Geothermal Journal

Comfort systems that are "Smarter from the Ground Up"

Geothermal System Benefits

An investment in a WaterFurnace geothermal system provides an array of benefits not found with other systems.

Lower Operating Cost
A geothermal system operates more efficiently than ordinary heating and air conditioning systems because they can deliver an astounding four units of energy for every one unit of electrical energy used. That translates into an efficiency rating of 400 percent, compared to the most efficient gas furnace, which rates only 94 percent. By combining stored earth energy with safe electric power, many homeowners realize savings up to 60% for heating, cooling and hot water.

Lower Life Cycle Cost
Because of the extraordinary efficiency of a geothermal system, any added investment related to installing a geothermal unit is usually more than offset by your energy savings. In new homes, most homeowners will experience an immediate positive return on their investment when the system cost is added to the mortgage. In replacement installations, homeowners find that any added investment over the cost of an ordinary system is generally recovered in energy savings within a few years. And with a long system life and less maintenance, overall life cycle costs are lower with geothermal.

Enhanced Comfort
Provides precise distribution of comfortable air all year long, eliminating hot spots and cold spots. During heating, you'll experience warm air without the hot blasts associated with ordinary gas furnaces. And compared to an air-source heat pump, the air is warmer. When cooling, a geothermal unit delivers cool, dehumidified air. For ultimate comfort, a zoning system can be added, using multiple thermostats to precisely control temperatures in various zones.

Safe
Because natural gas, propane or oil are not required to operate a geothermal unit, there's no combustion, flames or fumes and no chance of carbon-monoxide poisoning.

Clean
With the all-electric geothermal system, there are no fumes produced during operation. By adding optional high efficiency air cleaners, you'll achieve high levels of indoor air quality.

Quiet
Unlike ordinary air conditioners or heat pumps, there is no noisy outdoor unit to disturb your outdoor environment or your neighbors. Geothermal units are designed and constructed for "whisper quiet" operation, similar to your refrigerator. Some models include variable speed fan motors and acoustical enclosures for the compressors.

Reliable
Unlike air conditioners and heat pumps, geothermal units are installed indoors (like your refrigerator), so they are not subject to wear and tear caused by rain, snow, ice, debris, extreme temperatures or vandalism. Geothermal units have proven to be very reliable and require less maintenance.

Environmentally Friendly
According to the Department of Energy and the EPA, geothermal systems are the most environmentally friendly way to heat and cool your home. The system emits no carbon dioxide, carbon monoxide or other greenhouse gasses which are considered to be major contributors to environmental air pollution. With a geothermal system, you can take comfort in a better environment. In addition, the lower peak demand for geothermal systems helps to postpone the need to build more expensive electric generating plants.

Flexible
Geothermal systems are installed in homes from the cold climate of northern Canada and Alaska to the heat of Florida and Texas. Whether your home is new or old, large or small, a geothermal system will deliver. One compact unit provides heating, central air conditioning and domestic hot water. Various sizes, configurations (horizontal, vertical, splits), and options enable a system to be installed in virtually any application.

Homeowners Benefit with "Down to Earth" Comfort System

Homeowners all over North America have discovered the benefits of using the energy source in their own backyards to provide heating, cooling and hot water.

Geothermal heating and cooling systems, also known as GeoExchange systems, tap into the constant, moderate temperatures found a few feet below the surface of the earth, to offer the finest in home comfort conditioning. "Geothermal" means pertaining to the heat of the earth, and it's literally right there in your own backyard. The lot surrounding a suburban home or other building contains a vast reservoir of low-temperature thermal energy-typically 10 times the amount required over an entire heating season. This resource is constantly re-supplied by the sun and the surrounding earth.

Highly efficient geothermal systems use a small amount of energy to capture and move a large amount of free energy. In a typical home, 70% of the total energy bill comes from heating, cooling and hot water. As a result, the greatest opportunity to reduce your energy costs is to improve the efficiency of your heating, cooling and hot water system by utilizing this "down to earth" technology. And this energy source is free, renewable, clean and environmentally-friendly. A geothermal system captures this free energy from the earth by using a series of pipes (an earth loop) buried in the ground.

During the heating mode, a special fluid circulates through the pipe where heat energy is transferred from the ground (the heat source) to the fluid and then to the geothermal unit located in the home, providing warm comfort to the structure. Inside the home, the heat can be distributed through either a conventional duct system or a hydronic radiant heat system.

To provide air conditioning, the process reverses. Heat is removed from the home and transferred to the loop fluid. As the warm fluid travels through the pipe in the earth, it is cooled. In the cooling mode, the earth serves as a "heat sink," a place to deposit the heat removed from the home. In addition to earth loops, geothermal systems can also use a pond, lake or well water as the heat source or heat sink to provide heating and cooling comfort for the home.

