# Ground-source Heat Pumps

With superior efficiency, these systems draw from the earth's temperature underground to heat and cool interior spaces.

*By Barbara Baird*

They are called ground-source, geoexhange, earth-coupled, ground-water, ground-water assisted, ground-water-source or water-to-water. But don't let the variety of names pertaining to geothermal systems confuse you because it's all the same idea. It's all about using an environmentally friendly, efficient type of heat pump to acquire the earth's energy and transfer it into your living and working spaces.

## Why go ground-source?

People choose ground-source heat pumps (GSHPs) to save energy dollars. Other pluses include the environmentally friendly nature of the system—emitting no pollutants onsite—along with a long warranty and quick and quiet delivery of hot or cool air. Since the compressor is installed inside the house and makes the same amount of noise as a refrigerator, there is no noisy outside unit to care for or disturb the peace and quiet.

> According to the Environmental Protection Agency, GSHPs generate no onsite emissions and **have the lowest emissions among all heating and cooling technologies.**

Gary Heavin of Doolittle, Mo., says, "We have 3,600 square feet on one level and I can conservatively say that our ground-source heat pump has saved us $200-$250 per month or more."

His neighbor over in Rolla, Mo., Bill Franklin, has owned two houses with GSHPs in the past 16 years and wouldn't be without one. He says, "The reasons I like ground-source heat pumps are because there aren't a lot of maintenance expenses and my utility bills, on a building of 8,000 square feet maintaining 68 to 70 degrees, run about $212 per month on average."

## How does it work?

The earth stores 47 percent of the energy it receives from the sun. A ground-source heat pump uses this heat as its exchange medium, as opposed to extracting heat from the outside air that standard air-to-air heating/cooling systems use.

Ground-source heat pumps can be fashioned with closed loops or open loops—depending on the amount of land available, water supply and types of soil and rock at the site. The loops, made of polyethylene piping (the same type used for cross-country natural gas lines), do not easily degrade or corrode and can be expected to last for 50 years or more. The loops can be installed vertically, horizontally or in a pond or lake.

In the winter, the fluid traps the heat from the earth and transports the heat into a building. In the summer, the system reverses and pulls heat from the building and deposits the heat in the ground.

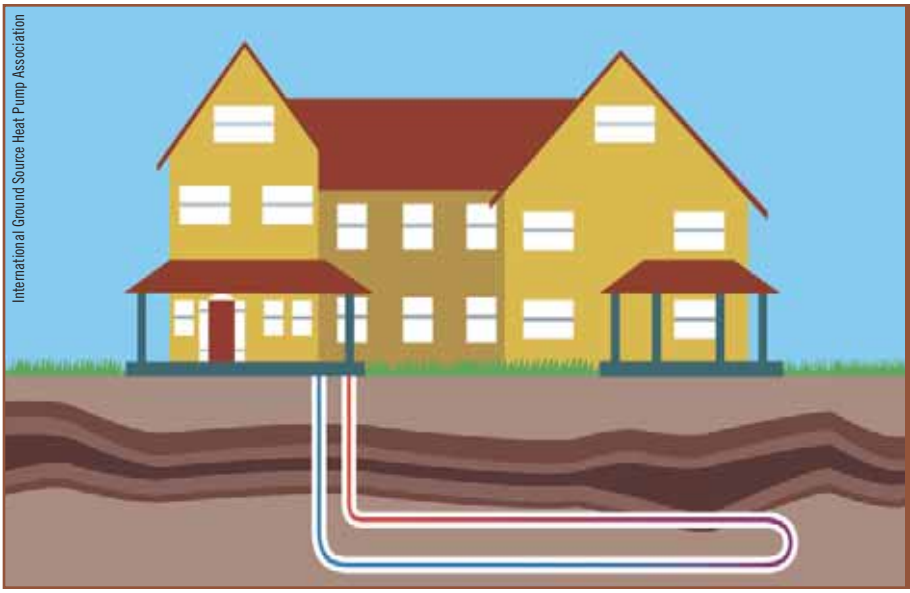
Another advantage to using a ground-source heat pump is that most can be designed with a device— called a desuperheater—that heats water. The desuperheater works best in the summer when excess heat taken from the building is circulated through the water heater before being taken outside. Most homeowners with GSHPs report their water heaters rarely run in the summer months.

