Geothermal Heating and Cooling

Geothermal energy also sometimes called ground source heat pumps, or thermal heating utilizes the fact that the upper 10 feet of the Earth's crust maintains a constant 50-60°F.

This constant temperature allows this resource to be utilized almost anywhere.

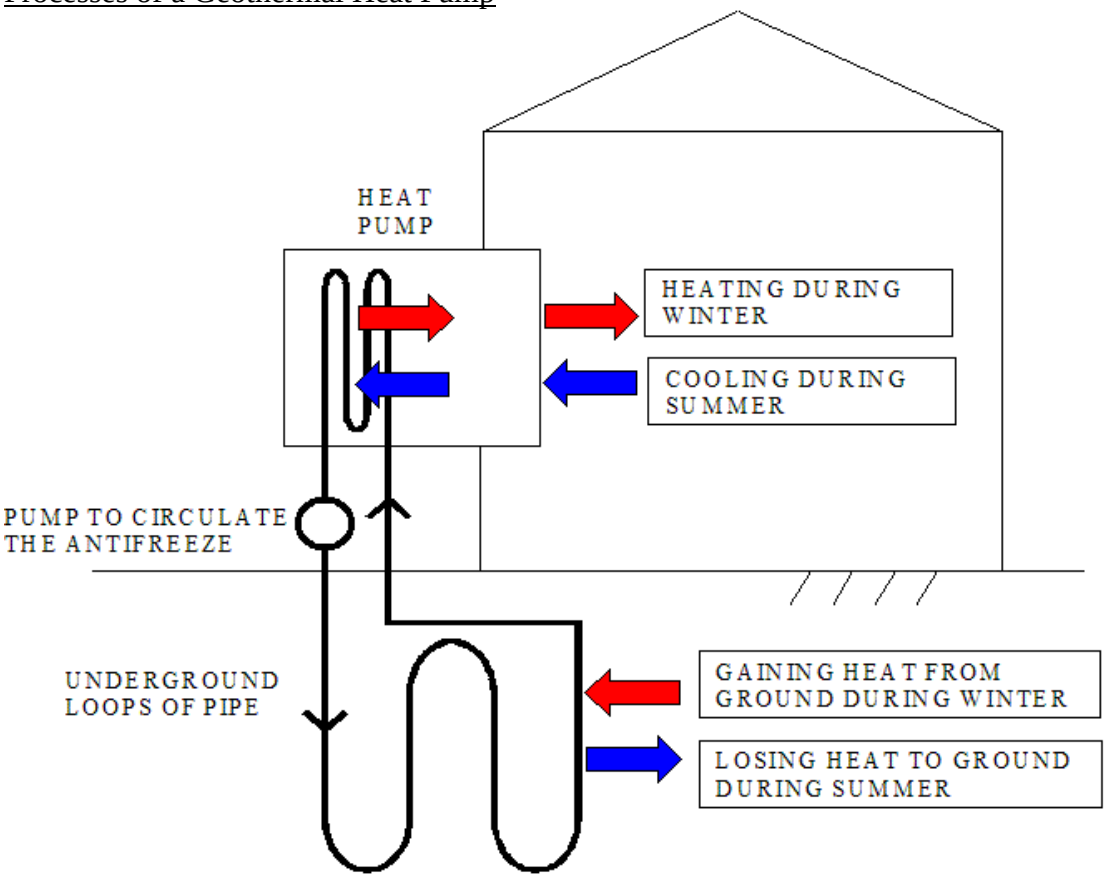
The most common method of employing geothermal energy is through a geothermal heat pump.

Geothermal Heat Pumps

Consist of 3 parts:
The heat exchanger
The heat pump unit
The air delivery system using ductwork

-The systems also require a medium of exchange usually water or an antifreeze like liquid.