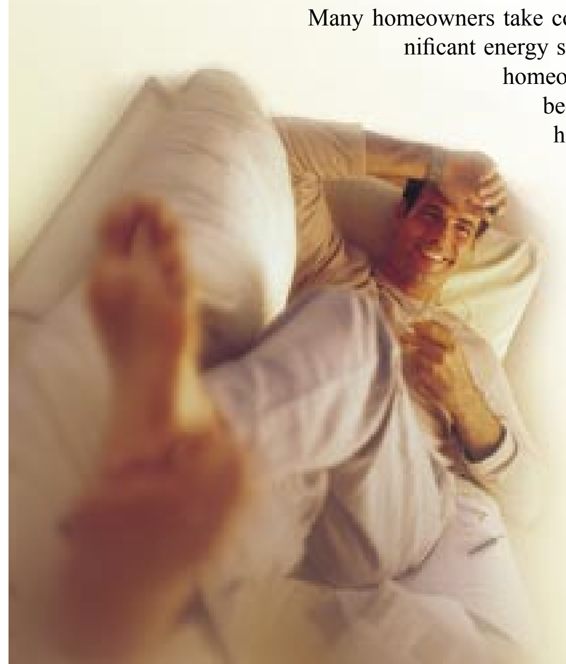
As a bonus, a geothermal unit can provide some or all of your hot water at higher efficiencies, offering additional energy savings. Using a simple connection to your water heater, the geothermal unit will deliver hot water to the tank during the heating and cooling modes. In fact, the heat removed from your home during cooling is deposited into your water heater providing you with virtually free hot water.

A geothermal system can easily be installed in most homes - new or old, large or small. With many sizes, configurations and options available, the system will be designed and installed to provide the homeowner with many years of reduced energy costs, enhanced comfort, safety and reliability-all from a technology that's "down to earth".

Selecting a WaterFurnace geothermal system is not only a smart investment in affordable comfort, but also a smart investment in the preservation of the environment for generations to come. That's why it's "Smarter from the Ground Up."

Geothermal Systems Deliver Peace of Mind

Making the smart decision to purchase a WaterFurnace geothermal system is an investment in energy savings, comfort and reliability; in summary, an investment in peace of mind.



Many homeowners take comfort in knowing that a geothermal system can help them achieve significant energy savings compared to ordinary heating and cooling systems. In fact, many homeowners realize savings up to 60% in heating, cooling and hot water. And because a geothermal system doesn't burn natural gas, propane or fuel oil, homeowners are impacted less by skyrocketing costs of fossil fuels.

With a geothermal system, you can save money without sacrificing an ounce of comfort. Geothermal units are known for delivering a consistent, even flow of conditioned air throughout the home, eliminating hot spots and cold spots. Some models feature dual capacity compressors and variable speed blower motors to provide precise temperature control and comfort, no matter what the temperature is outside.

While comfort and energy savings are prime considerations, your home comfort system should also assure peace of mind without worries about reliability, maintenance, and safety. Industry studies have shown that geothermal systems are very reliable and require only minimal maintenance. Because the units are installed indoors, wear and tear from harsh weather conditions is eliminated. And without the need to burn fossil fuels, there are no concerns about safety; no flame, no fumes, no flues, no carbon monoxide, and no outdoor fuel tanks. Further, the life expectancy of a geothermal unit is significantly greater than for ordinary air conditioners and heat pumps.

Energy Savings & Economics

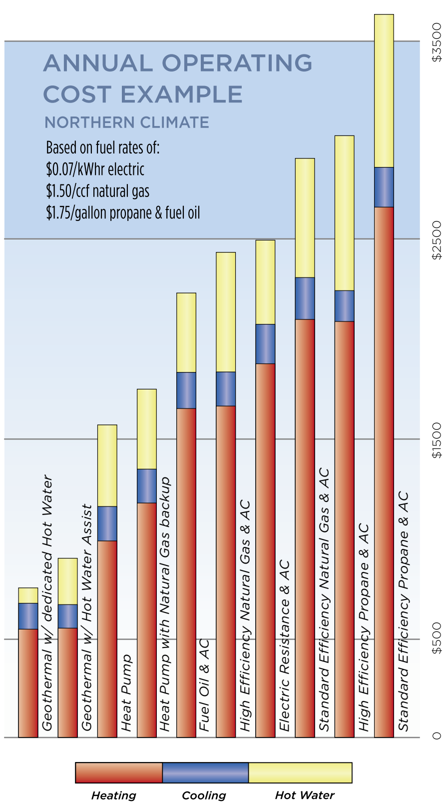
If you were given the choice of burning money or saving money, which would you choose? The question may sound crazy, but that's what each homeowner faces when deciding whether or not to invest in a geothermal system. Because a geothermal system tends to have a higher installation cost than most ordinary systems, many homeowners view it as an expensive system. But this is only half of the picture. As a homeowner, consider more than the initial investment when purchasing a new system: consider the monthly energy costs and the annual maintenance costs. You may find that a fossil fuel furnace will cause you to burn money rather than save it, and an ordinary air conditioner will cause you to waste energy rather than conserve it.

