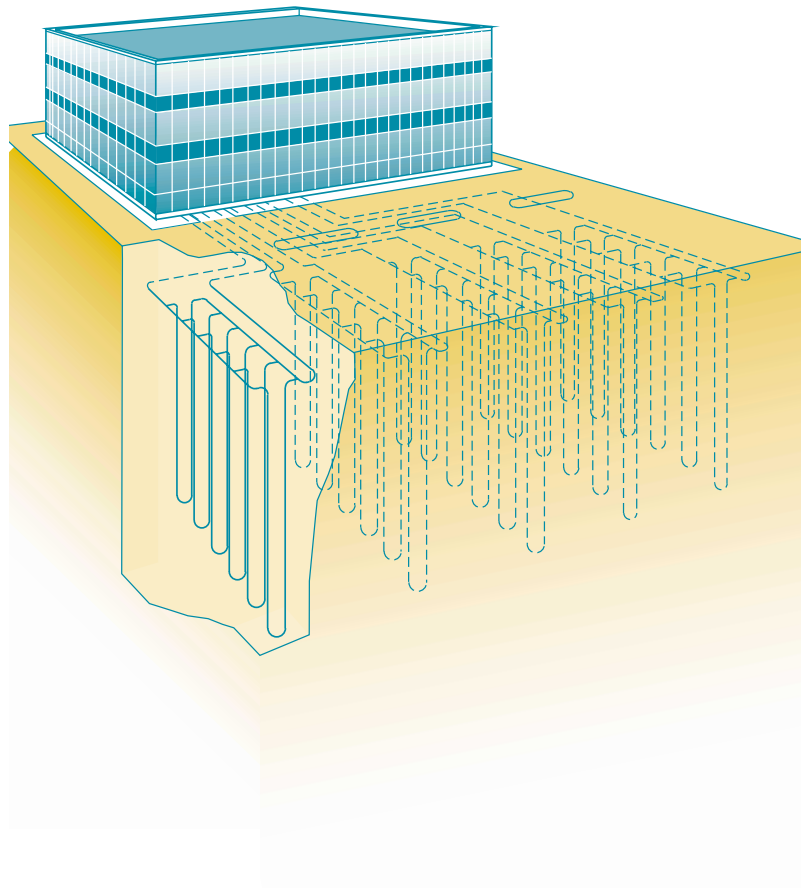




# EARTH ENERGY, GROUND-SOURCE/GEOTHERMAL HEAT PUMPS, GEOEXCHANGE<sup>SM</sup>



**NO MATTER THE NAME, THE CHOICE IS THE SAME: A COST-EFFECTIVE  
AND ENVIRONMENTALLY FRIENDLY RENEWABLE ENERGY SYSTEM**



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

## EARTH ENERGY: PART OF CANADA'S RENEWABLE ENERGY STRATEGY

In responding to the climate change challenge, the Government of Canada recognizes the importance of the role of renewable energy (earth, sun, wind, biomass and hydro) in reducing greenhouse gas (GHG) emissions. Natural Resources Canada's (NRCan's) Renewable Energy Deployment Initiative (REDI) promotes investment in renewable energy technologies for heating and cooling. Not only can renewable energy technologies contribute to the reduction of GHG emissions through the increased use of sustainable energy sources, they can also help reduce a building's energy costs.

Earth energy systems (also referred to as ground-source heat pump, GeoExchange<sup>SM</sup> or geothermal heat pump systems) are among the renewable energy systems included in the REDI program. These systems transfer solar heat from the ground to warm or cool buildings and to heat water. They are considered to be the most energy-efficient, environmentally clean and cost-effective space conditioning systems available.

In addition to REDI, a number of NRCan initiatives promote greater energy efficiency and encourage clients in Canada's commercial buildings sector to consider ground-source heat

pump technology in their retrofit and new construction projects. The Federal Buildings Initiative, the Commercial Building Incentive Program, the Energy Innovators Initiative and the C-2000 Program play a vital role in sensitizing their participants to the benefits of ground-source heat pump systems.

Not only does NRCan stimulate market demand for renewable energy systems, it reinforces the industry infrastructure to meet that demand. Together with the Earth Energy Society of Canada and other stakeholders, NRCan helps develop the Canadian market in this expanding sector by ensuring the availability of tools and resources such as RETScreen, buyers' guides, technical resources, standards for design and installation, and trained personnel.

