TORONTO
Facilities & Real Estate
Energy & Waste Management

Renewable Energy Case Study

Yonge Hearts Child Care Centre
Ground Source Heat Pump

Facility Profile

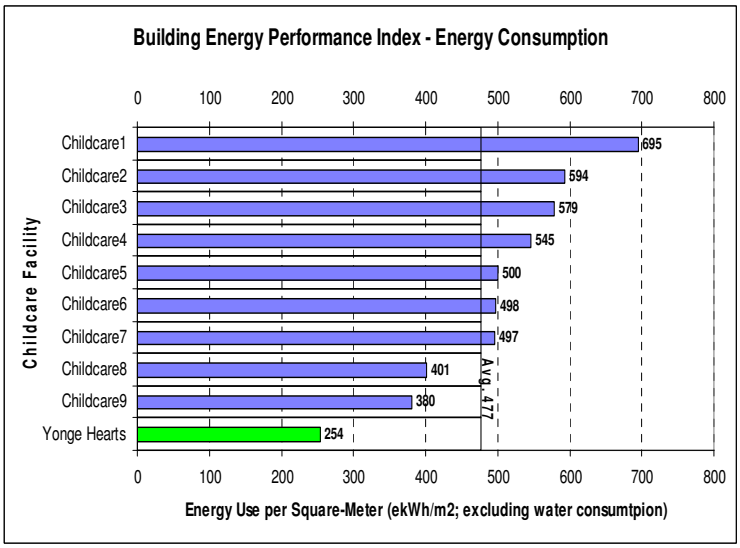
The Yonge Hearts Child Care Centre (YHCC) located at 5176 Yonge St, is the result of decade-long negotiations concerning the density of land use at properties owned by Sam-Sor Enterprises Inc. and Imperial Oil in the former City of North York. As part of that agreement, City staff secured land and approximately $3 million in funding to construct a permanent home for the YHCC, a non-profit organization serving the community and Toronto Public Service employees within the City-owned site. The newly constructed two-storey child care centre was completed in the fall of 2003, and houses about 100 children. The total floor area is 953 m^2 (10,258 ft^2)

Ground Source Heat Pump Implementation

Before the start of construction, polyethylene piping was inserted into a number of vertically bored holes in the earth under the building. Heat is removed from the earth through this piping by non-toxic antifreeze solution, upgraded by the heat pump, and transferred to indoor air. During summer months, the process is reversed: heat is extracted from indoor air and transferred to the earth through the antifreeze solution.

Project Summary	
Project completion:	Fall 2003
Estimated cost avoidance:	$10,000/yr
Simple payback of incremental cost:	5-8 years ???
Estimated renewable energy delivered:	200,000 ekWh /yr
Estimated CO_2 emission reduction:	45 tonnes/yr
Project Funding: City of Toronto, NRCan	

Other energy efficient features of the building include: energy efficient lighting, energy efficient windows, high levels of insulation and heat-recovery on the air makeup.



Benefits of Ground Source Heat Pump

- YHCC exceeds the Model National Energy Code for Buildings (MNECB) by 33.3%
- The ground source heat pump uses the earth as source of heat in the winter, and as the "sink" for heat removed from the centre in the summer. The earth beyond a certain depth is at a constant temperature of about 8 to 12 degree C and this is the source of renewable heating and cooling for the building
- The system's benefits include lower operating costs, lower on site carbon dioxide emissions, and lower maintenance costs.
- The system design improves occupant comfort by providing fresh air directly to each heat pump unit.
- Using the earth itself to heat and cool the YHCC is a perfect example of green power in action. Using green power eases demand for non-renewable energy, particularly when demand becomes crucial during hot and smoggy days.

Building Energy Performance Index (BEPI)

The BEPI is a benchmark that compares the total energy usage with other similar childcare centres in the City's EnergyCAP energy information system. The 2005 total energy consumption per square-meter of floor area for the YHCC is charted against similar childcare facilities. The BEPI for the YHCC is about half of the average (254 vs. 477 ekWh per m^2), showing that the GSHP contributes to the facility using approximately 50% less energy than the conventional system.