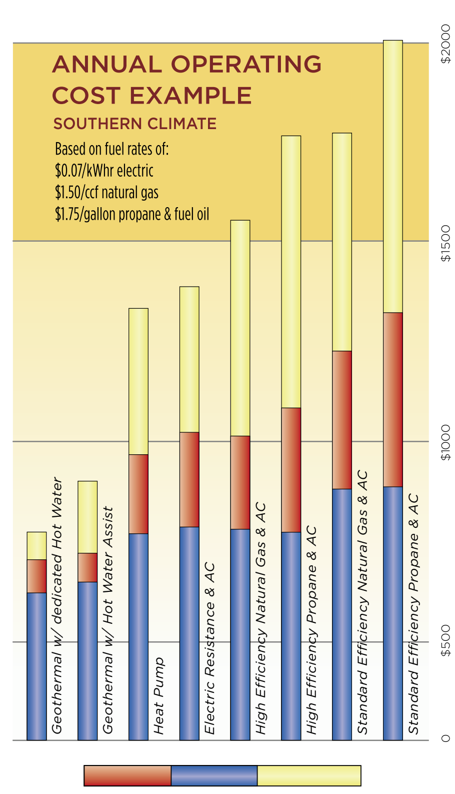
When selecting a system, always consider the payback, efficiency, cash flow, operating costs and system life-span. System payback is how long it takes to recover in energy savings the difference in the costs between geothermal and ordinary systems. On average, the added initial cost of installing a geothermal system can be recovered within three to five years. Your geothermal dealer will be able to help you figure your payback on this investment.

Geothermal systems can be used in new and retrofit applications. But as a new home buyer, you are an especially good candidate for a geothermal system. Because you are already making a long-term investment in new construction, the initial cost of the system can usually be tied into your monthly mortgage payment. The monthly savings from the system will generally cover the additional amount added to your mortgage payment. So you are creating a positive cash flow - right away!

Another consideration is total heating, cooling and domestic hot water operating costs. A geothermal system is the total comfort system with the lowest overall cost. With most ordinary systems, overall operating costs are based on the efficiency of more than one system - a fossil fuel furnace, a central air conditioner and a water heater. With a geothermal system, all operations are handled by one system, assuring that efficiency and savings are achieved in all areas. In addition, system maintenance and life span should not be overlooked. For instance, ordinary systems frequently require regular maintenance for the furnace and the air conditioner. However, a geothermal system requires little or no maintenance beyond periodic checks and filter changes.

When faced with the purchase of a new heating, cooling and water heating system, you have two choices: either burn money with an ordinary system or save it with a WaterFurnace geothermal system.





FACTOIDS

Fascinating Facts about Geothermal Systems-

- **The first recorded geothermal system was a 1912 Swiss patent.**
- **The ground absorbs 47% of the sun's energy that reaches planet Earth. This amount of energy represents 500 times more than mankind needs every year.**
- **About half a million geothermal systems have been installed since 1980.**
- **Installing a geothermal system in a typical home is equal, in greenhouse gas reduction, to planting an acre of trees, or taking two cars off the road.**
- **Current geothermal installations save more than 14 million barrels of crude oil per year.**
- **If one in 12 California homes installed a geothermal system, the energy saved would equal the output of nine new power plants.**

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Earth Loop Designs

The earth loop transfers heat to and from the ground - eliminating the need for fossil fuels. It's the heart of a geothermal system, and its biggest advantage over ordinary heating and cooling technologies. Earth loops come in two basic types. Closed loops, made of durable, high-density polyethylene pipe, are buried in the earth or submerged in a lake or pond. They transfer heat by circulating a solution of water and environmentally safe antifreeze. Open loops use ground water pumped from a well as a heat source.

The type to use depends on the terrain, the cost of trenching or drilling, the availability of quality ground water, and available space. Your geothermal dealer will help you make the best choice.

