# Home Geothermal Heat Pump

Do you want to conserve energy and save money on both heating and cooling your home? Well, the answer is not only right under your nose, it may be right under your feet!

Below the frost line a few feet you'll find the ground is an average temperature of about 55 degrees F. The heat comes from a layer of hot melted rock deep in the earth’s crust called magma. Magma can reach temperatures of 2400 degrees F and as this heat radiates up, depending on geographic latitude, ground temperatures can vary from between 45°F to 75°F. This creates a nice reliable and sustainable source of heat that can be harnessed for our heating and [home cooling](https://www.thespruce.com/repair-a-central-air-conditioning-system-1824750) needs.

This constant temperature of the earth is used in a geothermal or ground source heat pump. As opposed to a furnace that burns natural gas or oil to produce heat in winter, the geothermal heat pump concentrates the heat that is in the ground just below the surface. Geothermal can not only be used to heat and cool our home but to heat our domestic water too.

How a Geothermal System Works

So how does this magic happen? Well, it’s really pretty simple. The geothermal system is a [heat pump](https://www.thespruce.com/central-air-conditioning-maintenance-1824760) that uses the earth as a heat sink (summer) or a heat source (winter).

A geothermal system will use a series of pipes (buried below the frost line in the ground) which is called a loop. Pipes in the loop are most commonly made of plastic and filled with a water and antifreeze solution. A pump circulates the water solution to the heat pump inside the home. There a compressor and heat exchanger use the nominal 55-degree water to either heat or cool the home.

In the winter the air (e.g., 10 degrees F) is colder than the earth’s temperature underground (e.g., 55 degrees F). The geothermal system circulates the water solution through the ground loop and absorbs the heat from the earth. The nominal 55-degree water is brought to the heat pump or furnace to be heated further as needed and then distributed by ductwork throughout the home.

In summer the air (e.g., 90 degrees F) is hotter than the 55 degrees F underground. Here, the geothermal heat exchanger absorbs heat in the home and the system circulates the water solution through the ground loop to cool it off, dumping the heat into the ground. The cool water is then used by the heat exchanger and distributed by ductwork throughout the home to cool the house.

Costs and Characteristics of Geothermal Systems

* Geothermal is a very energy-efficient heating and cooling ground source heat pump system with utility savings over [conventional gas forced air systems](https://www.thespruce.com/gas-furnace-repair-and-troubleshooting-1824770) and air sourced heat pumps of between 25 and 50 percent.
* Payback is between 5 to 10 years but much shorter if being compared to an all-electric resistance heating and cooling option where geothermal can use up to 75 percent less electric energy.
* As of January 01, 2017 geothermal is only eligible for a [$300 Federal tax credit](https://www.energystar.gov/about/federal_tax_credits/air_source_heat_pumps)if the heat pump system meets DOE Energy Star SEER and COP standards. Previous tax credits ended December 31, 2016.
* Geothermal may in some cases be retrofit to an existing furnace with an air handler. You can also find geothermal heat pumps that have their own integrated air handler. If your house has [hot water baseboard heat](https://www.thespruce.com/types-of-home-heating-systems-1824772) it can also be retrofit with a geothermal system.

Types of Geothermal Systems

Ground loop geothermal heat pump systems are most commonly installed as a closed-loop system. That means the fluid in the loop is constantly recirculated. Open-loop systems are less common and use a ground well, lake, river or other surface water as the fluid for the heat exchanger. The water is then dumped back into the ground or into the water body after use.

Closed-loop systems are typically installed as a horizontal loop, vertical loop or water body systems. Waterbody systems use surface water bodies as the constant source of heat as opposed to the ground. Let’s review these three different methods.

Horizontal loop: Horizontal loop systems are the most economical to install but one of their drawbacks is the amount of land required to install the horizontal ground loops. A geothermal system may require 1,500 to 3,000 linear feet of pipe or more depending on house size and loads. If you have the required land available the most common residential method is to either install two pipes side by side in a five-foot deep trench or one pipe run in a six-foot deep trench and the other in a four-foot deep trench.

A third method can be used where the required land for longer runs of pipe is not readily available. That method loops or coils the pipe in deeper short trenches. This allows the required surface contact with the soil but in less horizontal trench length.

Vertical loop: The vertical looped system is used in situations where required land is tight or soils are not conducive to trenching. More expensive than the horizontal system to install, the vertical system uses a series of drilled holes. The holes are nominally 4” in diameter and spaced around 20 apart. Depths depend on the system design and soils but can range from 100 to 400 feet deep. The pipes are fed down and back up each drilled hole to and connected by a trenched manifold pipe across the top that connects the system to the heat pump in the house.

Water body: Another less common method of capturing ground heat is to use a close-by water body like a pond or lake. With this method, the plastic pipe runs from the heat pump to the water body and is placed in coils 8 to 10 feet under the water surface. The water body has to be of an adequate size to support the geothermal heat loads and have the proper depth. Coordination with and approval by local and state agencies is often required.

Costs of a Geothermal System

The cost of installing a geothermal system will vary by the type of loop system used and the size of the geothermal system itself. Costs for a horizontal ground loop geothermal system is about $2,700.00 per ton in 2017 dollars. If you opt for a vertical loop system the cost will increase significantly as the drilling costs could be $30,000 to $40,000 or more depending on soils, site access and size of the system.

In the right application geothermal can be a cost-effective and environmentally sensitive solution for [home heating](https://www.thespruce.com/options-for-heating-your-home-1908017) and cooling. It’s worth a look, especially when the answer is right under your feet.

From: https://www.thespruce.com/geothermal-heat-pumps-4125664