Natural Resources Canada | Ressources naturelles Canada

TORONTO

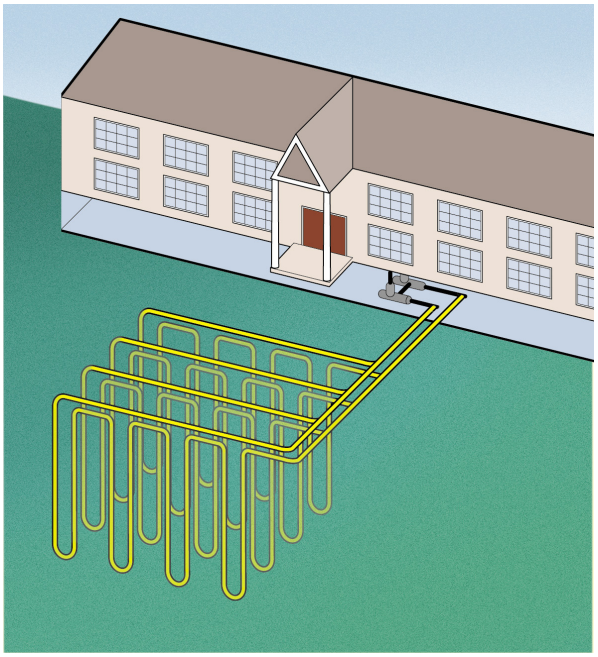
Fact Sheet

Earth Energy heats (and cools) Child Care Centre

The City of Toronto uses a Ground Source Heat Pump system (GSHP) technology to provide heating and cooling to Yonge Hearts Child Care Centre. The newly constructed two-storey child care centre was completed in the fall of 2003, and houses about 100 children. The total floor area is 953 m^2 (10,258 ft^2)
The GSHP utilizes heat from earth to provide economical and environmentally benign thermal energy to the child care centre. Solar-heated ventilation air supplements the existing natural gas heating system. The result is a reduction in fossil fuel use and the associated greenhouse gas emissions by approximately 45 tonnes a year.

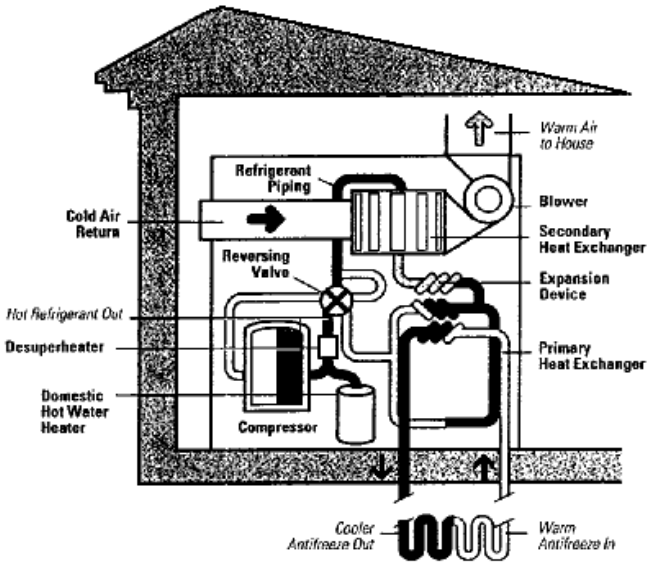
How it works.

All GSHP systems have two parts: a circuit of underground piping outside the building, and the heat pump unit inside the house.
A non-toxic antifreeze solution circulates through the underground piping and absorbs heat from the surrounding soil. Antifreeze solution is then brought back to heat pumps, inside the building. The heat is transferred to the refrigerant, which boils to become a low-temperature vapour. The antifreeze solution is pumped back out to underground piping system to be heated again.



The reversing valve directs the refrigerant vapour to the compressor. The vapour is then compressed, which reduces its volume and causes it to heat up. Finally, the reversing valve directs the now-hot gas to the condenser coil, where it gives up its heat to the air that is blowing across the coil, and through the duct system to heat the building. Refrigerant then passes through the expansion value, where its temperature and pressure are dropped further before it returns to the heat exchanger to begin the cycle again. Some designs utilize this excess heat to preheat domestic hot water, thus improving overall efficiency.

Most heat pumps have a reversing valve which allows them to cool as well as heat the building. This valve changes the flow of the fluid such that the refrigerant picks up the heat from the inside air and transfers it to antifreeze mixture. The heat is then pumped outside into underground piping. Some designs utilize this excess heat to preheat domestic hot water, thus improving overall efficiency.



How a GSHP/EES works

Benefits

Efficiency: A closed loop GSHP installation in southern Ontario will have a heating seasonal performance factor (HSPF) of 9.2 to 11.0, compared with an HSPF of 3.4 for electrical-resistance heating.
Energy Savings: Energy-cost savings compared with electric furnaces are around 65 percent.
Domestic Hot Water Heating: GSHP can reduce your water heating bill by 25 to 50 percent.
Operating Costs: usually considerably lower than those of other heating systems, because of the savings in fuel.
Environmental benefits: reduce the use of carbon-based energy and lower greenhouse emissions
Life Expectancy: 20 - 25 years.
Simple Payback of incremental cost: ranges from 5 to 12 years.

Source: NRCan brochure (2004): "Heating & Cooling with a Heat Pump", Earth Energy Society of Canada (www.earthenergy.ca)