Processes of a Geothermal Heat Pump



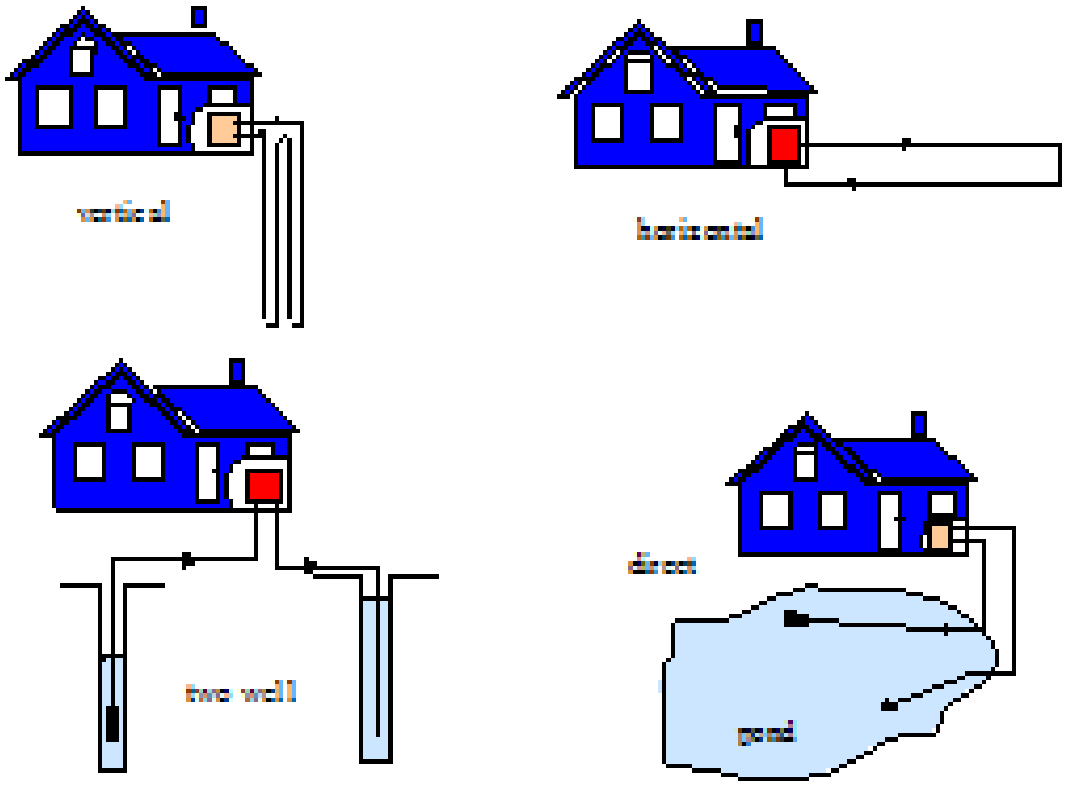
www.newenergydirection.com

Cooling:
The way a geothermal heat pump works is that during the summer when you want to use the system for cooling purposes, the system pumps the hot air in your house out to the ground via the exchanger. This effectively removes the desired amount of heat from one's house thus cooling it down.

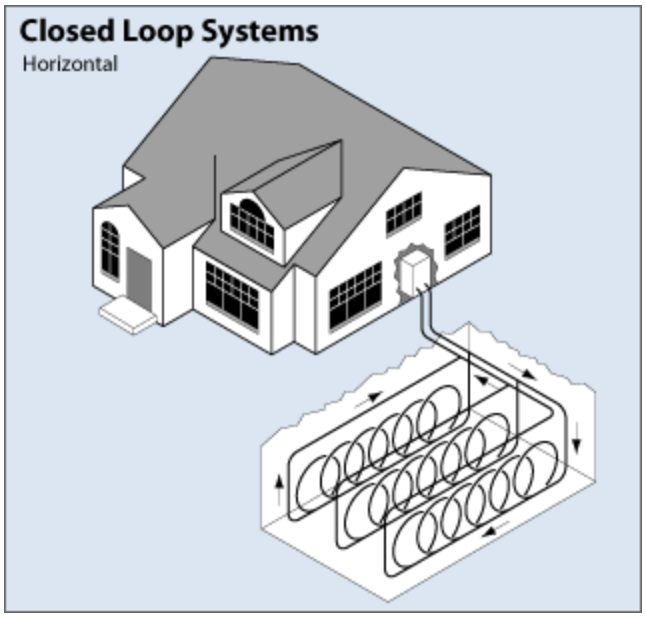
Heating:
During the winter time when you want to use the system to heat your house, you would move heat from the ground to your house via the heat exchanger, effectively warming your house.

