Geothermal Heat Pumps
Frequently Asked Questions

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WHAT IS GEOTHERMAL ENERGY?

We have two types of Geothermal Energy –

High-grade - This is the heat of the pressure from the earth that turns water into steam. An example would be Old Faithful at Yellowstone National Park. **Low-grade** - This is the heat in the crust of the earth. Actually, this is stored solar energy. By tapping into this low grade geothermal energy we can deliver big energy savings when heating, cooling and making hot water.

WHAT IS A GROUND SOURCE HEAT PUMP?

Ground source heat pumps (GSHP's) are electrically powered systems that use energy from the sun and collected using the greatest solar collector in existence: our earth. Using the earth's relatively constant temperature a geothermal system can provide heating, cooling, and hot water for homes and commercial buildings.

WHAT IS A GEOTHERMAL HEAT PUMP?

Operating on the principle of heat being moved from a warmer temperature to a cooler temperature, as a mechanical device a heat pump is used for heating and cooling. The earth is used to warm us in the winter and cool us in the summer through a heat pump.

THE TECHNICAL VIEW OF THE HEAT PUMP PROCESS:

Remember a heat pump is able to move heat from a low temperature source to a high temperature source. Using a cycle of evaporation, compression, condensation and expansion, the process elevates low temperature heat to over 100° F and moves it indoors. As a heat transfer medium, a refrigerant is used and circulates in the heat pump. This cycle begins as the cold liquid refrigerant goes through a heat exchanger (evaporator) and absorbs the heat from the low temperature source (ground loop liquid). As the heat is absorbed, the refrigerant evaporates into a gas. As the gaseous refrigerant is passing through a compressor, it is pressurized and raises its temperature to over 160°F. Heat is removed and pumped into the home at about 100° F after the hot gas is circulated through a refrigerant-to-air heat exchanger. The refrigerant changes back to a liquid when it loses the heat. As it passes through an expansion valve, the liquid is cooled and the process begins again. We reverse the flow to air condition.

GEOTHERMAL HEAT PUMPS CAN HEAT A HOME; CAN IT ALSO COOL A HOME?

Yes, heat pumps can heat and cool as one system, which makes them very versatile and efficient. Simply flip a switch on your indoor thermostat to change your heat pump from heating to cooling.

HOW DO YOU GET HEAT OUT OF 50 DEGREE GROUND WATER?

You have a heat pump in your house right now! Your refrigerator takes heat out of the food and releases the heat to the outside. (Feel how warm it is behind your refrigerator.) A heat pump works in much the same way. It removes heat from the water that is circulated through the loop field and concentrates it before releasing it into your home. Open-loop and closed-loop systems are the most common forms of transferring heat from the ground into the home.

HOW DO GROUND SOURCE HEAT PUMPS WORK?

Ground source heat pumps get their energy from one of two types of loops; closed loop or open loops. Closed loops can be installed in three ways: horizontally, vertically, or in a pond/lake. 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. Your local installer can review your site and help recommend the system that best matches your application.

ARE GEOTHERMAL UNITS DIFFICULT TO INSTALL?

Most units are easy to install, especially when they are replacing another forced-air system. This is known as a retrofit. Geothermal units 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. Your dealer or installer can assess the cost of installing ductwork.

AN OPEN-LOOP SYSTEM IS WHAT?

If ground water is plentiful, you may use an open-loop system cost-effectively. These systems are the easiest to install and for decades have been used successfully in areas where permitted by local codes. Ground water from an aquifer is used in this type of system and is directly piped from the well to the building, transferring its heat to a heat pump. Upon leaving the building, disposing of the water can be done by one of the three following methods.

1. Surface drainage – draining to a pond, river, lake or stream, etc. – a low area.
2. Sub surface – draining to a committed drain field that fits the required amount of water of the heat pump.
3. Re-injection or discharge well – using a separate discharge well the water is pumped back into the same aquifer.

Always consult your local environmental officials when considering an open-loop system.

HOW MUCH GROUNDWATER DOES AN OPEN-LOOP SYSTEM NEED?

Different amounts of water are used in open-loop systems subject to the size of the unit and the specifications the manufacturer has for that heat pump. The specifications for the amount of water for each unit are stated in gallons per minute (GPM). The combination of heat pump and water well need to be large enough to furnish enough water as needed by the heat pump and include your domestic water requirements.

WHAT PROBLEMS CAN BE CAUSED BY POOR WATER QUALITY?

Serious problems will occur when using poor quality water. Prior to having your heat pump installed, test the water for acidity, hardness and iron content. The buildup of mineral deposits inside the heat pump heat exchanger occurs as a result of poor water quality. This will require periodic cleaning. We do not suggest using water from ponds, lakes, flowing springs or rivers unless they are shown to be free of organic matter. Sediments like these will make the heat exchanger heat pump inoperable by contaminating them.

