GEOEXCHANGE

A Cleaner Alternative:

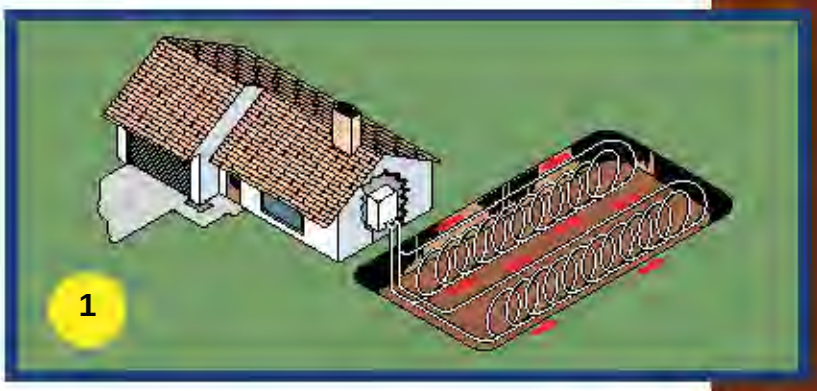
Geoexchange systems reduce reliance on fossil fuels

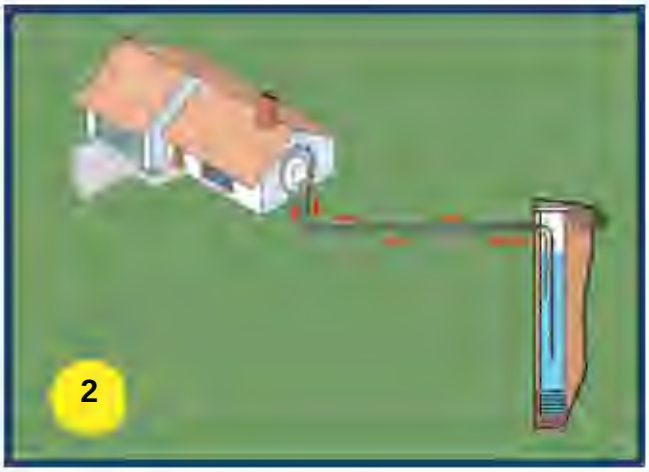
What do the jockeys at Saratoga Race Course, at least 18 public schools in New York State, and an increasing number of Manhattanites have in common? They all use an alternative clean energy system known as "geoexchange" to keep warm in the winter or cool in the summer.

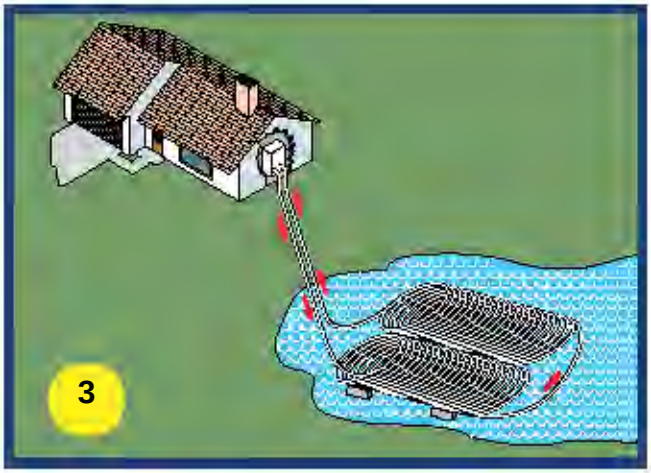
DEC chose geoexchange to heat and cool the new classroom building (right) at the Stony Kill Farm Environmental Education Center. A typical installation (inset) is about the size of a typical home heating system.

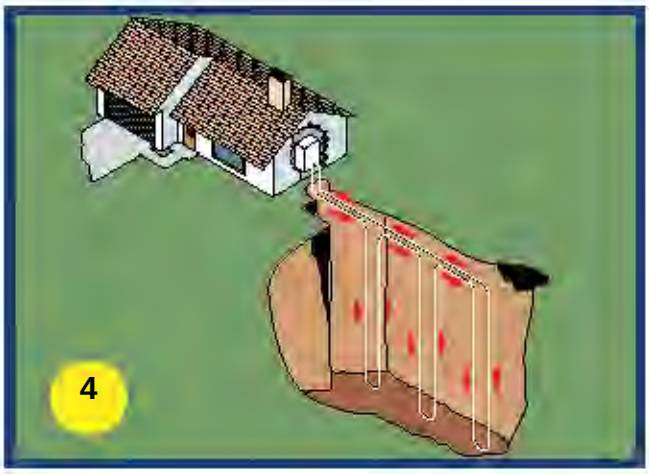
The new Center for Architecture building is one of the many sites in Manhattan making use of geoexchange technology.

by Kathleen Sanford









Types of Geoexchange Systems

1. Buried Horizontal Closed-Loop
2. Standing Column Well
3. Closed-Loop Pond System
4. Buried Vertical Closed Loop

Colleges, hotels, museums, retail establishments and homes all across New York State have used geo-exchange to reduce their reliance on fossil fuels and lower their air emissions. Staffers and visitors at some DEC facilities will also enjoy the benefits of these very efficient heating and cooling systems.