Hot Water Heating:
The heat pump can also serve as a hot water heater by transferring the heat from the exchanger to the water tank, particularly during the summer time.

Types



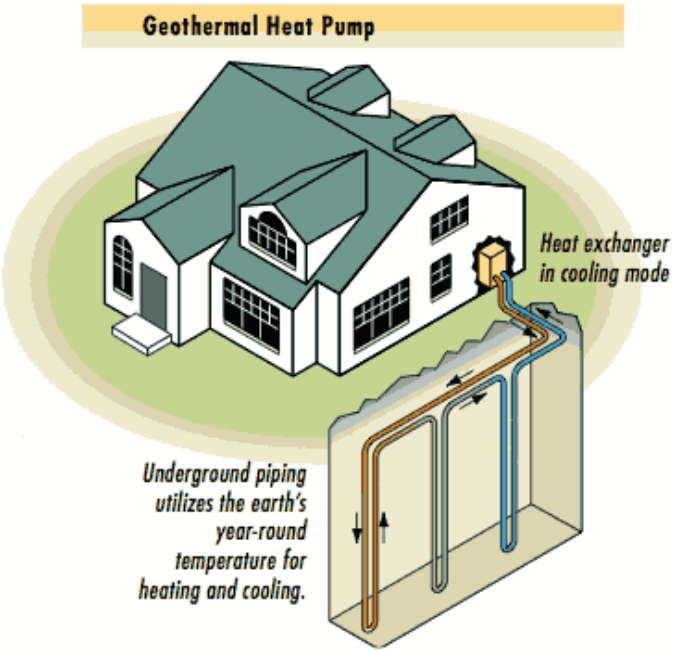
www.geo-energy.org



energysavers.gov

Closed Loop:

Horizontal- The most common type for residential systems especially newly constructed homes that have more space is the horizontal closed loop system where the ductwork or piping is aligned horizontally. The two pipe method requires one pipe to be buried at 6 feet, with the other pipe at 4 feet and usually 10-20 feet out from the building. The Slinky method shown in the picture above uses coiled piping that reduces the size required for the system and allows it to be closer to the building. Tanglewood Nature Center uses a copper piping design with tubes branching out from 3 circular devices using antifreeze fluids located right outside of their main building.
http://www.tanglewoodnaturecenter.com/resources/Documents/Tanglewood_History.pdf

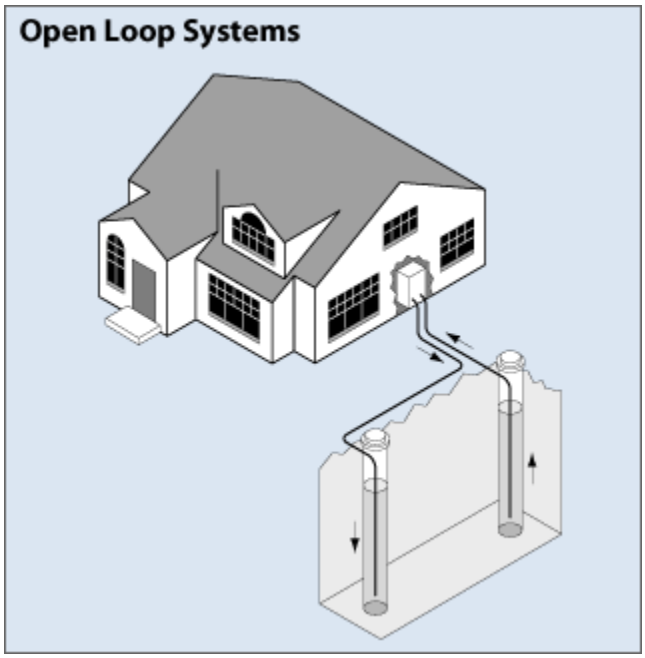


http://home.ltgovernors.com/geothermal-heat-pumps-make-sense-for-homeowners.html

Vertical – uses the same principle as the horizontal method except that the duct and pipes are arranged vertically. This method is often used by commercial buildings and schools where due to space limitations they can only go down. Holes are normally dug about 20 feet apart and 100-400 feet deep.

