission of fuel and electrical power.

The LTEP indicates that:

"With a long-term demand forecast in place, Ontario must determine the most effective way to meet that demand so that there is no gap in supply. Ontario needs a balanced, cost-effective supply mix that supports the economy, is modern, can adapt to future changes and provides clean, reliable electricity to Ontario families and businesses for generations to come."

"A clean, reliable energy system relies on a balance of resources. Good system planning includes a sustainable supply mix that meets the demands of the public. It also means continually looking for efficiencies and emphasizing the best use of current resources. Ontario's supply mix includes".

This supply mix. including geothermal energy, balances reliability, cost and environmental performance.

In Chapter 2 of the LTEP, it states that:

"Energy Storage can help to balance the electricity grid by storing off-peak generation and using it during peak hours. This helps to reliably incorporate more renewable generation into the grid. Energy storage is an important part of the move to a Smart Grid. Ontario will continue to investigate the potential for new storage technologies. There are a number of issues that impact the development of energy storage".

Geothermal energy is ideally suited to "thermal storage" in the earth. Canada has participated in international research on thermal energy storage for over 15 years. The concept of thermal energy storage has been applied throughout the world for many years. There are growing opportunities for small and medium sized geothermal commercial projects in cities and smaller towns and municipalities.

The LTEP indicates that:

> ***"Selecting a supply mix and investment in supply is a matter of choices and trade-offs. A variety of power supply sources — some designed for baseload requirements, some designed for meeting peak requirements — is superior to relying heavily on only one source. For this long-term plan the government has considered environmental, economic, health, social and cost implications to come up with the best possible supply mix."***

Large scale wind and solar energy systems have not been supported in many parts of the province largely because of impacts to agricultural land and rural communities. Geothermal does not face these same concerns. There are no large installations to interfere with the social fabric and no destruction or use of agricultural land. Geothermal energy systems are out of sight, sustainable, modern and reliable. They will assist Ontario to phase out coal-fired generation at a faster pace and they will help to advance Ontario's conservation goals.

Geothermal energy systems ease the necessity for the extra costs of transmission expansion and the need to integrate renewables into the system. They are self contained in the homeowner's or commercial land base.

OGA suggests that the province's renewable energy capacity target will be better met, with less public dollars needed for transmission lines and other capital costs, with geothermal energy projects added to the development of renewable energy projects from wind, solar, biogas, landfill gas and biomass projects across Ontario.

The LTEP states that:

"Ontario will continue to provide broad support for achieving these targets through policy initiatives such as bringing forward a proposed regulation to require the broader public sector (municipalities, universities, schools and hospitals) to develop energy conservation plans".

The OGA is anxious to assist the provincial energy agencies regarding actions to enhance the appeal of geothermal energy systems.

"These new conservation programs, together with programs for very large industrial customers, will require an investment of about $3 billion over the next five years. The results will be significant: an avoided lifetime supply cost of $10 billion and a net benefit to Ontario ratepayers of about $7 billion over the life of the initiative" **(LTEP)**

Geothermal energy means less transmission lines are needed and the investment needed to build and maintain this type of infrastructure could be reallocated to heat and cool more residential and commercial buildings across the province.

"The Green Energy and Green Economy Act, 2009 identified three main areas of focus for Ontario's Smart Grid:

- ***Helping consumers become active participants in conservation.***
- ***Connecting new and renewable sources of energy to the overall system (consumers and businesses produce energy that can be connected to the local grid***
- ***Creating a flexible, adaptive grid that can accommodate the use of emerging, innovative energy-saving technologies and control systems. "*** **(LTEP)**

Geothermal has the potential to ease the demand of more grids and on the existing grid. In conjunction with the other renewables and non renewables, geothermal creates more room for them on the grid, and where they are needed, saving billions in the process.

Geothermal energy systems are a unique technology. They simultaneously offer benefits to their users, to the local and national economy, to utilities, and to society. They increase the comfort of users while reducing their energy bills. They provide local employment opportunities while reducing the trade deficit. They reduce electric utilities' cost to provide service. And they minimize the burning of fossil fuels, thus improving the environment .

Benefits of Geothermal Energy to Users

Among the benefits geothermal energy systems offer consumers are:

- Comfort (higher air supply temperatures in colder weather)
- Reliability (simplicity, no exposure of system to weathering)
- No outdoor unit (reduced noise, better esthetics)
- Lowest operating cost
- Many geothermal energy systems offer an opportunity to heat domestic water, providing additional operating cost savings.

