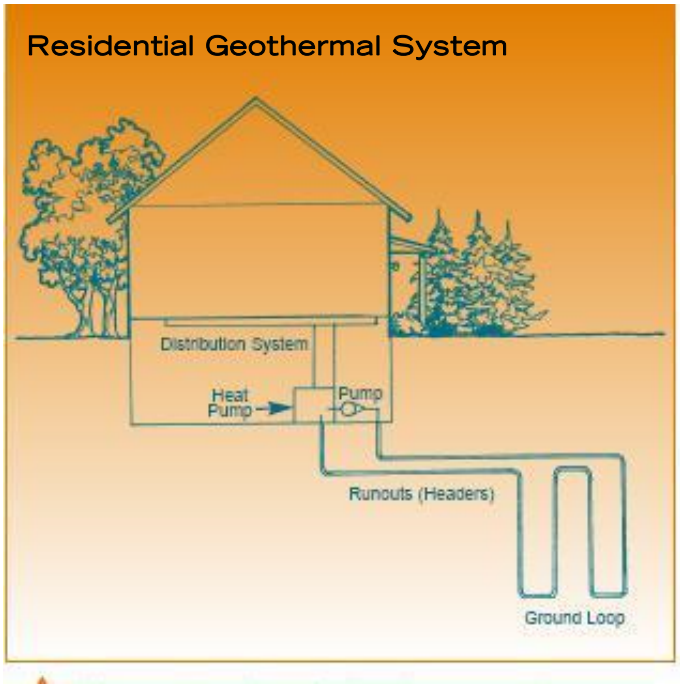
THE SKINNY

Geothermal Systems

Keeping your home comfortable throughout seasonal temperature swings outside necessitates expensive and sometimes inefficient heating and air conditioning systems. But, only a few feet down in the ground, the temperature remains relatively constant at around 50 to 59ºF. Geothermal systems use the earth s constant temperature to regulate indoor air temperature across all seasons using an underground piping system. Homes can both be cooled in the summer and heated in the winter with the same system. With some systems delivering heating efficiencies of 300 to 600%, geothermal can lower monthly energy bills by two-thirds, and like other forms of renewable energy, geothermal cooling and heating offsets greenhouse gas emissions and air pollution because they do not rely on fossil fuels.

How does Geothermal work?

Most geothermal (also known as geo-exchange or ground source heat pump) systems are closed-loop systems composed of large areas of underground piping, a heat exchanger and ductwork in the building. Heating and cooling with geothermal is a simple process; a length of tough polyethylene pipe, installed underground, is filled with a mixture of water and antifreeze that helps facilitate heat transfer. In the winter, the fluid gains heat from the constant, warm ground temperature as it circulates through the pipes and transfers it into the air or water used to heat the building. In the summer the process reverses and the fluid pulls heat out of the building and deposits it into the ground. It does not matter whether the house is heated using hot air or hot water and cooled using cool air or cool water. The process works just the same.



Geothermal systems are most cost effective when they are integrated into the design and installed during the construction of a new home. But, retrofits can also work well and geothermal can be integrated into most home heating and cooling systems, or can replace an existing furnace or boiler system.

The three most common geothermal systems are all closed-loop, meaning there is no direct interaction between the heat exchange liquid and the earth; heat-exchange takes place through the piping. The major differences between the types of closed loop systems involve how their piping is installed.

Horizontal Installation - Where sufficient land is available, piping is buried horizontally, parallel to the building. Typically, two pipes are buried at four feet and six feet underground. Alternatively, both pipes may be buried together at five feet and coiled in The Slinky approach. Horizontal installation is the most cost effective, especially for new construction, but may disrupt vegetation and can only be used where enough land is available.

Vertical Installation - If land is limited or landscaping and vegetation must be protected; vertical installation may be a better choice. Instead of running piping in a horizontal underground trench, it is inserted into four-inch vertical holes, drilled 100 to 400 feet deep.

Pond/Lake If the home is near a lake or pond, piping can be placed in the water instead of buried in under the ground. Although water temperature can be colder in winter or hotter in the summer than the constant ground temperature, lake loops still work well because water s high conductivity compensates for the cool or warm temperature. Lake loops are simple and relatively inexpensive. Piping needs to meet certain volume, depth and quality criteria to prevent freezing and ensure proper exchange conditions.

Geothermal benefits

Even though they are more expensive to install than traditional heating and cooling systems, a geothermal system can save you between 25% and 80% on heating and cooling bills, depending on the fuel source it replaces. Like most renewable energy systems, lower monthly energy costs will offset the initial cost of a geothermal system over time, especially in new construction. Even a retrofit geothermal system can pay for itself in two to ten years. With better efficiencies than traditional forced-air heating, geothermal pumps reduce pollution, offset greenhouse gas emissions and help to lessen our dependence on foreign energy sources. Geothermal systems are also quieter than traditional heating and cooling methods, last longer and require less maintenance. Once the loop is in position it is very difficult to modify but a well designed and installed loop should never fail. And because most of the equipment is buried underground, geothermal systems require less mechanical room space than traditional HVAC equipment.

According to the Environmental Protection Agency, geothermal systems can reduce energy consumption and corresponding emissions by up to 44% compared to air-source heat pumps and up to 72% compared to electric resistance heating with standard air-conditioning equipment. There are now over one million geothermal systems currently being used in the US, and the proportion of home and business owners using geothermal is growing. Systems in use today eliminate the equivalent of 5.8 million metric tons of carbon dioxide annually, which is equivalent to taking nearly 1.3 million cars off the road, or planting 385 million trees.

Geothermal Costs & Savings

A geothermal system installed during construction for a 2500 square foot house can cost about $18,000 (adds 2-4% to the total cost of new construction). A retrofit system may cost up to $22,000.

Geothermal heat pumps are eligible for a Federal tax credit of $300 through 2008.

Energy Savings

Compared to heating with propane or electric, a geothermal system save 60-80% annually on heating & cooling costs and result in a payback of 4 to 6 years.

Compared to natural gas, a geothermal system will save 25-40% annually and achieve a payback of 10 to 15 years.

How do I determine the right system for my home?

Whether you have traditional forced-air or hydronic heating, geothermal systems are a great option for home heating and cooling. They can even generate hot water for domestic use.

Traditional forced-air heaters can be supplanted by a geothermal system with a water-to-air heat pump. Water-to-water heat pumps can be used where hydronic or radiant floor heating has been installed. A hybrid system can produce hot water and heat for homes that use both heating methods. Homeowners looking to also use their geothermal pumps to heat domestic water supply only need install a desuperheater, a devise that recycles the waste heat from the heat pump s compressor to heat domestic water.

Once you have determined the type of pump needed for your system, the next step is to right-size the piping and volume requirement to your house size. Properly sized systems ensure efficiency and proper heating and cooling. Capacity for geothermal systems is measured in tons; a typical household system uses a 3-ton setup. However, home size, heating and cooling needs, local hydrology, geology and land availability ultimately will determine the right size for your specific home. The best way to start is to seek the help of an experienced local contractor.

Learn More

Geothermal Heat Pump Consortium: www.geoexchange.org

U.S. Department of Energy: Energy Efficiency and Renewable Energy: www1.eere.energy.gov/geothermal/

Energy Star: www.energystar.gov

The Center for ReSource Conservation

The CRC offers assistance to homeowners and businesses on improving the energy efficiency of their homes and buildings, including **classes and training seminars**, **information resources**, a **contractor referral network** and **a low cost residential energy audit program**.