www.earthrivergeo.com

Lake/pond Source- This option though site specific can be a very low cost option, where a supply line in run underground from the building to the water source and is often coiled at least 8 feet below the surface to prevent freezing. Cornell University in Ithaca, NY uses Lake Source Cooling to provide all of the cooling needs of the campus.



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Open Loop System- this system uses well or ground water as the heat exchange fluid that circulates through the system. Once through the system the water returns through the ground well, a recharge well or surface discharge.

Benefits of using Geothermal Energy

-Since you are effectively moving heat from the ground to your house and vice versa, the system uses very little energy because there is no creation of energy.

-Can be used for heating, cooling, and water heating

-Reduces electricity usage, but you still have to back-up the system to power the compressor.

-Saves money due to reduced heating/cooling costs
-Reduced emissions due to elimination of fossil fuel use

-Durability- geothermal heat pumps have a rated lifetime of 50 years, with the compressor/ heat exchanger being the only part that will require maintenance.

Financial Incentives

New York State

Energy Conservation Improvements Property Tax Exemption
-provides for a 100% property tax exemption caused by the addition of the geothermal system.

Home Performance with Energy Star State Loan Program
-provides loans for up to 100% of the cost of the system. Normally provides $3,000-25,000, or $13,000 maximum for projects with a payback period longer than 15 years.

Residential Loan Fund
-provides low interest rate loans (up to 4% below the lender rates for 10 years) to help finance the installation of heat pumps. Maximum incentive is $20,000.

Existing Facilities Program
-applies mostly to commercial and industrial buildings but also to agricultural operations. Provides $0.12/kwh for the energy saved by using a geothermal heat pump.

Federal

US Dept. of Treasury Renewable Energy Grants
-only applicable to the commercial, industrial, and agricultural sectors. Provides up to 30% of the cost of installing a geothermal heat pump.

USDA REAP Grants
-mostly for schools, commercial/government buildings, but also for agricultural buildings as well. Provides up to 25% of the project cost.

Residential Energy Efficiency Tax Credit
-For purchases made in 2011, a $500 maximum tax credit. For purchases made in 2009-2010, up to $1500 in rebates.

Residential Renewable Energy Tax Credit
-For heat pumps installed after 2008 no maximum amount, for installations in 2008 up to $2000 in credits.

Costs
Note: Make sure to contact a licensed Geothermal Installer for a more precise estimate on cost pertaining to the specific building and location factors NOT a general contractor.
-Important to note that heating/cooling costs from using a geothermal system are not volatile like fuel oil or propane prices are. They generally remain fixed over the lifetime of the project.
-Payback period traditionally is between 3-7 years.

-Assuming that heating and cooling costs are reduced by 70% (though many times they are eliminated altogether)
-Savings of hot water heating =$500

For example: 4 ton vertical system for a 2000 ft^2, raised ranch home with no basement in Steuben County.

System cost+ installation= $27,500
Average monthly heating bill=$330
Average monthly cooling bill=$13
Average cost per year heating + cooling= $4116

Savings
Gov't REC= 30% (25,000) =$7500
Savings of hot water heating =$500
Reduced energy costs= $2881.20
Average yearly savings= $3381.20
Payback period= capital costs-savings

= 5.9 years

Compiled by: Greg Gronski, Alternative Energy Research Assistant
Data taken from:
http://www.nrel.gov/learning/re_geo_heat_pumps.html
http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12650
http://www.dsireusa.org/incentives/index.cfm?state=us
http://www.usa.com/steuben-county-ny-weather.htm
http://www.moravecgeothermal.com/installations