Business and Economic Benefits

More than any other heating and cooling system, geothermal energy systems rely on local value-added services. A substantial, sometimes even dominant, fraction of the installed cost goes to local economies. With the help of the provincial government, as was done with wind and solar, the development and manufacture of geothermal energy systems, export of this technology could help improve our trade balance. As the province has done with wind and solar, adequate promotion and other incentives to promote the manufacture of geothermal heat systems in Ontario would result in huge potential exports for geothermal energy technologies.

Benefits to Utilities

Geothermal energy systems offer electric utilities increased customer satisfaction and business stability. Once the ground loop is installed, it is likely that a customer will continue to use it indefinitely, creating a satisfied customer willing to purchase service from the electric utility for an extended time. Geothermal energy offers a flatter load profile, reducing the need for electric system construction while more efficiently utilizing existing facilities, and thus potentially lowering the cost of electricity sold. And they help to alleviate the need for imported fossil fuels for use at the time of winter peak loads.

Benefits to Society

Geothermal energy systems offer lower carbon dioxide emissions than all other equipment. In addition, geothermal energy systems can be instrumental in achieving space heating and cooling market transformation. As geothermal energy systems increase in both efficiency and market generation, the overall efficiency of the space conditioning market improves.

Geothermal energy systems can help create a new competitive standard for space conditioning, providing strong encouragement for efficiency improvement in all other types of space conditioning equipment geothermal energy systems typically require less quantities of refrigerant than standard air conditioners. Geothermal energy systems are typically sealed at the factory, and do not require field installation of pressurized refrigerant lines. The result is minimal risk of leakage of refrigerants to the atmosphere.

Unlike some other types of heating and cooling systems, geothermal energy systems are virtually pollution free at the point of use. When combined with the installation of local solar and wind power. the net emissions for electrical power can be reduced to zero.

The OGA would like to work with OPA, MEI and other federal and provincial agencies to achieve its goals through implementing a set of focused, interrelated initiatives designed to address the three key barriers, namely:

1. **First-Cost Competitiveness**

This initiative will develop innovative methods of financing the first-cost premium, examining methods such as leasing, innovative rates, energy-efficient mortgages, shared savings, and DSM incentives. Other tasks will entail actions to reduce the cost and time of installing ground loops through improved drilling methods, equipment, procedures, sizing, and grouting of loops.

2. **Technology Confidence Building**

The initiative will undertake activities designed to increase awareness of the benefits of geothermal energy systems, and build confidence in the technology. A preferred method will be to engage in as many cost-shared regional marketing program demonstrations as possible, with selected utility partners. Other activities include developing model marketing programs; supporting standards development; and encouraging geothermal energy systems through other electrical industry programs. The initiative will develop

and implement educational programs designed to reach key customers, opinion leaders, trade allies, and educational institutions.

3. Infrastructure Strengthening

Significant increases in geothermal energy systems sales require infrastructure strengthening. Regulatory changes may be needed to ensure appropriate protection of the below-ground environment. Provincial education of the installing and drilling contractors might possibly be needed to ensure quality installations and consumer awareness. Design tools and sizing standards are needed. And in some cases model provincial legislation or regulation through perhaps several ministries, may be needed, to empower utilities to take an active role.

OPA currently supports the installation of geothermal energy systems through consumer rebates and incentives in an effort to stimulate this growing industry. This will lead to the creation of a self-sustaining market for geothermal energy systems. However, making this change in the market will require expenditures short-term.

In short, this is a unique opportunity to:

- make Ontario residents more comfortable in their homes and businesses,
- contribute to job formation locally and provincially,
- enhance the energy efficiency of heating, cooling, and water heating systems,
- reduce the emissions of greenhouse gases,
- leverage Federal funds to create major private investment,
- use market forces instead of regulation, and
- demonstrate voluntary partnerships between the OGA and the government and non -government agencies.

Ontario Geothermal Association

Summary and Conclusions:

1. *The LTEP states that:*

"Ontario has become a North American leader in producing energy from sources that are continually renewed by nature such as wind, sun and bioenergy. Renewables do not produce harmful emissions, which contribute to smog, pollution and climate change. Increasing Ontario's renewable energy supply helps reduce the province's reliance on fossil fuels. Greater investments and reliance on renewable energy help to ensure that Ontario has a clean and reliable electricity system for generations to come."

More geothermal technology and research will greatly assist Ontario in meeting this goal.

