Ground Source Heat Pumping

A contractor's guide to understanding the ground source heat pump market

Boom or Bust

Introduction

Ground source heat pumps and geothermal systems have become the new *"buzzwords"* within the underground and trenchless industry. As with any new and emerging market, there are great opportunities, but also potential challenges.

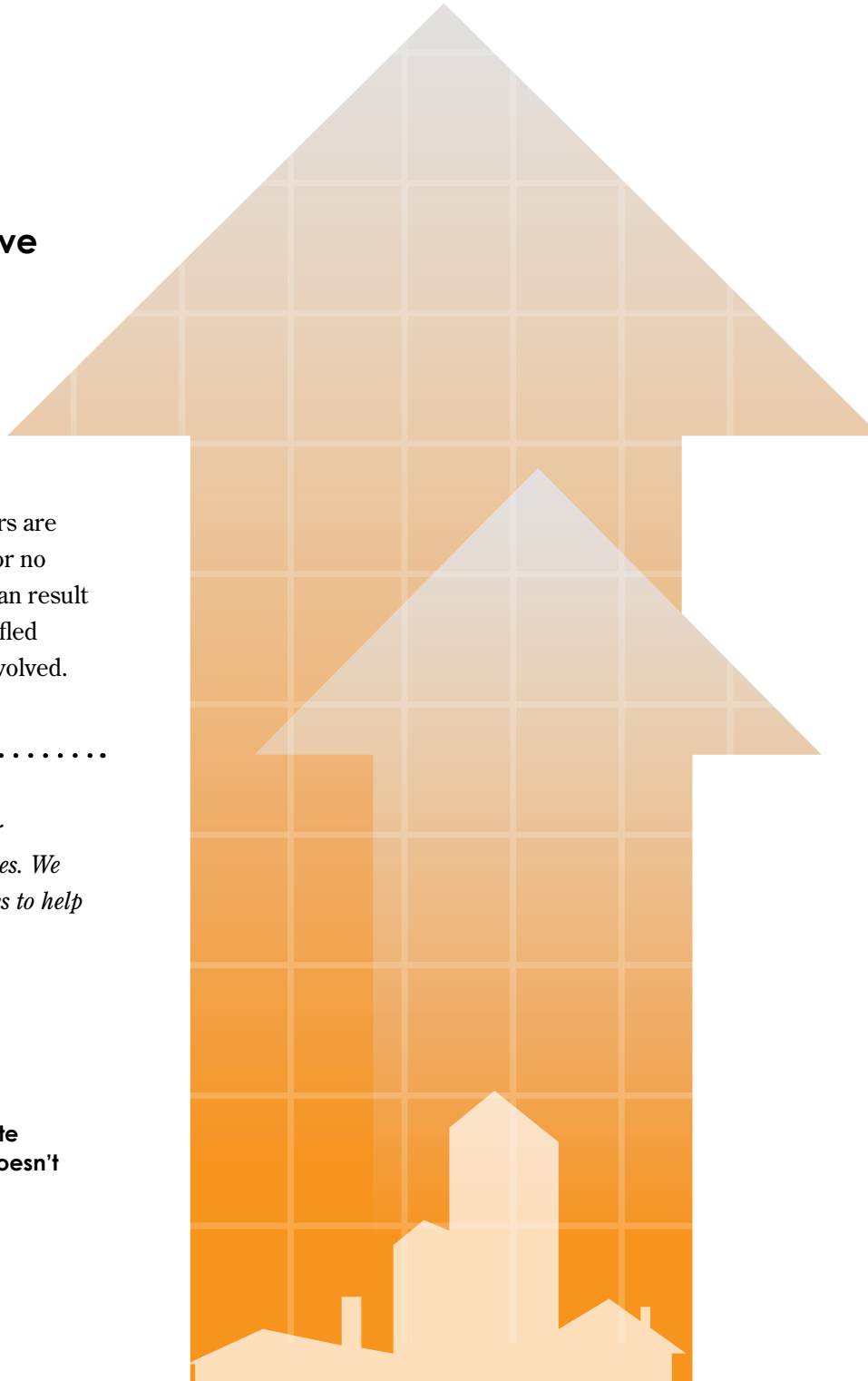
CURRENTLY the industry is experiencing a shortage of installers due to the rapid acceptance of this technology by homeowners and businesses. The opportunity for underground contractors lies in the installation of ground source heat pump loops.