Government-industry partnerships will lead to increased market demand and a robust industry infrastructure. They will also provide the necessary momentum to mobilize, condition and transform the Canadian market for ground-source heat pumps as a renewable energy technology.

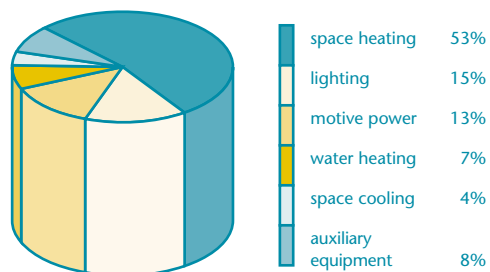
### Renewable Energy Curbs Greenhouse Gas Emissions

Canada is committed to reducing its GHG emissions by six percent from 1990 levels between 2008 and 2012. Greater use of renewable energy and increased energy efficiency are considered key to limiting GHG emissions.

### Energy Use in Commercial/Institutional Buildings: Heating Uses More Energy than Lighting

The energy used by the commercial sector accounts for about 13 percent of total energy demand in Canada and about the same amount of GHG emissions from secondary energy use. In commercial buildings, more than half the energy used is for space heating. The high demand for space conditioning means that commercial/institutional (C/I) facilities could significantly reduce their GHG emissions by using renewable energy sources instead of the carbon-intensive fuels used in conventional systems, and by using energy efficiency measures to reduce their overall energy use.

Energy Demand by End Use in Commercial/Institutional Buildings, 1997



---

## THERE IS AN OPTION: EARTH ENERGY FOR HEATING AND COOLING

Earth energy systems take advantage of the state of the Earth's steady temperature, below the frost line. A series of buried pipes transfers absorbed solar heat into a building. In winter, it is converted into warm air and distributed through ducts. In summer, the system is reversed to transfer heat out of the building, where it uses the cooler ground as a heat sink.

The system can be configured as either a closed or open loop, and the loop itself can be either horizontal or vertical. Closed-loop systems

circulate a fluid mixture within the buried pipes, while open-loop systems circulate well or surface water. Ground-source heat pumps do not create heat through combustion; they simply move solar heat from one place to another.

On average, an earth energy system has an efficiency rating or coefficient of performance (CoP) of more than three, which means that it will provide at least 3 kW of energy to condition space for every 1 kW of electrical power that is required to operate its components.

---

## EARTH ENERGY SYSTEMS LEAD TO A BETTER ENVIRONMENT AND A BETTER BOTTOM LINE

Earth energy systems provide a variety of benefits.

### *Lower Energy Use*

Because the Earth's underground temperature is being leveraged by a heat exchanger to add more heat or to absorb excess heat, earth energy systems use 25–75 percent less electricity than conventional heating or cooling systems. This adds greatly to a building's energy efficiency.

### *Lower Costs*

Earth energy systems:

- reduce maintenance and repair costs;
- extend equipment operating life, due to smaller equipment with shorter operating cycles; and
- reduce ancillary costs for transformers, etc.

Earth energy systems have a lower life-cycle cost than conventional space conditioning systems. Maintenance costs can be one-half of that of conventional systems, and operating costs can be one-quarter. The average simple payback period for an earth energy system in the C/I sector is six years.


### *Lower GHG Emissions*

Ground-source heat pumps can reduce GHG emissions by two thirds or more compared with conventional heating and cooling systems.

A school with an earth energy system consuming 40 percent less energy than a similar facility with conventional systems would prevent more than 1.7 million kg of carbon dioxide from being emitted into the atmosphere over the building's 20-year lifespan.

### *Countless Benefits from Design Features and Performance*

Without boilers and chillers, commercial buildings with ground-source heat pump systems require smaller mechanical rooms, allowing for more profitable use of space. The aesthetics of the building are improved by fewer external penetrations of the building envelope. Indoor equipment is protected from harsh weather and vandalism,

- 
- smaller mechanical rooms
  - improved building aesthetics
  - zone-specific heating and cooling
  - occupant comfort
  - a single system for space heating and cooling, plus hot water
  - increased equity

resulting in lower operating and maintenance costs. The modular design of earth energy systems permits zone-controlled heating and cooling. Enhanced indoor air quality and quieter operation increase occupant comfort. All of these features can provide landlords with a competitive leasing advantage and increase the equity value of the facility.