Horizontal Trench Loops

If adequate land is available, horizontal loops can be installed. One or more trenches are dug using a backhoe or chain trencher. Polyethylene pipes are inserted and the trenches are backfilled. There are various designs of horizontal loops, using one, two or three circuits in a trench. The more pipe per foot of trench, the shorter the trench can be. Trenches normally range from 100 to 300 feet depending on the design. A typical home requires 1⁄4 to 3⁄4 of an acre for the trenches.

Horizontal Slinky Loops

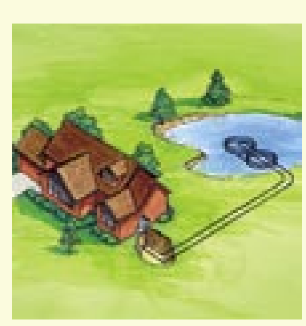
Another type of horizontal loop is called the Slinky. In this installation, a trench is dug with a backhoe several feet deep, and about 3 feet wide. The coils are "layed off" and spaced evenly throughout the length of the trench. (Think of a flattened, stretched out slinky toy.) Slinkys can be designed as "compact" or "extended". Trench lengths are typically 100 to 150 feet long.

Horizontal Bore Loops

Where there is adequate space for a horizontal loop, but there is a desire to minimize disruption on the surface, the horizontal bore loop may be the preferred solution. This loop type requires special equipment to bore holes horizontally under the surface. This machine has the capability to start at the surface and drill at a slight angle down to a typical depth of 10-12 ft., then drill back to the surface. Using the right technique, the operator can "steer" the drill head to go deeper or shallower, or turn right or left. The drill head emits a radio signal that can be detected by a special device that tells the operator exactly where and how deep it is. A small-diameter tunnel is created underground by displacing soil with pressurized water. The operator drills the horizontal bore, then directs the drill bit to come back to the surface, typically, about 200 ft. away. At that point, two ends of pipe are attached to the end of the drilling pipe in place of the drill bit, and are pulled back through the hole to the header, and until the u-bend at the end of the pipe is buried. This technique allows the loop to be placed underneath homes, basements, wooded lots or even swimming pools. The only digging required is for the header and the supply and return piping into the house. This type of loop is most often used in a retrofit situation to minimize disruption to the landscape.

Vertical Loops

Vertical loops are used where space is limited or where soil conditions are not conducive to horizontal loops. Installing vertical loops requires the use of a drilling rig. Multiple holes are bored about 10 feet apart. A double pipe connected with a U-bend is inserted into each hole. The hole is filled with grout to provide good contact around the pipe and to seal the hole. The vertical pipes are then connected to a header system horizontally a few feet below the surface. The depth of the holes is dependent upon soil/rock conditions and the size of the system. Although most holes are bored about 100 to 250 feet deep, there is no "magic depth" that needs to be reached. Capacity is not based on depth; rather how much pipe is in the ground and the overall thermal conductivity of the borehole.



Pond Loops

If an adequately sized body of water is close to your home, a pond loop can be installed. A series of closed loops can be coiled and sunk to the bottom. A 1⁄2-acre, 8-foot-deep pond is usually sufficient for the average home. Ideally, the pond should be close to the home (less than 200 ft.). If the pond is farther from the home, the benefit of using a pond loop is reduced due to added trenching, materials and pumping costs. Pond loop coils are connected together on dry land, and then floated into location. Once filled with fluid, they will sink to the bottom and remain there. Generally, a 300 ft. coil is used for each ton of capacity. This is less pipe than is used in an earth loop because water is a better conductor of heat energy. Pond loops are a cost effective way to install a geothermal system, because trenching is limited to only the supply and return piping from the pond to the house.

Open Loop-Well System

If an abundant supply of quality well water is available, an open loop system can be installed. A proper discharge site, such as a ditch, field tile, stream, or pond, must also be available. Be sure to check all local codes before selecting a discharge method. This installation usually costs less to install and delivers the same high efficiency. Care should be taken when considering using an open loop system. Depending on water quality, periodic cleaning of the heat exchanger inside the unit may be necessary. Well water containing too many contaminants may not be suitable for use with a geothermal system as it may cause the unit's performance to degrade over time. Proper testing of the water prior to installation is required.

Green Technology

Geothermal systems capitalize on the solar energy stored year-round just beneath the earth's surface. This free geothermal energy is an unlimited, renewable resource. The lot surrounding a typical suburban home contains 10 times more energy than is required over an entire heating season. And this resource is constantly replenished by the sun, the surrounding earth and heat rejected while the geothermal system is cooling in the summer.