2. New construction and planned development will offer significantly improved economics for geothermal energy systems. Various geothermal energy systems could be considered, all providing significant installed cost reductions compared to individual installations:

- Large geothermal energy systems installation providing a district heating and cooling system to the community
- Large ground loop providing a thermal storage capacity for individual heat pumps in the community
- Individual geothermal energy systems for each building/home, but installed en masse at the time of building/home construction to lower installation costs
- Increased use of electronics for monitoring, control, diagnostics and proof of payback.

3. Geothermal energy systems, and possibly hybrid systems can play important roles helping Ontario pursue its energy efficiency objectives. Incentives such as tax credits or utility rebates can be based on energy efficiency achieved, rather than type of heat pump. R&D projects can be pursued based on the individual merit of each prospective project, rather than type of heat pump. This will require close coordination between the Geothermal Technologies Group (which is responsible for geothermal energy systems) and Building Technologies Group (which is responsible for heat pumps). This coordination will help ensure that both types of heat pumps are developed, evaluated, and promoted in a way that ensures that apples- to - apples comparisons are made and that duplication of effort is avoided to the extent possible.

3. Additional evaluations will help determine the likely impacts of R&D efforts to lower costs and to identify promotional projects that may be of interest to stakeholders. It is critical that the province and OPA along with others pursue the following evaluation activities:
4. Evaluate the potential for first cost reductions for geothermal energy systems, including potential economies of scale, alternative business models, and potential partnering relationships. Working with industry stakeholders, identify concepts to lower ground loop installation costs then estimate their likely cost impacts. Potential concepts may include:

- Reducing the need for, and/or cost of, evaluating ground conditions (soil type/mix, thermal conductivity, water content/ground water depth)
- For new construction, maximizing use of excavation required for the building foundation, including coupling ground loop to the foundation
- Hybrid systems using air cooled condensers or possibly cooling towers to reduce ground loop size while still meeting peak cooling requirements
- Lower cost drilling/excavation equipment and drilling technology to reduce the cost of V loops in borehole fields.
- Looking at potential improvements in economics by using variable electricity rates, such as:

    1. Commercial: Demand charges and time of use rates
    2. Residential: Current/upcoming time dependent rate structures
    3. Benefits of reducing peak electric demand. Understanding the peak demand reduction benefits of geothermal energy systems is essential to justifying utility rebates that could substantially accelerate market adoption of geothermal energy systems.

5. Detailed performance modelling could significantly improve the economics of geothermal energy systems. A more rigorous modelling process would better quantify the potential benefits of geothermal energy systems and could better target OPA, municipal and provincial activities to accelerate market adoption.

6. Schools and other government buildings (with assistance from energy services companies) have proven to be attractive, early market niches for geothermal energy system installations. Further analysis, documentation and publication of the energy savings, economics, reliability, comfort, installation and operational lessons learned, etc., associated with schools and other government buildings will help develop public confidence in geothermal energy. Having this knowledge and experience available will help facilitate geothermal energy systems market growth in other building applications.

7. The OGA would like to collaborate with the OPA and other government agencies to identify interest in a joint OPA/provincial/municipal promotional program. This would include meetings with interested stakeholders to compare information, identify common interests, agree on priorities, and outline a joint collaboration effort, as appropriate. Stakeholders potentially interested in partnership to promote geothermal energy systems may include:

Ontario Geothermal Association (OGA)
MEI, MOE, MMAH, MTCU,OMAFRA
Association of municipalities Ontario (AMO)
Heat pump manufacturers
OPA
Federal Agencies – NRCAN, CANMET
Geothermal Heat Pump Consortium, Inc. (GHPC)
International Energy Agency (IEA)
International Ground Source Heat Pump Association (IGSHPA)
Canadian GeoExchange Coalition (CGC)

Recommendations

Depending on the results of the additional analyses outlined above, the OGA recommends examining the following projects:

- Ground-Loop Cost Reduction

After developing and evaluating various concepts for lowering ground loop cost, develop prototype designs for the more promising concepts and conduct laboratory or field tests, as appropriate.

- Hybrid systems installed at individual customer sites should be researched in order to reduce the capacity requirements for district heating and cooling systems, when a few, peak hours or days may otherwise dictate sizing requirements. Also, community - based systems provide a scale that may interest energy service companies or third party owner/operators.
- Promotion of Geothermal Energy Applications:

Promotional activities in conjunction with the OGA should include:

1. Development of on-going training programs for designers, installers, drillers and system maintenance technologists

2. Support for regional information dissemination programs in conjunction with the OGA

- Analysis of Building Energy Loads:
    1. Opportunities to optimize the application of geothermal energy usage should be researched in order to improve the system of performance.
    2. Develop partnerships between the OGA and local governments, utilities, developers, manufacturers and installers to consider community-based geothermal energy systems when constructing planned communities.

