HIGHLANDS GEOEXCHANGE

RESIDENTIAL

Q&A

IS GEOEXCHANGE HEATING & COOLING RIGHT FOR YOU?

GEOEXCHANGE

Geoexchange heating and cooling will save you money, reduce your energy use and keep the environment cleaner for your family and your community.

It is the most cost-effective, energy efficient and environmentally friendly method of heating and cooling your home available today.

This booklet will show how you can reduce your utility bills by up to 70% today and for many years to come.

Geoexchange heating and cooling technology continues to gain momentum amid concerns over pollution, energy conservation and rising energy costs.

Our technology is proven, reliable and safe.
It significantly reduces energy usage and utility bills for homeowners and business owners.

Millions of Geoexchange systems are saving money and protecting the environment across North America, Canada, Europe, Asia, Australia and New Zealand.

We've prepared this booklet to answer some of the commonly asked questions about how Geoexchange systems work and how they can benefit you.

1 WHAT IS GEOEXCHANGE?

How does a Geoexchange heating and cooling system work?

Outdoor temperatures fluctuate widely with the changing seasons but underground temperatures do not. 1.2 to 2.0 meters below the earth's surface, temperatures remain relatively constant year-round. A geoexchange system, which typically consists of an indoor unit and a buried earth loop, capitalizes on these constant temperatures to provide "free" energy.

In winter, fluid circulating through the system's earth loop absorbs stored heat and carries it to the indoor unit. The indoor unit compresses the heat to a higher temperature and distributes it throughout the building.

In summer, the system reverses, pulling heat from the building, carrying it through the earth loop and depositing it in the cooler earth.

What makes a Geoexchange system different from ordinary systems?

Unlike ordinary systems, geoexchange systems do not burn fossil fuel to generate heat; they simply transfer heat to and from the earth to provide a more efficient, affordable and environmentally friendly method of heating and cooling. Typically, electric power is used only to operate the unit's fan, compressor and pump.

What are the components of a Geoexchange system?

The three main parts consist of the ground source or geothermal heat pump unit, the liquid heat-exchange medium (closed or open loop), and the heat delivery system (either air-delivery ductwork or water delivery such as a hydronic floor slab or radiators).

How efficient is a Geoexchange system?

A Geoexchange system is three to five times more efficient than the most efficient ordinary system. Geoexchange systems do not burn fossil fuels to make heat, they provide three to five units of energy for every one unit used to power the system.

Why do ground source heat pumps not have a "star" rating like air-to-air heat pumps?

The existing star scale is not extensive enough to include ground source heat pumps.

Hypothetically; if the existing formula and scale were used many WaterFurnace ground source heat pumps would exceed 12 stars on the 6 star scale.

What is a COP and what does it tell me about the efficiency?

The Coefficient of Performance (COP) is a ratio of the unit input (kW) over the unit output (kW) at specific operating conditions and hence is a measure of unit efficiency. It's a scientific way of determining how much energy the system produces versus how much it uses. For instance, a typical LPG furnace with an efficiency of 80 to 90 % will have a COP of 0.8 to 0.9. Most ground source heat pump systems have COPs of 3-5 (WaterFurnace's Envision Series is rated up to a peak of 6.8). That means for every one unit of energy used to power the system, 3-5 units are supplied as heat.

Rated COPs are often different to that experienced in the home due to factors such as location of the unit in exposed areas, blocking of air filters, varying outdoor air temperature, defrost cycles etc.

One of the main benefits of a Geoexchange system is that due to their internal and underground nature, they are less susceptible to these fluctuations and as such the annual average COP will only be slightly less than the certified COP. Whereas, due to their reliance on outside temperatures, direct sun exposure etc, the COP of air-sourced systems can vary dramatically over the course of a year. The defrost cycle is one such example where an air sourced system is using energy to heat itself rather than your home.

Do Geoexchange systems require much maintenance?

Geoexchange systems are practically maintenance free. When installed properly, the buried loop will last for generations. And the other half of the operation – the unit's fan, compressor and pump – is housed indoors, protected from the harsh weather conditions.

Usually, periodic checks and filter changes are the only required maintenance.

2 HOW DOES IT WORK?

Are all Ground Source heat pumps alike?

No. There are different kinds of ground source heat pumps designed for specific applications.