How It Works

Geoexchange is the transfer of heat back and forth between the earth and an indoor space. More and more construction projects are applying this clean energy technology for heating and air conditioning. Also called "geothermal heat pump systems" or "ground source heat pump systems," these installations consist of pipes installed beneath or next to a building called a "ground loop." When the pipes are installed vertically underground, they are placed into drilled wells which are often called "geothermal wells." These wells are commonly between 300 and 1,800 feet deep. Other systems use horizontal loops installed in shallow trenches or at the bottoms of lakes or ponds.

Fluid circulates through the pipes, creating a connection with the Earth below the frost line where the ground temperature remains at 45 to 55 degrees Fahrenheit year-round. The pipes are attached within the building to a compressor and heat exchanger, which together are about the size of a small gas furnace. During the winter, this equipment concentrates the natural thermal energy derived from the earth and sends higher temperature air into the building's indoor spaces through standard ductwork. Electricity is required to run the equipment, but no fuel is burned to create the heat.

Geoexchange isn't only for heating. When summer heat and humidity make it uncomfortable indoors, cooler fluid in the pipes draws heat from the building and deposits it back into the earth. An added benefit

during the summer is that some of this excess heat can be used to produce hot water.

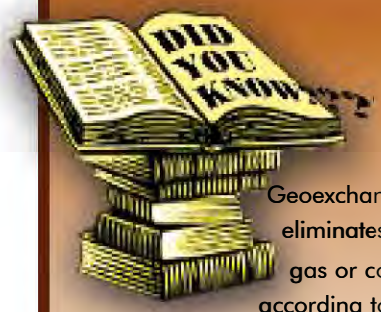
Whether to Close or Open the Loop

Geoexchange piping systems are frequently classified as "closed-loop" or "open-loop." Closed-loop systems may be vertical or horizontal, and are fully encased in pipe so that the circulating fluid does not contact soil or rock. Vertical closed-loop systems are usually less than 500 feet deep and at large facilities may involve a hundred or more wells. Closed-loop systems are most easily installed in rural or suburban settings where properties are large enough to accommodate horizontal trenches or large numbers of wells.

Open-loop systems are not fully encased in pipe, and use groundwater as the circulating fluid. When circulation takes place within a single well, the well is referred to as a "standing column." Standing column wells are typically deeper than 1,000 feet, and are the most practical well type for urban settings like Manhattan where small lot sizes make closed-loop systems impractical. Other "open-loop" systems circulate fluid by withdrawing water from one well and injecting return water into another, or discharging it. These systems require more groundwater than standing columns. Sometimes, where groundwater is of sufficient quality and quantity, a single well may be used for both water supply and geoexchange.

Protecting GrounDwater

DEC plays a role in ensuring that geothermal well construction adheres to standards and guidelines designed to protect groundwater resources and to control any fluid discharge that may be associated with well operation. Which specific permits, registrations and other requirements apply depends on the depth



Practical and Environmental Benefits of Geoexchange

Geoexchange technology eliminates the need to burn oil, gas or coal to create heat and, according to the Geothermal Heat Pump Consortium (GHPC), is 25-40 percent more efficient than other heating and cooling systems.

GEOEXCHANGE

- Saves money.
- Reduces greenhouse gas emissions. According to GHPC, installing a geoexchange system in a single-family home is equal in greenhouse gas reduction to planting an acre of trees or taking two cars off the road.
- Conserves the earth's non-renewable energy resources such as coal, oil and natural gas.
- Eliminates potentially dangerous on-site combustion or fuel handling.
- Equipment is quiet and unobtrusive. The heat exchanger and compressor are usually indoors and are similar in technology to the parts in an average refrigerator. There is no outdoor condenser or chiller and no rooftop cooling tower.
- Maintenance is easy and inexpensive.
- Eliminates exposure to harsh weather or vandalism.
- Is great for historical sites.
- Allows more creativity in new building design.