According to an EPA study titled "Space Conditioning, The Next Frontier" (Report 430-R-93-004), the Department of Energy and the EPA recognized geothermal systems as the most environmentally friendly, cost-effective and energy efficient heating and cooling technology available. So you can make a significant contribution to a cleaner environment - while saving up to 60% on your home's energy bills.

Geothermal heat pumps help electric utilities achieve significant reductions in their peak demand loads. By reducing the demand on electric utilities, the need for new power plants is reduced, along with a reduced need for natural resources like coal or gas used to generate electricity. These systems also minimize the threats of acid rain, air pollution, the greenhouse effect and global warming - problems directly linked to the burning of fossil fuels. A typical 2,500 square-foot home with a geothermal system saves the electric utility company from having to burn more than nine additional tons of coal a year compared to an electric resistance heating system. And this savings increases with larger installations.

The U.S. General Accounting Office estimates that if geothermal systems were installed by more people, they could save several billion dollars annually in energy costs and substantially reduce pollution. In fact, for every 100,000 residential units installed, more than 37.5 trillion BTUs of energy used for space conditioning and water heating can be saved. This represents an emissions reduction of about 2.18 million metric tons of carbon equivalents, and cost savings to consumers of about $750 million over the 20-year life of the equipment.

Geothermal heat pumps strengthen U.S. energy security. Every 100,000 homes with geothermal heat pump systems reduce foreign oil consumption by 2.15 million barrels annually and reduce electricity consumption by 799 million kilowatt hours annually.

Variety of Geothermal System Applications

WaterFurnace geothermal units can be installed in a wide variety of installations -- new or old homes, large or small. Although most systems are simply single units in a forced air application, geothermal systems can also be used for other types of installations.

Radiant Floor Heating Some geothermal units can provide hot water for radiant floor applications, utilizing tubing encased in the floor. By circulating warm water through the tubing, the room is comfortably conditioned. Since the entire floor acts as a giant radiator, you'll experience consistent comfort throughout the room from head to toe. Floors covered in tile, wood, linoleum or stone are kept toasty warm, even on the coldest days. Homeowners with radiant floor heating systems enjoy the benefit of warm bathroom floors even with bare feet. Basement floors or other concrete slab floors are also a perfect application for radiant heating. And with an individual thermostat in every room, you can simultaneously keep the bathroom floors at a higher temperature, your bedrooms and main living spaces warm and cozy, while just taking the chill off a basement floor; it's completely up to you.

Domestic Hot Water Homes with large demands for domestic or potable water heating will benefit from the exceptional efficiency of geothermal units. When used in conjunction with another geothermal unit to condition the air inside the home, the complete system provides the ultimate in savings and comfort with safe, reliable, quiet performance.

Pool Heating Units can also be utilized to heat water for pools and spas. You'll find a geothermal unit will heat your pool or spa for much less than an ordinary pool heater. And compared to fossil fuel burning heaters, it's much safer too, without the concerns associated with carbon monoxide poisoning.

Snow & Ice Melt Using a geothermal unit, you can keep your sidewalks or driveway free of ice and snow during the cold winter months. Eliminate the hazards of walking on ice-covered sidewalks, and forget the back-breaking effort of shoveling snow.

Commercial Applications In addition to being a smart choice for residential installations, many commercial and institutional buildings utilize geothermal systems including offices, retail, hotels, apartments/condos, resorts, schools, hospitals, assisted living centers and manufacturing facilities.

Let's Get Technical

The Interesting Basics...

Geothermal units utilize some of the same technology found in your home's refrigerator. They are both devices that move heat energy. A refrigerator removes heat from food. A geothermal system removes heat energy from the earth to heat your home and removes heat energy from inside your home to cool it.

Both technologies rely on a scientific principle that states *"energy (heat) flows spontaneously from an area of high concentration (hot body) to an area of low concentration (cold body)."* Heat flows from hot matter to cold matter. Never vice-versa. It's why ice cubes melt on a hot day, and why boiling water cools after you remove it from the stove. Energy/heat wants to naturally disperse, and it will do so unless hindered by an outside force.

