Geothermal heating/cooling has been named "the most energy-efficient and environmentally sensitive of all space conditioning systems", by the Environmental Protection Agency.

The application of geothermal heating/cooling is also known as ground source heat pumps

What is a ground source heat pump?

Ground source heat pumps (GSHPs) are electrically powered systems that tap the stored energy of the greatest solar collector in existence: earth.

- These systems use the earth's relatively constant temperature, approximately 55°, to provide heating, cooling, and hot water for homes and commercial buildings.
- By tapping this steady flow of heat from the earth in the winter, and displacing heat in the earth in the summer, **a geothermal heat pump can save homeowners 40% to 70% in heating costs and 30% to 50% in cooling costs compared to conventional systems.**

- Ground source heat pumps work in a similar manner as air source heat pumps, minus the high cost.
  - **A typical household can save $1500 a year or more.** This can give most systems a payback period of three to five years.
  - **GSHP's are more than three times as efficient as the most efficient fossil fuel furnace.**
  - By moving heat that already exists in the earth, instead of burning a combustible fuel, **GSHP's can deliver up to five units of energy for every one unit used** to power the heat-pump system.

Ground source heat pumps can be categorized as having closed or open loops, and those loops can be laid out in different orientations, depending on the situation.

- A closed loop system can be laid out either vertically in 50 -250 foot deep holes drilled like a well, or horizontally in 3-6 foot deep trenches.
- The open loop system circulates a constant source of ground water and dispels the water back to its origin, such as a stream, well, or pond.

- During the winter, the fluid collects heat from the earth and carries it through the system and into the building. During the summer, the system reverses itself to cool the building by pulling heat from the building, carrying it through the system and placing it in the ground.
  - This process creates **free hot water** in the summer and delivers substantial hot water savings in the winter.

The type chosen depends on the available land areas and the soil and rock type at the installation site. These factors will help determine the most economical choice for installation of the ground loop.

More Benefits:

- While GSHP's require a small amount of electricity to concentrate the energy and circulate it through the system, most systems derive approximately 70% of their energy from a clean, renewable source- the earth.
- All components of the unit are housed inside the building reducing the wear and tear on the unit by Mother Nature and eliminating the fear of vandalism or theft.

The principle action of a heat pump moves heat from lower temperature location to a higher temperature location. This principle can be witnessed in an air conditioning window unit, or air source heat pump, where cold air is blown into the house and warm air is released out of the back of the unit. A ground source heat pump works in a similar manner, except that its heat source is the warmth of the earth. The process of elevating low-temperature heat to over 100 degrees F and transferring it indoors involves a cycle of evaporation, compression, condensation and expansion. A refrigerant, like freon, is used as a heat-transfer medium which circulates within the heat pump.

The cycle starts as the cold, liquid refrigerant passes through a heat exchanger (evaporator) and absorbs heat from the low-temperature source (liquid from the ground loop). The refrigerant evaporates into a gas as heat is absorbed. The gaseous refrigerant then passes through a compressor where the refrigerant is pressurized, raising its temperature to over 180 degrees F. The hot gas then circulates through a refrigerant-to-air heat exchanger where heat is removed and pumped into the house at about 100 degrees F. When it loses the heat, the refrigerant changes back to liquid. The liquid is cooled as it passes through an expansion valve and begins the process again. To work as an air conditioner, the flow is reversed.

The ductwork is no different than that of a conventional forced-air system. The difference is found in the temperature of the air flowing from the registers in the winter. With a conventional air source heat pump, the air flow is seldom warmer than 80 degrees. But because water transfers a greater volume of heat than air, the Ground source heat pump is able to deliver warmer air.

Another benefit of a ground source heat pump can be found when teamed with a desuperheater. This component skims residual warmth from the compressor to heat water. Which means that in the summer, when the system is working to get rid of heat, the desuperheater can provide practically free hot water. And since most systems are oversized, there is usually enough warmth left over for low cost hot water in the winter too.

- GSHP's do not require a flue, and since there is no on-site combustion, there's less chance of fire, and no chance of carbon monoxide infiltrating the home.
- GSHP's also carry the Environmental Protection Agency's Energy Star Label, which is used to designate energy-efficient equipment. Often homeowners may find tax benefits, lower mortgages, or utility rebates.

Frequently Asked Questions

General:

How long will my GSHP system last?

GSHPs are durable and highly reliable. The GSHP contains fewer mechanical components, and all components are either buried in the ground or located inside the home, which protects them from outside conditions.

How noisy is the GSHP unit?

GSHPs are very quiet, providing a pleasant environment inside & outside of the home. GSHPs have no noisy fan units to disturb outdoor activities, on or near the patio.