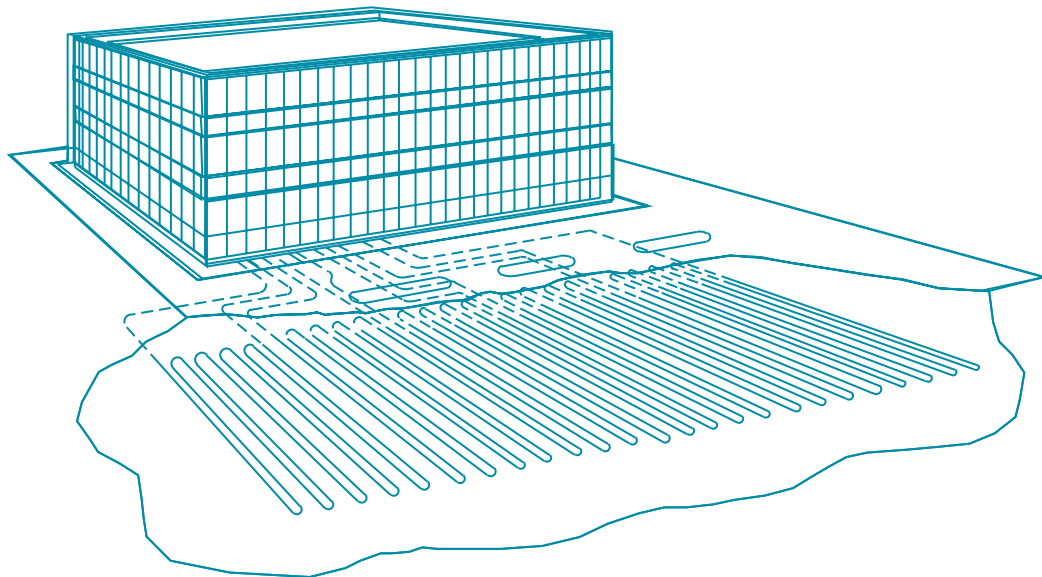
***More Local Job Opportunities***

The design and installation of an earth energy heating and cooling system calls for a range of expertise, from loop designers, drillers and equipment manufacturers to distributors, dealers and installers. Many more jobs are created in the process, which benefits the local economy.

For information on the Renewable Energy Deployment Initiative, call 1 877 722-6600 (toll-free), e-mail [redi.penser@nrcan.gc.ca](mailto:redi.penser@nrcan.gc.ca) or visit the Renewable and Electrical Energy Division Web site at [www.nrcan.gc.ca/es/erb/reed](http://www.nrcan.gc.ca/es/erb/reed).

For information on earth energy systems, contact the Earth Energy Society of Canada at (613) 230-2332, fax (613) 822-4987, e-mail [eggertson@earthenergy.ca](mailto:eggertson@earthenergy.ca), or visit its Web site at [www.earthenergy.org](http://www.earthenergy.org).

Information can also be obtained from the Geothermal Heat Pump Consortium, Inc. in Washington, DC at 1-888-ALL-4-GEO (255-4436) or on its Web site at [www.geoexchange.org](http://www.geoexchange.org).



A single efficient system can be used for both heating and cooling, eliminating the need for separate furnace and air-conditioning systems. It can also heat water at no additional cost.

---

## **NRCAN'S ENERGY EFFICIENCY OPPORTUNITIES**

REDI's market development activities complement the following NRCan initiatives to encourage energy efficiency in the C/I sector:

### ***New Construction Market***

The Commercial Building Incentive Program (CBIP) provides \$10 million a year in incentives for energy-efficient building design and construction. An incentive of up to \$80,000 is available to offset the design costs of a facility that will be at least 25 percent more energy-efficient than one designed to meet the specifications of *Canada's Model National Energy Code for Buildings*. Under CBIP's prescriptive measures for optimum energy efficiency performance in buildings, earth energy systems yield the largest energy savings of any single energy efficiency measure.