Many ground source heat pumps, for example, are intended for use only with higher temperature ground or ground water applications. Others will operate at entering water temperatures as low as -4°C, which are possible in closed-loop systems.

Ground source heat pumps can also differ in the way they are designed. Self-contained units combine the blower, compressor, heat exchanger and coil in a single cabinet.

How does a Ground Source heat pump work?

Anyone with a refrigerator has witnessed the operation of a heat pump. Rather than making heat, a ground source heat pump takes existing heat and moves it from a lower temperature location to a higher temperature location. Refrigerators are heat pumps that remove heat from colder interior spaces to warmer exterior spaces for cooling purposes. Heat pumps also move heat from a low temperature source to a high temperature space for heating.

An air source heat pump, for example, extracts heat from outdoor air and pumps it indoors.

A ground source heat pump works the same way, except that its heat source is the warmth of the earth. The process of elevating low temperature heat to over 38°C and transferring it indoors involves a cycle of evaporation, compression, condensation and expansion. A refrigerant is used as the 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 (fluid 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 more than 82 °C. The hot gas then circulates through a refrigerant-to-air heat exchanger where heat is removed and pumped into the building at about 38 °C. When it loses heat, the refrigerant changes back to a liquid which is then cooled as it passes through an expansion valve and begins the process again. To work as an air conditioner, the system's flow is reversed.

Does a Geoexchange system heat and cool?

Yes. A simple flick of a switch on your indoor thermostat will change from one mode to another. In the cooling mode, a ground source heat pump takes heat from indoors and transfers it to the cooler earth. In the heating mode, the process is reversed.

Can a Geoexchange system also heat my domestic water?

Yes. Ground source heat pumps can provide free preheating of your domestic hot water using an option called a desuperheater. This 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 and some of this heat can be transferred into the cooler water through the copper wall of the desuperheater heat exchanger. A small circulator then transfers this heated water into the storage tank of your domestic hot water service.

3 CHOOSING YOUR SYSTEM

Do I need separate earth loops for heating and cooling?

No. The same loop works for both. To switch heating to cooling, or vice versa, the flow of heat is simply reversed.

Does the underground pipe system really work?

The buried pipe, or earth loop, was an important technical advancement in heat pump technology. The idea of burying pipe in the ground to gather heat energy originated in the 1940s. New heat pump designs and more durable pipe materials have been combined to make Geoexchange systems the most efficient heating and cooling systems available.

What types of loops are available?

There are two main types: closed and open.

What is a closed loop system?

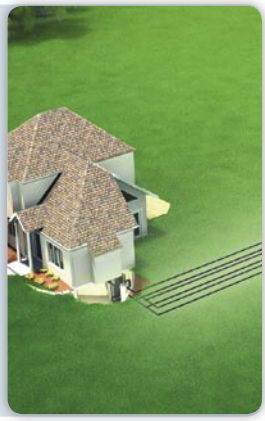
A closed loop system uses a continuous loop of buried polyethylene pipe. The pipe is connected to the indoor heat pump to form a sealed, underground loop through which water or an environmentally friendly antifreeze-and-water solution is circulated. A closed loop system constantly re-circulates its heat-transferring solution in pressurized pipe, unlike an open loop system that consumes water from a well.

Closed loops can be either horizontal or vertical or located within a water body (closed water loop). Land area, soil conditions and availability of a suitable water body will determine the most suitable and cost effective closed loop for your site.

What is the difference between horizontal and vertical closed loops?

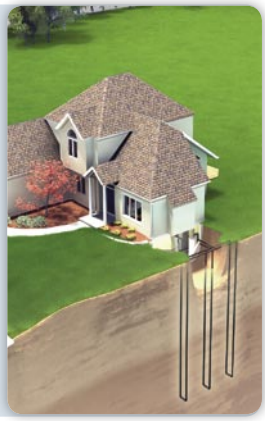
HORIZONTAL CLOSED LOOPS

Horizontal closed loops are placed in trenches or excavated areas to depths of several metres deep. Backfill material is then placed over the loop and the surface restored. The length and diameter of pipe in the ground are all related to the heating and cooling capacity required in the home.



VERTICAL CLOSED LOOPS

Vertical closed loops are typically drilled to depths from 50 to 100 m deep. U-shaped loops of pipe are inserted in the boreholes which are then backfilled with a grout solution to ensure both protection of underground aquifers as well as increased connectivity with the surrounding ground.