GEOTHERMAL BUT NOT GEOTHERMAL

Traditional geothermal wells tap into underground, naturally occurring reservoirs of extremely hot water or steam, in areas where you might also find volcanoes, geysers or hot springs. Geoexchange technology works in New York even though we don't have these natural phenomena. That's because all that is needed is a connection with the Earth's crust, which at shallow depths generally remains close enough to comfortable indoor temperature for efficient heat transfer.

REAL-LIFE APPLICATION

Some local heating contractors may install geothermal heat pumps as one of their services. If not, the New York State Energy Research and Development Authority (NYSERDA) or GHPC may be able to direct you to a specialist and inform you about available incentive programs. Choose a contractor who is knowledgeable about system installation, required permits and authorizations. DEC regional permit administrators and staff at the Environmental Protection Agency's Region 2 headquarters can inform you, about state and federal regulatory requirements.

Some Surprising Facts

DEC is also responsible for ensuring that natural gas and oil wells do not cause negative environmental impacts. The practices required to protect groundwater and other environmental resources during the drilling and operation of deep geothermal wells are the same as those used for oil and gas wells. The first well in New York known to be drilled deeper than 500 feet and successfully used for geoexchange was drilled in Albany in 1994. Many people are surprised to learn that oil and gas wells have been around for much longer. **Here are a few more surprising facts about oil and gas wells in New York:**

- More than 75,000 oil and gas wells have been drilled in New York since the 1820's.
- New York's first commercial oil well was drilled in Carrollton Township in 1865. Oil from 19th-century wells was used primarily for lubricant and lamp oil. Lubricants remain today as the primary product refined from New York's oil production.
- New York's first gas well was drilled in Fredonia in 1821 and was used for light. Natural gas from today's wells is used primarily for residential heating and electric power generation. Electricity from the state's grid powers most of the geoexchange systems installed in New York.
- Gas wells more than two miles deep are not uncommon, and if successful, one such well may produce enough natural gas in a year to heat 10,000 or more homes.
- During one recent year, enough gas was produced from wells in New York to heat 800,000 homes. Market value of the gas produced was estimated at $440 million. Much of this money stays in New York in the form of goods and services.

and type of the well. The Division of Water oversees registration of well drillers and pump installers for open loop and standing column systems which use wells up to 500 feet deep. The division is also responsible for administering the discharge permit program.

Geothermal wells deeper than 500 feet require extra construction-related safeguards because of the greater potential for the well to become a connection between drinkable groundwater and deeper non-drinkable water zones or hydrocarbon-bearing zones. Staff in DEC's Division of Mineral Resources apply their familiarity with drilling for oil, gas and salt to oversee the permitting program for the deeper geothermal wells. Most deep geoexchange wells drilled in New York are standing column wells.

Geoexchange IN USE

Saratoga Race Course

Construction of a new Jockey House required a quiet, unobtrusive heating and cooling system that would not detract from the park-like setting. Ten closed-loop wells, each 480 feet deep, were installed in 2000.

Newfane Central School District, Niagara County

A closed-loop geothermal heat pump system was incorporated into the design of a new elementary school in the town of Newfane. The New York State Energy Research and Development Authority reported anticipated energy cost savings of approximately $65,000 per year.

Urban Construction

An affordable housing project in Harlem, a residential/retail renovation project near South Street Seaport, the Center for Architecture and fashion designer Diane von Furstenberg's new showroom are among numerous sites in Manhattan making use of geoexchange technology. Deep standing column wells are typical. Ms. von Furstenberg's project was noted in Time Magazine's cover story on April 9, 2007.

Museum of the Earth, Ithaca

The museum, which opened in 2003, won an environmental conservation award from the Town of Ithaca in 2006. One of its environment-friendly features is a two-well standing column geoexchange system.

Sullivan County Community College

Classrooms, computer stations, offices, kitchens, libraries, and a faculty lounge are all serviced by a closed-loop system installed in 2001 which consists of more than 200 vertical wells, each 410 feet deep. An additional system was installed for two new dormitories in 2003. Enough kilowatt hours are saved each year to power more than 70 homes.

Where is DEC Using Geoexchange?

DEC chose geoexchange to heat and cool the classroom at the Stony Kill Farm Environmental Education Center. The building uses a closed-loop system, comprised of four vertical wells that are each 400 feet deep. Because of its environmental and cost benefits, DEC plans to use this technology for any future building or renovation projects where it is feasible.

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Editor's Note: "Geoexchange" is a registered trademark of the US-based industry association, Geothermal Heat Pump Consortium.