## Closed loop systems

The closed loop system is the standard in the industry and comes in horizontal, vertical and slinky coil configurations. In all cases, a loop of piping gets buried. Then either water or antifreeze solution is placed into the pipes and circulated. The most common solutions are propylene glycol, a non-toxic fluid used in food-processing refrigeration, and methanol, similar to antifreeze solution such as found in windshield washer liquids.

A horizontal geothermal ground loop system is the preferred method for good soil or clay in mild climates. Heavy equipment must first dig a 400- to 600-foot-long trench, 5 to 6 feet deep, depending on how many tons of heating/cooling is needed onsite.

A vertical geothermal ground loop system works in extreme climates or where there's rocky terrain or limited ground space. A rig drills holes ranging from 150 to




## How it works

The diagram shows conventional, horizontal closed-loop ground-source heat pump piping. Fluid in the pipe draws warm air stored in the earth and transports it to help heat the house in winter. In summer, the fluid draws warm air from inside the house and deposits it underground, sending cooling temperatures back into the house. The exchange equipment is located indoors.

300 feet deep. Then hairpin shaped loops get dropped into each hole and grouted into place. An average vertical ground loop needs 300 to 600 feet of piping per ton of heating/cooling. This system is more expensive than the horizontal system, but typically cheaper than drilling for water. It requires less piping than a horizontal system because it uses the earth's temperature at depth more than the horizontal system does.

Slinky coil geothermal ground loops use overlapped loops of piping laid horizontally in the bottom of a long trench. Typically these trenches measure from one-third to two-thirds shorter in overall length than their traditional horizontal cousins.

Geothermal pond loops require at least a half acre by 8-foot-deep pond or lake. Coils of pipe are placed in the bottom of the water and a horizontal trench is dug to transfer the loop to the building.

## Open loop system

Fresh water from a well or pond runs through the piping of an open loop system, so it requires clean water and a runoff area. Double well designs can work fine. The use of this type of system is not allowed in some areas because of water quality and runoff issues. These systems are also referred to as "pump and dump" systems.

## What's the cost comparison?

Installing a ground-source heat pump is expensive—from $10,000 to $18,000, almost twice what it costs for a conventional air-source electric heat pump. People get them because of the energy savings over a long term, from 5 to 10 years (longer if energy prices continue to rise). A system's life is estimated at 25 years for the inside components and 50-plus years for the ground loop.

## Where to find contractors

The contractor should be certified by the International Ground Source Heat Pump Association (IGSHPA) and should have references from satisfied customers. Check the association's Web site at: www.igshpa.okstate.edu.

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## A Haywood County residence

When he built his house in Haywood County three years ago, Ken Thomas installed an open loop geothermal heat pump system with pipes running from his water well to a pressure tank, then through the house and ending in a creek on his 3-acre property. He had determined that his 290-foot well could deliver 40 gallons per minute, which more than twice what you'd typically need for such a system. He heats and cools his 2,100-square-foot house for between $60 and $80 per month, using a programmable thermostat. He keeps the place at 72 degrees in winter and 68 in summer, and he has no auxiliary heating system. Summer cooling costs less than winter heating in this mountain country. The water in his system maintains a year-round temperature of about 52 degrees.

"I am amazed at the savings," says Ken, who is the marketing and communications manager at Haywood Electric Membership Corp. He estimates he's paying about 65 percent less than he was in his previous house built in 1979 with an air-source heat pump.

## A Randolph County office building

Randolph Electric Membership Corp., the cooperative based in Asheboro, incorporated a ground-source heat pump system into its 21,060 square-foot contemporary office building when it was built in 1995. And 13 years later, the system still works like a charm, has required very little maintenance, and has saved the cooperative in energy costs.

A good example of a commercial-sized system, Randolph EMC installed 17 water-source heat pumps working from 80 grouted wells. It is a closed-loop system, with piping running horizontally in a field five feet underneath a parking lot. The pipes circulate water that maintains a year-round temperature of 68 degrees, effectively preheating the building internal space so the heat pump equipment does not have to work hard to get the space cooled in summer and warmed in winter. Unlike conventional air-source heat pumps, the ground-source equipment is housed indoors, increasing its life.

Joe Millkan, owner of Superior Mechanical Inc. of Randleman, was involved in the system's installation and has maintained it. "It has been pretty much maintenance-free," he said.

*—Michael E.C. Gery*