How long will the loop pipe last?

Closed loop systems should be installed using only high-density polyethylene or polybutylene pipe. They have a chemical half life of ~250 years, are inert to chemicals normally found in soil and properly installed would be expected to last well beyond the life expectancy of your home. PVC or copper pipe should not be used.

How are the pipe sections of the loop joined?

Pipe sections are joined by thermal fusion. Thermal fusion involves heating the pipe connections and then fusing them together to form a joint that's stronger than the original pipe. This technique creates a secure connection to protect from leakage and contamination.

Will an earth loop affect my lawn or landscape?

No. Research has proven that loops have no adverse effect on grass, trees, or shrubs. Most loop installations use trenches about 600 milimeters wide. This, of course, will initially leave temporary bare areas, but they can easily be restored with grass seed or sod. Vertical loops require little space and result in minimal lawn damage.

I have a pond nearby. Can I put a loop in it?

Yes, if it's deep enough and large enough. A minimum of 1.8 meters in depth at its lowest level during the year is needed for a pond to be considered as suitable. The surface area required depends on the heating and cooling load of the structure.

What is an open loop system?

An open loop system uses groundwater from an ordinary well as a heat source. The groundwater is pumped into the heat pump unit where heat is extracted and the water is disposed of in an environmentally safe manner. Because groundwater is a relatively constant temperature year-round, wells are an excellent heat source.

How much groundwater does an open loop system require?

The water requirement of a specific model is usually expressed in litres per second (l/s) and is listed in the unit's specifications. Generally, the average system will use 0.07 l/s per kilowatt of capacity while operating. However, the exact volume of water required depends on the size of the unit and the manufacturer's specifications. Your contractor should be able to provide this information.

Your well and pump combination should be large enough to supply the water needed by the heat pump in addition to your domestic water requirements. You probably will need to enlarge your pressure tank or modify your plumbing to supply adequate water to the heat pump.

What do I do with the discharge water?

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 (if permitted in your local area). 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 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.

Are there any laws that apply to open loop installations?

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.

Does an open loop system cause environmental damage?

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. Systems are designed to ensure this does not result in heating or cooling of the aquifer.

Can I reclaim heat from my septic system disposal field?

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.

What problems can be caused by poor water quality?

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 level 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.

Impurities, particularly iron, can eventually clog a return well. If your water has high iron content, make sure that the discharge water is not aerated before it's injected into a return well.

4 WHAT EVERY OWNER SHOULD KNOW

How do I know if the dealer and loop installers are qualified?

GeoExchange Australia staff and their certified Dealers are qualified with both the International Ground Source Heat Pump Association (IGSHPA) and WaterFurnace. Always check that your dealer is appropriately qualified.

Is a ground source heat pump difficult to install?

Most units are straight forward to install, particularly when they replace another forced-air or hydronics 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.

Another popular way to use ground source technology is with in-floor radiant heating, in which hot water circulating through pipes under the floor heats the room.

I have ductwork, but will it work with this system?

In all probability, yes. Your installing contractor should be able to determine ductwork requirements and any minor modifications, if needed.

If a home has ceiling cable heat or baseboard heat, do air ducts need to be installed?

Not always. It may be desirable to install ground source heat pump room units. For some small homes, a one-room unit would handle the heating and cooling needs. Ceiling cable or baseboard units could be used for supplemental heat if desired.

Do I need to increase the size of my electric service?

Ground source heat pumps don't use large amounts of resistance heat so your existing service may be adequate. Generally, a 50-amp service will have enough capacity and smaller amp services may be large enough in some cases. This is dependent on the capacity of the ground source heat pump being installed. Your electric utility or contractor can determine your service needs.

Is a Geoexchange system suitable for an off-grid home?

The answer to this question is a large maybe? Most off-grid homes will be highly energy efficient and as such should require only minimal heating and cooling. However, although highly efficient. The ground source heat pump is still powered by electricity and as such will increase your energy usage. A careful analysis should be made of the electrical requirements prior to committing to a Geoexchange system on an off grid home.

What is the Kilowatt size of the ground source heat pump that's being proposed?

Furnaces are designed to provide specific amounts of heat energy per hour. The term "Kilowatt (kw)" refers to how much heat can be produced by the unit in an hour.