Appendix

1 –

Geothermal Systems By Loop Type courtesy of the CGC

Ontario

Closed Vertical

14,81%

Closed

Horizontal

66,55%

Open Loop

12,54%

Pond / Lake

Loop

6,10%

#2

System Retrofits - Fuel Replaced (Ontario) courtesy of CGC

Oil

46,6%

Electricity

32,3%

Wood

1,5%

Oil + Electricity

0,4%

Oil + Wood

2,2%

Natural Gas

5,8%

Propane

11,1%

Appendix #2

NextEnergy National Headquarters Building Specifications:

☒☒25,000 sq. ft. building heated and cooled using geothermal.

☒☒Ground source loop made of 21,600 ft. of 3⁄4" GeoPipe.

☒☒100% of electric energy consumed in the building is purchased from Sky Generation, a wind turbine located on the Bruce Peninsula.

☒☒Office and warehouse have infloor heating. Piping is installed at 6" centres to allow a reduction in circulating infloor fluids at lower temperatures than conventional infloor systems to take advantage of the inherent efficiency/capacity gains of water-to-water geothermal units.

☒☒Office flooring made with pre-cast foam insulated concrete to help with infloor heating process giving an R20+ insulation value between floors, which concentrates the heat, or cooling?

☒☒Infloor heating and cooling create one of the most comfortable working environments available.

☒☒Co-efficient of Performance (COP) approaches 5 in the office and 6 in the warehouse.

☒☒Climate Master Tranquility27 heat pumps with ClimaDry reheat/passive cooling coils, allowing passive cooling on the air side along with forced dehumidification when required to control dew point. These units are located throughout the offices, usually hanging from the ceiling in the hallways.

☒☒Lighting will be provided by next generation T8 instant on, hi-efficiency lights, these lights use less energy while providing superior lighting ability. Additionally, we installed smart occupancy sensors that turn off when no one is in the room.

	Photo-voltaic	Wind Generators	GeoExchange
Capital cost	$1,400,000,000	$210,000,000	$3,556,000
kWh generated annually	438,000,000[1]	260,172,000[2]	6,297,000[3]
Cost per kWh over life of system	$0.107 (30 years)	$0.036 (20 years)	$0.001 (50 years)

☒☒Zero combustion within the building creates an offset of greenhouse gas emissions of 150 tonnes annually, or the equivalent to approximately 75 cars annually.

☒☒Insulation within the building is a combination of cellulose, fiberglass, and Styrofoam that results in an R-rating of R46 in the ceiling, R36 in the walls throughout, and R14 under infloor heating/cooling.

The system is controlled and monitored by an internet browser based computer, which will monitor, manage and display instantaneous energy produced by the geothermal loop and the wind power being consumed. The data is "live" online through an IP address and reflects the actual "real time" loads and consumption of all components in the building. The data is summarized to display on demand economics of the system to communicate the financial and environmental viability of the building.

With the thermal masses in the 300 gallon storage tanks, the concrete floors and earth loop, we have the opportunity to utilize "time of use electrical" rates by ramping down our energy consumption during high energy cost periods without adversely affecting building temperatures and occupancy comfort.

A Heat Recovery Ventilation system is incorporated that has fresh air supplied through an Earth Duct 100 feet long to temper incoming air in the winter and summer.

The warehouse floor can be used as cooling sink for office cooling loads and mixed with earth loop to optimize infloor cooling temperatures using only pump watts not compressor watts.

50% of all energy used in domestic hot water production is recycled.

Domestic hot water generated primarily by desuperheaters off geothermal units.

The warehouse has a 50' X 6' skylight and translucent loading dock doors which allow sunlight in, assisting in warming of the building, while reducing the number of lights needed during the daytime.

The building has a "weather station" that collects weather data specific to this site in real time to facilitate an on demand heat loss/gain profile to show real time energy generation from the earth loop and the wind energy consumed. This assists us in running our geothermal system as efficiently as possible.

10" pipe runs underground into building for fresh air supply, which is connected to an 85% efficient Heat Recovery Ventilator. Running the ventilator underground assists the entering air in reaching a neutral temperature.

Earth loop can operate in series with infloor to provide passive cooling combined with forced air humidity control to lower energy consumption in cooling by approximately 80%.

Appendix #3

Wood and other woody biomass (traditional biomass), used mainly for cooking and heating and in the forest products industry, accounts for over 70 percent and is by far the most important source of renewable energy. Large hydroelectric energy comes in second at 16 percent, so traditional biomass plus hydroelectric make up 88 percent of global renewable energy. Solar water heaters produce seven percent, more than wind, solar, and all the other small renewables combined. Biofuels made from corn, sugar cane and palm oil account for 1.5 percent.