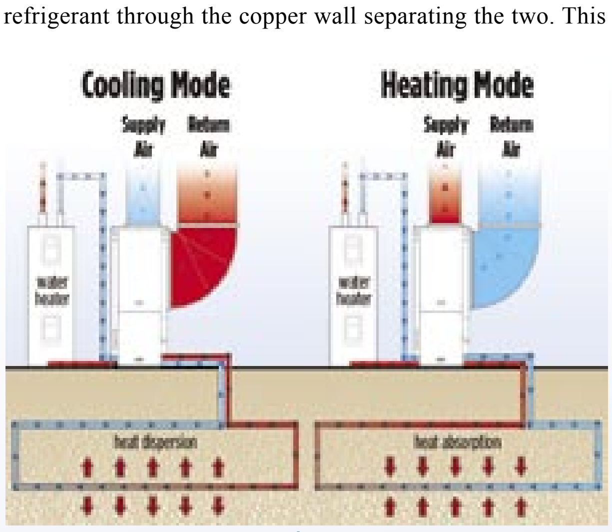
This applies to geothermal heating and cooling systems. In nature, the ground serves as a giant solar collector, storing heat energy a few feet below its surface. Here, temperatures remain very constant and moderate, unaffected by fluctuating outdoor temperatures. Energy is exchanged using a series of pipes buried below the earth's surface (closed loop), placed in a pond (pond loop), or with well water (open loop).

Applying the principle stated, we know that in cold outdoor weather, the warmer earth will gladly release its heat energy into the cooler loop. This heat is absorbed from the warmed loop by cool refrigerant in the water-to-refrigerant heat exchanger (coax). Finally, the heat is released from the warmed refrigerant into the cooler house (via supply air ducts) by the air-to-refrigerant heat exchanger (air coil). As heat is drawn away from the earth loop to the house, the loop is cooled again to a point where its temperature is lower than the surrounding soil and the process repeats.

During warm outdoor weather, the cooler earth serves as a heat sink. Heat is absorbed from the house by the cool refrigerant in the air coil (via return air). The cool loop fluid absorbs heat from the warmed refrigerant in the coax. (This heat can also be diverted to create hot water using the desuperheater.) Because the loop is now warmer than the cool earth, the heat simply moves away from the loop—the area of high concentration, and drawn into the cool earth—the area of low concentration.

The Boring Details...

Heating Mode: During heating, a geothermal system absorbs the heat from the ground via the earth loop. The heating cycle starts as cold, liquid refrigerant passes through the water-to-refrigerant heat exchanger (coax, and also the evaporator during heating). The coax is made of copper, and consists of a tube within a tube—water from the loop travels through one tube (the inside tube), refrigerant passes through the other (outer) tube. As the loop fluid flows through the coax, the heat energy transfers from the loop fluid to the refrigerant through the copper wall separating the two. This



RED = warm BLUE= cool

heat transfer causes the cold liquid refrigerant to turn into a gas. (Unlike water, refrigerant changes from a liquid into a gas at a very low temperature.) The now gaseous refrigerant is sucked into the compressor where it is compressed. After compression, the refrigerant will be very hot (approx. 165° F) and discharged through the reversing valve and into the air coil. The air coil is a radiator-like device that has thin aluminum "fins" attached to the copper refrigerant tubing. The refrigerant passes through the air coil (the condenser during heating). As air from the return air duct system passes over the air coil, heat is released from the refrigerant and absorbed by the cooler air. The result is warm air (typically 95° to 105° F) which is delivered through the duct system by the blower. The refrigerant, now cooled again, passes through the expansion valve (which acts as a flow control), returning to the coax where it can accept more heat from the warmer loop fluid. This process is continuous during the heating mode.

Cooling Mode: During cooling, a geothermal system rejects the heat from the indoor air into the earth loop. The cooling cycle starts as cold, liquid refrigerant passes through the air coil (the evaporator during cooling). As the refrigerant flows through the air coil, the heat energy transfers from the warm return air to the refrigerant. This heat transfer causes the cold liquid refrigerant to turn into a gas. The compressor draws the refrigerant gas, compresses it, and discharges it through the reversing valve. During cooling, the reversing valve is energized, which changes the openings from one port to another, causing the refrigerant flow to go in the opposite direction that it was in the heating mode. (However, the flow to the compressor does not change direction.) After compression, the hot refrigerant passes through the coax (the condenser during cooling). In the coax, the hot refrigerant releases its heat energy to the cool loop fluid through the copper walls. Now cooled and liquified, the refrigerant passes through the expansion valve, back to the air coil. Warm air passing over the cool air coil causes the air to be cooled and dehumidified. This process is continuous during the cooling mode.

Hot Water Mode: Most geothermal units installed in homes have an optional feature called a desuperheater. This component consists of a refrigerant-to-water heat exchanger installed at the discharge of the compressor. The hot gas at this point is in a "superheated" condition. In the desuperheater, the refrigerant releases some of the heat into the cooler water through the copper wall of the desuperheater heat exchanger. A small circulator moves the water from the water heater to the heat pump and back to the water heater. This excess hot gas is available in both the heating and cooling modes. However, there is a greater hot water benefit during cooling because some of the heat that is extracted from the air ends up in the superheat, and is transferred to the water. The amount of hot water generated is a function of the run time of the unit. On very hot days and cold days, the desuperheater may be able to generate the majority of the hot water required for the home due to the long run times of the unit. On milder days when the unit has short duty cycles, the electric elements in the water heater will maintain the desired temperature so there will always be enough hot water. A safety device (sensor) shuts off the circulator for the desuperheater in the event that the water temperature reaches 130° F.