Before you can determine what size furnace you'll need, you must have a heat loss/heat gain calculation done on the structure. From that, an accurate determination can be made of the size of the system you'll need.

Most fossil fuel furnaces are substantially oversized for heating requirements, resulting in increased operating cost and unpleasant temperature swings.

How long is the payback period for a Geoexchange system?

Payback periods are a function of the type of ground loop installed, the operating conditions and hours of the system and the alternative or conventional heating and cooling system. To figure this accurately, you must know how much you'll save each year in energy costs with a ground source system as well as the price difference between it and an ordinary heating system and central air conditioner.

As an example: If you'll save $2000 per year with a ground source system and the price difference is $10,000, your payback will be five years. If you install a ground source system in a new home, the monthly savings in operating costs generally will offset the additional monthly cost in the mortgage, resulting in an immediate positive cash flow.

"The WaterFurnace system has been a hassle free and cost effective alternative. We carefully investigated all the alternatives before selecting this system and have been delighted with the efficiency and performance."
Steve, Adelaide Hills

5 GLOSSARY

kW (Kilowatt):	kW is used to signify the heating and cooling capacity of a system and the heat losses and gains of buildings and homes.
kWhr (kilowatt hour):	The amount of energy equivalent to a steady power of 1 kilowatt running for 1 hour, or 3.6 megajoules.
Closed loop system:	A heat pump system that uses a loop of buried plastic pipe as a heat exchanger. Loops can be horizontal, vertical or located in a water body.
COP (Coefficient of Performance):	The ratio of heating or cooling provided by a heat pump (or other refrigeration machine) to the energy consumed by the system under designated operating conditions. The higher the COP, the more efficient the system.
Compressor:	The central part of a heat pump system. The compressor increases the pressure and temperature of the refrigerant and simultaneously reduces its volume while causing the refrigerant to move through the system.
Condenser:	A heat exchanger in which hot, pressurized (gaseous) refrigerant is condensed by transferring heat to cooler surrounding air, water or earth.
Cycling losses:	The efficiency of a heating or cooling system is reduced due to start-up and shut-down losses. Oversizing a heating or cooling system increases cycling losses.
Desuperheater:	A device for recovering superheat from the compressor discharge gas of a heat pump or central air conditioner for use in heating or preheating water.
Evaporator:	A heat exchanger in which cold, liquid refrigerant absorbs heat from the low-temperature source (fluid from the ground loop).
Fossil fuel:	Combustible fuels formed from the decomposition of organic matter. Examples are natural gas, lpg, wood, fuel oil, diesel, wood pellets, lignite and coal.
Ground source heat pump:	A heat pump that uses the earth as a heat source and heat sink.
Heat exchanger:	A device designed to transfer heat between two physically separated fluids or mediums of different temperatures.
Heat Pump:	A mechanical device used for heating and cooling which operates by pumping heat from a cooler to a warmer location. Heat pumps can extract heat from air, water, or the earth. They are classified as either air-source or ground source units.
Heat sink:	The medium – air, water or earth – which receives heat rejected from a heat pump.
Heat source:	The medium – air, water or earth – from which heat is extracted by a heat pump.
Open loop system:	A heat pump system that uses groundwater from a well or surface water from a lake, pond, or river as a heat source. The water is returned to the environment.
Payback:	A method of calculating how long it will take to recover the difference in costs between two different heating and cooling systems by using the energy and operating cost savings from the more efficient system.
Supplemental heating:	A heating system used during extremely cold weather when additional heat is needed to moderate indoor temperatures. May be in the form of fossil fuel or electric resistance.

6 LETS GET STARTED!

Call your accredited GeoExchange dealer to discuss the potential for a Geoexchange system in your home. Our dealers are certified with both the International Ground Source Heat Pump Association (IGSHPA) and WaterFurnace for both system design and installation.

A preliminary assessment of your home will require a copy of your building plans and a site plan, as well as information on construction materials, insulation and local soil and geological conditions.

Geoexchange dealers can provide you with a cost comparison using industry-leading software so that you can quickly see the benefits of installing a Geoexchange system.

Call us on 02 8404 4193, visit our website at www.geoexchange.com.au or contact your local dealer below

Your local accredited GeoExchange dealer

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