For information on CBIP call 1 877 360-5500 (toll-free), e-mail [cbip.pebc@nrcan.gc.ca](mailto:cbip.pebc@nrcan.gc.ca) or visit the CBIP Web site at <http://oee.nrcan.gc.ca/cbip>.

The C-2000 Program for Advanced Commercial Buildings is a demonstration program for high-performance office buildings. C-2000 provides incremental financial support and technical assistance to help design development teams to conform to the program's whole building, energy and environmental performance requirements.

The C-2000 Program and the Commercial Buildings Incentive Program (CBIP) are complementary. While design stage support is available through CBIP, additional financial help, as well as design facilitation and expert support for design development issues related to environmental impact reduction, indoor environment improvement and other non-energy issues, can be obtained through the C-2000 Program.

For information on the C-2000 Program, call Nils Larsson at (613) 769-1242, e-mail [nlarsson@nrcan.gc.ca](mailto:nlarsson@nrcan.gc.ca), or visit the program's Web site at [www.buildingsgroup.net](http://www.buildingsgroup.net) or the Green Buildings Information Council Web site at [www.greenbuilding.ca](http://www.greenbuilding.ca).

### ***Retrofit Market***

The Energy Innovators Initiative (EII) provides assistance and support to companies and institutional organizations that are committed to energy efficiency throughout their operations. As part of its Energy Innovators Plus program, the EII provides qualifying organizations with up to \$250,000 to help fund comprehensive pilot retrofit projects.

For further information on the EII, contact the program by fax at: (613) 947-4121, e-mail [innov.gen@nrcan.gc.ca](mailto:innov.gen@nrcan.gc.ca), or visit its Web site at <http://buildings.nrcan.gc.ca>

The Federal Buildings Initiative (FBI) provides organizational support and technical assistance to federal organizations committed to making money-saving energy efficiency improvements to their facilities. The FBI's strategy is to finance comprehensive energy-efficiency projects through outside sources of capital funds and to pay for the upgrades through the energy savings.

For further information on the FBI, contact the program by fax (613) 947-4121, by e-mail at [fbi.ibf@nrcan.gc.ca](mailto:fbi.ibf@nrcan.gc.ca), or visit its Web site at <http://oee.nrcan.gc.ca/fbi>.

## **Champions Coast to Coast**

*Earth energy systems are ideal where there is demand for both space heating and cooling during an annual cycle. Although new construction provides an easier opportunity for considering earth energy systems, comprehensive energy efficiency retrofits or retrofits requiring the addition of cooling capacity also provide opportunities that shouldn't be overlooked.*

### **Bob McMath Secondary School, Richmond, B.C.**

*A single, ground-coupled heat pump in this 14,000 m<sup>2</sup> facility with more than 1000 students saves \$11,000 in electricity costs each year. First cost savings were \$50,000 less than the benchmark design, and installation costs fell 22 percent below the government's capital budgetary allowance for schools in the province.*

### **Hockey Arena, Miami, Manitoba**

*This facility reduces its annual energy costs by almost two-thirds by combining space heating with ice making. Not only is the skating season doubled, but many of the ancillary costs of an ammonia-based cooling system, such as ventilation and safety training, are eliminated.*

### **Trustcan Realty, Toronto, Ontario**

*This downtown, three-storey office tower uses earth energy to save more than 40,000 m<sup>3</sup> of natural gas and to reduce carbon dioxide emissions by 90 tonnes a year.*

### **Biosphère, Montréal, Quebec**

*Groundwater provides space conditioning for the 4500 m<sup>2</sup> facility, saves 459 MWh of electricity and reduces carbon dioxide emissions by 86 tonnes a year.*

### **Federally Sentenced Women's Facility, Truro, Nova Scotia**

*Energy-efficient design principles and earth energy heat pumps in this federal correctional facility reduce its annual energy consumption to 1300 MJ/m<sup>2</sup> per year and save over \$8,000 annually in energy costs.*

This publication is distributed for informational purposes only and does not necessarily reflect the views of the Government of Canada nor constitute an endorsement of any commercial product or person. Neither Canada, nor its ministers, officers, employees and agents make any warranty in respect to this publication nor assume any liability arising out of this publication.

Cette publication est aussi disponible en français sous le titre :  
*Energie du sol... à bien y PENSER*

Inventory number: M27-01-1411E