Frequently Asked Questions

Q: What are the components of a geothermal heat pump system?
A: The three main parts are the heat-pump unit, the liquid heat-exchange medium (open or closed loop), and the air-delivery system (ductwork). The unit's main components are the compressor, heat exchanger, air coil, blower motor and electrical controls.

Q: Is a geothermal heat pump difficult to install?
A: Most units are easy to install, particularly when they replace another forced-air system. They can be installed in areas unsuitable for fossil fuel furnaces because there is no combustion, thus no need to vent exhaust gases. Ductwork must be installed in homes that don't have an existing air distribution system. The difficulty of installing ductwork will vary and should be assessed by a contractor.

Q: I have ductwork, but will it work with this system?
A: In all probability, yes. Your installing contractor should be able to determine ductwork requirements and any minor modifications if needed.

Q: Do I need to increase the size of my electric service?
A: Geothermal heat pumps don't use large amounts of power so your existing service may be adequate. Generally, a 200-amp service will have enough capacity and smaller amp services may be large enough in some cases. Your electric utility or contractor can determine your service needs.

Q: Can a geothermal heat pump be added to my fossil fuel furnace?
A: Split systems can easily be added to existing furnaces for those wishing to have a "dual fuel" heating system. Dual fuel systems use the heat pump as the main heating source and a fossil fuel furnace as a supplement in extremely cold weather if additional heat is needed.

Q: Do I need a back-up heat supply?
A: Geothermal systems used in climates where temperatures drop below freezing are generally installed with an auxiliary back-up electric resistance heater. This component is mounted either inside the unit or in the supply duct just outside the unit. The auxiliary heater serves two purposes: To supply back-up heat during cold outdoor temperatures, and to provide emergency heat if the compressor fails. Your geothermal unit will generate the largest majority of your heating needs; the rest of the heat would be supplied by the auxiliary heater. Generally, sizing the unit in a northern climate to provide 100% of the heating does not make sense economically because the added initial cost of the larger unit and earth loop may not be recovered in energy savings over a reasonable period of time. Software is available to assist the dealer in determining the most appropriate size system considering initial cost and operating cost.

A typical installation of a geothermal comfort system.

Q: Can I install an earth loop myself?
A: Properly designing and installing an earth loop requires extensive training. In order to obtain optimum system performance, the earth loop size, design and configuration need to be carefully considered. In addition, special pipe, fittings, and tools for heat fusion and system flushing are required.

Q: Will an earth loop affect my lawn or landscape?
A: The actual process of installing the loop will disrupt the surface to some degree. With proper restoration, most loop fields are "invisible" after a couple months. After the initial installation, the loop will have no adverse effect on grass, trees, or shrubs. Nor will roots from trees cause a problem with the pipe.

Q: How long will the loop pipe last?
A: Closed loop systems should be installed using only high-density polyethylene pipe. This pipe does not rust, rot or corrode, and is inert to chemicals normally found in soil. Properly installed, these pipes will last for many decades. Actual life expectancy of the pipe is over 200 years. PVC pipe should never be used.

Q: How are the pipe sections of the loop joined?
A: Pipe sections are joined by thermal fusion which involves heating the pipe and fitting, then connecting them to form a joint that's stronger than the original pipe. This technique creates a secure connection to protect from leakage and contamination.

Geothermal Fusion: Pipe and fittings are thermally fused together using a special tool heated to 500° F.

Q: If the loop falls below freezing, will it hurt the system?
A: No. The antifreeze solution in the loop will keep it from freezing down to approximately 10° F. Environmentally-safe Environol antifreeze is recommended.

Q: Can I reclaim heat from my septic system disposal field?
A: No. An earth loop will reach temperatures below freezing during extreme conditions and may freeze your septic system. Such usage is banned in many areas.

Q: Are there any laws that apply to open loop installations?
A: All or part of the installation may be subject to local ordinances, codes, covenants or licensing requirements. Check with local authorities to determine if any restrictions apply in your area.

Q: Does an open loop system cause environmental damage?
A: No. They are pollution free. The heat pump merely removes or adds heat to the water. No pollutants are added. The only change in the water returned to the environment is a slight increase or decrease in temperature.