Appendix #4			
Competing Residential Space-Conditioning Technologies [EIA 2007] Technology	**Rated Cooling Efficiencies**	**Rated Heating Efficiencies**	**Typical Installed Costa**
Gas-Fired Furnace	--	**Typical: 80% AFUE; 780 kWh/yr** ENERGY STAR®: 90% AFUE; 500 kWh/yr 2007 Best Available: 96% AFUE; 275 kWh/yr	**$24.00/kBtuh** $32.70/kBtuh $44.00/kBtuh
Oil-Fired Furnace	--	**Typical: 81% AFUE; 850 kWh/yr** ENERGY STAR®: 83% AFUE; 800 kWh/yr 2007 Best Available: 95% AFUE; 650 kWh/yr	**$23.80/kBtuh** $26.20/kBtuh $50.50/kBtuh

Central A/C (Air Source)	**Typical: 13 SEER** ENERGY STAR®: 14 SEER Best Available: 21 SEER	--	**$814/ton** $886/ton $1714/ton
Central Heat Pump (Air Source)	Typical: 13 SEER ENERGY STAR®: 14 SEER Best Available: 17 SEERb	**Typical: 7.7 HSPF** ENERGY STAR®: 8.2 HSPF **2007 Best Available: 10.6 HSPFb**	**$1450/ton** $1570/ton **$2300/ton**
Ground-Source Heat Pump	Typical: 16 EER ENERGY STAR®: 14.1 EER Best Available: 30 EER	**Typical: 3.4 COP** ENERGY STAR®: 3.3 COP **2007 Best Available: 5.0 COP**	**$3000/ton** $2830/ton **$5250/ton**

Appendix # 5

Table 3-2: Installed-Cost Estimates for Ground Loops Type	**Ground-Loop Installed Cost**			
	Kavanaugh 1995 (1995 dollars)		**Rafferty 2008 (2008 dollars)**	
	$/ton	**Relative Cost**	**$/ton**	**Relative Cost**
Vertical Loop	$ 2,999	1.11	$4400/ton	1.32
Slinky	$ 2,875	1.06	$4200/ton	1.26
Horizontal Loop	$ 2,712	1.00	$4000/ton	1.20
Open Loop	-----	-----	$3300/ton	1.00

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Appendix #6

Potential Benefits of Retrofitting Existing U.S. Single-Family Homes with State-of-the-Art GHP Systems at Various Market Penetration Rates

	Market penetration rate of GHP retrofit				
	Estimated national benefits				
	20%	40%	60%	80%	100%
Primary energy savings [quad BTU]	0.8	1.7	2.5	3.3	**4.2**
Percentage savings	9.0%	18.0%	27.1%	36.1%	**45.1%**
CO2 emissions reduction [MM ton]	54.3	108.7	163.0	217.3	**271.7**
Percentage savings	9.1%	18.1%	27.2%	36.2%	**45.3%**
Summer pea k electrical demand reduction [GW]	43.2	86.4	129.5	172.7	**215.9**
Percentage savings	11.2%	22.4%	33.6%	44.9%	**56.1%**
Energy expenditures savings [Billion $]	10.4	20.9	31.3	41.7	**52.2**
Percentage savings	9.6%	19.3%	28.9%	38.5%	**48.1%**

Notes: (MM ton, million metric ton).

Appendix # 7

GEO-XERGY SYSTEMS Inc.™

District geothermal energy systems

Return on Investment Compared to Other Renewable Energy Technologies

Four common types of renewable energy include:

- Wind (power generation)
- Solar (photo-voltaics)
- Biomass (power generation)
- GeoExchange systems

GeoExchange is a technology that reduces the amount of energy required to heat and cool buildings. It does not "produce" power. Wind generators and Solar Photo-voltaic panels generate electricity. It is possible to estimate the

cost effectiveness, or potential return on investment by dividing the capital cost of building a system and calculating the cost of producing one kWh of energy over the expected life of the system. The following chart shows this comparison between three large scale systems, including photo-voltaic cell system, wind generators and a geothermal system. Note that long-term maintenance costs are not included in these calculations and would have a significant impact on wind generators and photo-voltaic systems.

[1] kWh production of photovoltaic system based on full production 20% of the time (4.8 hours / day). Capital cost and energy production figures based on Southern California Edison website. Estimated life of PV cells is 30 years

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