How safe are GSHPs?

GSHP systems are safe and protected. With no exposed equipment outdoors, children or pets cannot injure themselves or damage exterior units. GSHPs have no open flame, flammable fuel or potentially dangerous fuel storage tanks.

How effective is this underground system?

The buried pipe, or ground loop, is the most recent technical advancement in heat pump technology. Recently, new heat pump designs and improved buried pipe materials have been combined to make GSHP systems the most efficient heating and cooling systems available.

Are GSHP systems guaranteed?
Nearly all GSHP system manufacturers offer a warranty for major components that is equivalent to the warranties for conventional heating and cooling systems. Manufacturers of plastic pipe used for ground loops warrant their products for 50 years.

Can these systems be used for commercial, industrial, or apartment requirements?
Yes! Many GSHP systems are being installed using a multitude of systems hooked up to an array of buried vertical or horizontal loops. This simplifies zone control and internal load balancing.

Savings / Costs:
How much does a GSHP cost?
The initial investment for a GSHP system is greater than that of a conventional system. However, when you consider the operating costs of a geothermal heating, cooling, and water heating system, energy savings quickly offset the initial difference in purchase price.

Does my state offer any incentives for installing a GSHP system?
Some utilities offer rebates or incentives to their customers who purchase GSHPs.

Installation:

Are GSHP systems difficult to install?

Most units are easy to install, especially when they are replacing another forced-air system. This is known as a retrofit. GSHPs can be installed in areas unsuitable for fossil fuel furnaces because there is no combustion and thus no need to vent exhaust fumes. Ductwork must be installed in homes without an existing air distribution system.

Can I install a ground source heat exchanger myself?

It's not recommended. Thermal fusion of the pipe, drilling and trenching are procedures best handled by licensed professionals. Nonprofessional installations may result in less than optimum performance, which could cancel out anticipated savings

How can I be sure the pipe is installed properly?

Use a reputable contractor. Don't be afraid to ask for and use references. Reputable dealers and loop installers will be happy to give names and phone numbers for you to call and confirm their capabilities. Find out where the installer received training, whether he or she is IGSHPA-accredited, and how many systems he or she has installed. Also, check with your utility company representative for names of installers.

What are the advantages and disadvantages of the horizontal and vertical installations, respectively?
Horizontal installations are simpler, requiring lower-cost equipment. However, they require longer lengths of pipe due to seasonal variations in soil temperature and moisture content. Since a horizontal heat exchanger is laid out in trenches, a larger area is usually required than for a vertical system. Where land is limited, vertical installations can be ideal. If regional soil conditions include extensive hard rock, a vertical installation may be the only available choice. Vertical installations tend to be more expensive due to the increased cost of drilling versus trenching, but since the heat exchanger is buried deeper than with a horizontal system, vertical systems are usually more efficient and can get by with less total pipe.

Concerning Your Home:

Can a GSHP system be added to my fossil fuel furnace?
Yes. Called dual systems, they can easily be added to existing furnaces for those wishing to have a dual-fuel heating system. Dual-fuel systems use the GSHP system as the main heating source, and a fossil fuel furnace as a supplement in extremely cold weather should additional heat be needed.

Will my existing ductwork function with this system?
Yes, in most cases. Your dealer or installer will be able to determine ductwork requirements and if any minor modifications are needed.

My yard contains many shade trees. Will this affect ground temperature and my ability to use it as an energy source?
Not at all. The system is installed deep enough that it utilizes constant ground temperature.

Will an underground loop affect my lawn or landscape?
No. Research has shown that loops have no adverse effects on grass, trees, or shrubs. Most horizontal installations require trenches about six inches wide. Temporary bare areas can be restored with grass seed or sod. Vertical loops require little space and do not damage lawns significantly.

Environment / Climate:

How do GSHPs protect the environment?
GSHP systems conserve natural resources by providing climate control very efficiently-thus also lowering emissions. GSHPs also minimize ozone layer destruction by using factory-sealed refrigeration systems, which will seldom or never have to be recharged.

What are the environmental benefits of GSHP systems?
Currently installed systems are making a huge difference in our environment! The systems are eliminating more than three million tons of carbon dioxide and is equivalent of taking 650,000 automobiles off the road. GSHP systems conserve energy and, because they move heat that already exists rather than burning something to create heat, they reduce the amount of toxic emissions in the atmosphere. They use renewable energy from the sun, and because the system doesn't rely on outside air, it keeps the air inside of buildings cleaner and free from pollens, outdoor pollutants, mold spores, and other allergens.