Q: How can I discharge the water when using an open loop system?
A: There are a number of ways to dispose of water after it has passed through the heat pump. The open discharge method is the easiest and least expensive. Open discharge simply involves releasing the water into a stream, river, lake, pond, ditch or drainage tile. Obviously, one of these alternatives must be readily available and have the capacity to accept the amount of water used by the heat pump before open discharge is feasible. A second means of water discharge is the return well. A return well is a second well that returns the water to the ground aquifer. A return well must have enough capacity to dispose of the water passed through the heat pump. A new return well should be installed by a qualified well driller. Likewise, a professional should test the capacity of an existing well before it is used as a return.

Q: With an open loop system, what problems can be caused by poor water quality?
A: Poor water quality can cause serious problems in open loop systems. Your water should be tested for hardness, acidity and iron content before a heat pump is installed. Your contractor or equipment manufacturer can tell you what quality of water is acceptable. Mineral deposits can build up inside the heat pump's heat exchanger. Sometimes a periodic cleaning with a mild acid solution is all that's needed to remove the build-up. Where well water does not meet the requirements for an open loop geothermal system, a closed loop would be used.

Geothermal Heat Pump Consortium

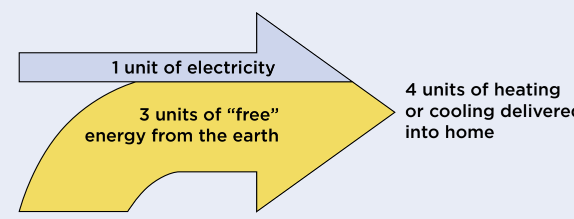
The Geothermal Heat Pump Consortium (GHPC), a non-profit organization created in 1994, has as its mission the implementation of the National Earth Comfort Program. The Earth Comfort Program is a collaborative effort between the U.S. Department of Energy, the U.S. Environmental Protection Agency, and private sector organizations interested in promoting the growth of energy-efficient, environmentally friendly heating and cooling technology. The Consortium acts as a resource for anyone wishing to know more about GeoExchange technology. For additional information, go to www.geoexchange.org.

Ask The GeoPro

Your questions answered by one of the geothermal experts from WaterFurnace...

Dear GeoPro: *As a high school physics instructor, I teach the Law of Conservation of Energy which states you can't get more energy out of a machine than what you put in. Yet geothermal systems are typically described as having efficiency of 300-400% (or 3-4 COP). How can this be? - Mr. Physics*

Dear Mr. Physics: The formula for Coefficient of Performance (COP) is BTU output (energy delivered into the home) divided by BTU input (electrical energy used to operate the unit). The BTUs captured from the ground are "free" so they are only considered on the output side of the equation and not on the input side.



Dear GeoPro: *Wouldn't an earth loop made of copper pipe be more efficient than one made with polyethylene pipe? - Puzzled in Pittsburgh*

Dear Puzzled: It's true that copper has better heat transfer characteristics than polyethylene. However, the ability of heat energy to move through the ground is dependent upon the soil or rock conditions, not the thermal conductivity of the pipe. In addition, copper pipe is much more expensive, and would be subject to corrosion.

Dear GeoPro: *What's a "ton" of air conditioning? -Melting in Miami*

Dear Melting: Years ago, before refrigerant-based air conditioners were used, some buildings were cooled using fans blowing over chunks of ice. It was calculated that the cooling capacity of one ton of ice was 12,000 BTUs per hour. That measurement carried over to today's technology. For example, a 3-ton air conditioner can remove 36,000 BTUs per hour.

Dear GeoPro: *I'm confused by claims of efficiency. Air conditioners are rated in SEER, heat pumps are rated in SEER and HSPF, and geothermal units are rated in EER and COP. Are the ratings different, and if so, how can I compare apples to apples? - Confused in Connecticut*

Dear Confused: The U.S. Department of Energy established SEER (Seasonal Energy Efficiency Ratio) and HSPF (Heating Season Performance Factor) as a measure of the efficiency for air source units over the entire heating and cooling season in a given climate. Because outdoor air temperatures do not affect the performance of geothermal systems, the "seasonal" factor is not relevant, so the DOE doesn't serve as the certification authority. Conversely for geothermal systems, the Air Conditioning & Refrigeration Institute (ARI) established EER (Energy Efficiency Ratio) as the cooling efficiency standard and Coefficient of Performance (COP) for heating efficiency; both based on steady-state conditions. Unfortunately, you can't directly compare ratings of EER to SEER, or COP to HSPF. The best way to compare efficiencies and resulting energy costs is to use software modeling programs that can calculate performance and operating costs for a given home in a specific climate. You'll find that air source units with even the highest SEERs and HSPFs are less efficient than a geothermal system.

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