DOES AN OPEN-LOOP SYSTEM CAUSE ENVIRONMENTAL DAMAGE?

No, there is no pollution created as the heat pump simply moves heat from one source to another. The water will change slightly by an increase or decrease in temperature

ARE THERE ANY LAWS THAT APPLY TO OPEN-LOOP INSTALLATION?

There may be local ordinances, codes, covenants or licensing requirements applied to all or parts of the installation. Always check to determine if any restrictions apply in your area by contacting your local authorities.

WHAT IS A CLOSED-LOOP SYSTEM?

These are becoming the most common systems. Closed loop systems come in 5 types. They all use a continuous loop in which the heat transfer fluid is circulated.

The most cost effective is a **horizontal loop** if you have adequate yard space, making trenches easy to dig. Digging trenches three to six feet below the ground using backhoes or trenchers, you place a series of parallel plastic pipes. Being careful not to allow sharp rocks or debris to harm the pipe, you backfill the trench. Typically, 400 – 600 feet of pipe per ton of heating and cooling capacity will be used in a standard horizontal loop.

Use of **vertical loops** is favored when installing in locations where yard space is inadequate and you wish to preserve the landscaping that is in place. Vertical holes are bored into the ground 150 – 450 feet deep. A single loop of pipe with a U-bend at the bottom goes into each hole followed by backfilling or grouting to increase the thermal conductivity. To and from the heat pump underground, connecting a horizontal pipe to each vertical pipe is needed. Less piping is needed for vertical loops, but they are more expensive to install.

Use of **slinky loops** reduces the heat exchanger per foot trench requirements but more pipe is required per ton of capacity. This pipe is laid in the trench, coiled like a slinky and overlapped. 200 to 300 feet of more pipe per ton of nominal heat exchange capacity may be required for two-pipe systems. As the number of pipes in the trench increases or as slinky overlap increases, the trench length decreases

A special kind of **closed loop** system is **pond loops**. You can place closed loop coils on the bottom of a pond or stream if it is deep enough and has enough flow. Just like a closed loop ground system, the geothermal transfer fluid is pumped. With no aquatic environmental impact, first cost economics are very attractive.

There is a variety of ways to connect geothermal heating and cooling systems to the earth. Good installation practices produce high system performance. Terra-Therm's authorized; highly trained dealers are professionals with understanding of local codes and conditions. Visit our website and find a Terra-Therm authorized dealer with knowledge to discuss the best systems for your needs.

WHAT IS THE LIFE OF THE PIPE EXPECTED TO BE?

A 50-year warranty covers the high-density polyethylene pipe that is used in a closed loop system. Testing done independently indicate a useful life span of over 200 years.

PIPE SECTIONS OF THE LOOP ARE JOINED HOW?

The only acceptable method used to join pipe sections is thermal fusion and stab fittings. To form a joint stronger than the original pipe the thermal fusion connections are either socket or butt fused. Fairly new but proving themselves to be reliable are stab fittings. Unacceptable and eventually causing the loop to leak and fail is the use of barbed fittings, clamps and glued joints.

WHAT TYPE OF FLUID IS USED IN THE LOOPS?

Propylene glycol and methyl alcohol – two types of antifreeze solutions that are used. A solution specific to your climate and ground conditions is formed by mixing water with the appropriate antifreeze.

WHAT TYPE OF TERRA-THERM GEOTHERMAL HEAT PUMPS ARE AVAILABLE?

Terra-Therm offers the most comfortable, reliable, efficient and quiet heat pump available today. Our complete line includes both Forced Air and Hydronic providing installations for both residential and commercial projects.

Forced air heat pump systems are generally used in homes today. Hot or cold air is distributed using conventional ductwork and humidity control is provided, also.

Hydronic heat pumps are used in a wide variety of distribution systems which include: radiant floor, baseboard hydronic, cast iron radiators, and fan coils heat or chill water. Residential, commercial and industrial applications are typical. Other uses that require heated or chilled water are: ice rinks, fish farms, snow melt, car washes, and dairy farms.

HOW CAN ANY SYSTEM BE MORE THAN 100% EFFICIENT?

Geothermal systems don't make heat; they simply move it from the earth into your home. In essence, you are just paying for the transportation. In fact, for every BTU of energy you use, you will get back 3 BTU's of heat making geothermal heating 300% efficient!

DO I NEED TO INCREASE THE SIZE OF MY ELECTRIC SERVICE?

The electrical service in most homes is already adequate. The low energy requirements of TERRA-THERM's units make it perfect for new construction as well as retrofit installations.

WHERE IS THIS HEAT PUMP INSTALLED?

TERRA-THERM heat pumps are placed indoors. This is very pleasing for many reasons. Installations indoor will free up space outdoors giving better architectural design and yard usage. Outdoor condenser noise is eliminated and you have greater system longevity as the heat exchanger coils and electrical controls are protected from the elements.

WHAT IS THE COST OF A SYSTEM? WHAT IS THE LENGTH OF THE PAYBACK PERIOD FOR A SYSTEM?

Of course, the costs vary depending on the size and complexity of the system you choose. Generally speaking, a geothermal system will be more expensive than a conventional system up front, but its low operating costs more than offset the initial expense.

This varies greatly, depending on individual circumstances. A standard home of 2000 square feet, on average, will cost between $14,000 - $18,000. This denotes right around double the costs of conventional heating, cooling and hot water systems. Generally we see a 3 – 5 year payback of these additional costs. After that, it's money in the bank.

WHAT ABOUT COMFORT?

A Geothermal unit system moves warm air (90-105(F) throughout your home or business via standard ductwork. An even comfort level is created because the warm air is moved in slightly higher volumes and saturates the building with warmth more evenly. This helps even out hot or colds spots and eliminates the cold air blasts common with fossil fuel furnaces.

WHAT ABOUT SNOW MELTING? CAN GEOTHERMAL DO THIS?

Yes. It is becoming increasingly modern for snow melting on sidewalks and driveways. You can include it into the overall geothermal systems design.

CAN I HEAT MY POOL?

Yes. You can easily and inexpensively heat an indoor or outdoor pool with a heat pump.

MY HOUSE IS VERY LARGE; CAN YOUR UNIT HEAT MY HOME?

Yes. These units are designed for homes up to 20,000 square feet. In most areas of the U.S. you may expect to pay $30 to $50 a month to heat and cool a 1,500 square foot home. We can do it whatever the size of your home.

WHAT KIND OF MAINTENANCE CAN I EXPECT?

There is very little maintenance involved with a properly installed TERRA-THERM closed-loop heat pump. You will regularly maintain the air filter and air blower assembly. On open-loop systems, water coil maintenance is recommended because water quality will greatly affect the efficiency of the heat exchanger.

WILL THERE BE IMPROVED INDOOR AIR QUALITY WITH THIS SYSTEM?

Yes. There are no indoor air pollutants because the heat pump system doesn't produce any products of combustion. Chimneys to vent away the harmful carbon monoxide and other dangerous gases are necessary with conventional gas and propane systems.

HOW DO YOU SIZE A HEAT PUMP?

Sizing is based on an accurate heating and cooling analysis of your home or building, done by a qualified, trained dealer contractor. Items taken into account include the type of windows and insulation R values. This results in BTU per hour heat loss and gain information. Then the heat pump is sized, keeping you warm even during the coldest winter night and cool on the hottest summer day.

HOW DOES GEOTHERMAL COMPARE WITH OTHER RENEWABLE ENERGY TECHNOLOGIES?

A geothermal system will give you the quickest return on investment of any form of renewable energy. Often, the price difference between a conventional heating system and a geothermal system can be paid back in 5-7 years. In fact, the savings realized on your energy bills from your geothermal system can be used to finance additional renewable energy technologies for your home if you choose.

IS A GROUND SOURCE HEAT PUMP WORTH THE EXTRA INITIAL COST?

Almost always, yes. Let's look at an example of a 1700 sq ft house and compare the cost of operation of a geothermal heat pump using a heat pump rate of $.05/Kwh with a 92% efficient LP furnace using $1.25/gal fuel prices. Assume the heat pump costs $15,000 installed and the furnace and A/C costs $6000 (not counting ductwork in either case). Assume also that your electric rate is increasing by 2%/year and LP is going up 5%/year and you finance your house for 20 years at 6% interest. The annual cost of operation of the heat pump combined with loan costs is $1927 ($1289 loan cost and $638 operating cost) and the annual cost of the conventional system is $2609 ($515 loan cost and $2054 operating cost). You save $647 your first year of operation. After 10 years, you save $11,231: More than enough to pay back the difference in cost. The bigger the house, the more you save.

DO UTILITY COMPANIES OFFER REBATES ON GROUND SOURCE HEAT PUMPS?

Many of them do but the purchase of a ground source heat pump should make sense without rebates. If they offer rebates, that is the icing on the cake but the real value is in your monthly savings on your energy bill. Contact your local utility company for their rebate program.

ARE GEOTHERMAL SYSTEMS SAFE?

They are the safest heating system you can put in your home. They use no combustion gasses or fossil fuels of any kind nor do they produce carbon monoxide or carbon dioxide. There is no risk of explosion since there is no flame at all!

WHAT ABOUT THE ENVIRONMENTAL IMPACT OF REMOVING HEAT FROM THE EARTH?

The EPA has called geothermal heat systems the "most environmentally friendly system you can put in your home". They burn no fuel and therefore, they produce no byproducts. The little heat that is borrowed from the earth over the winter is put back in the summer, making the cycle complete.

WHAT IS THE LIFE OF A SYSTEM?

The life of a system is nearly double that of a conventional system. Serviceable life is expected to be 25 to 35 years (by experts).