HOWEVER, some contractors are entering the market with little or no training and experience. This can result in unsuccessful projects and stifled market growth for everyone involved.

This e-book will provide you with an overview of the market, how it works, opportunities for contractors, challenges you may face, training available and how to best market your services. We encourage you to read this e-book, watch the videos and connect with our partner companies to help expand your knowledge of ground source heat pump systems.

Questions?

Trenchless Technology, in cooperation with Vermeer, developed this e-book to educate underground contractors about the ground source heat pump market. If this e-book doesn't address all of your questions, please don't hesitate to contact Vermeer or our partners.



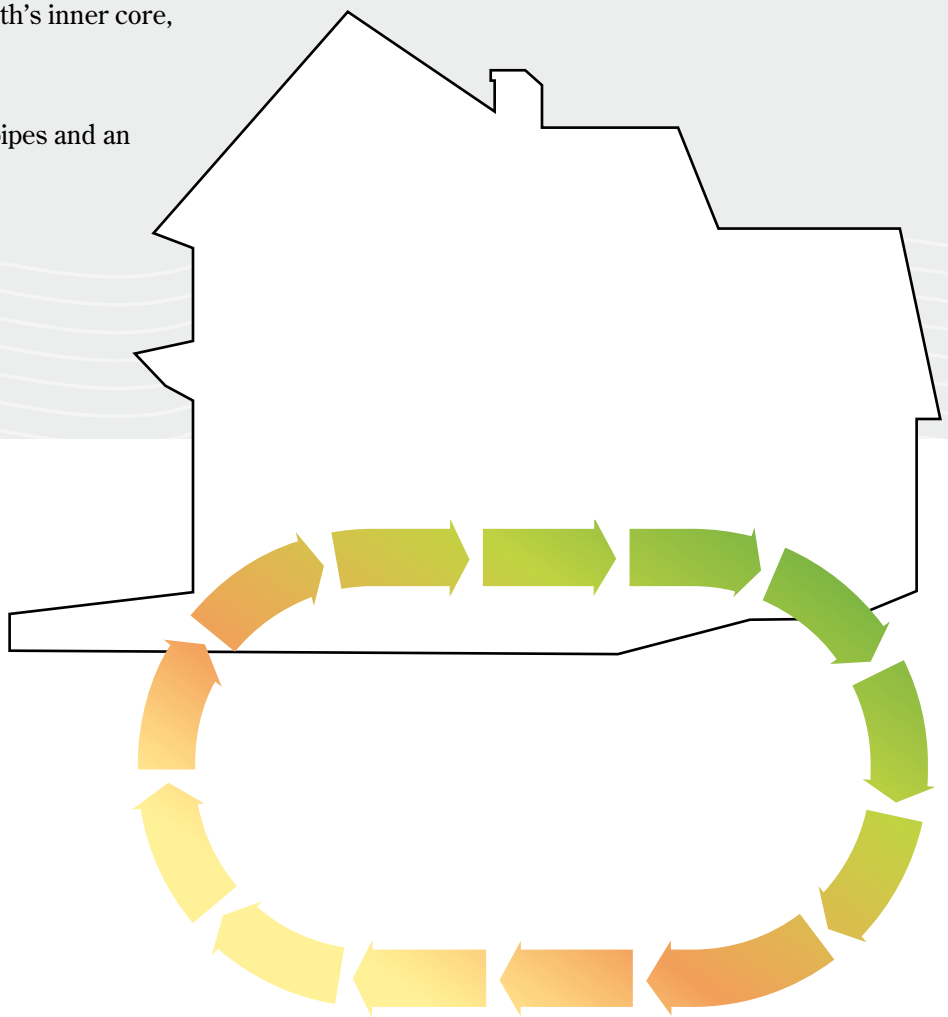
What is a ground source heat pump?

Ground source heat pumping (GSHP) — more commonly referred to as geothermal in the residential market — is the process of heating and cooling a building's air and water by moving heat in and out of the ground.

The correct definition of geothermal refers to the heat produced by the Earth's inner core, which is made of magma. This concept is entirely different from GSHP.

Using true geothermal heat in your home would require some pretty long pipes and an impossibly long drill capable of reaching the center of the Earth.

It's definitely not safe down there, as demonstrated by the monstrous, flesh-eating Dimetrodons in the 1959 screen adaptation of Jules Verne's Journey to the Center of the Earth.

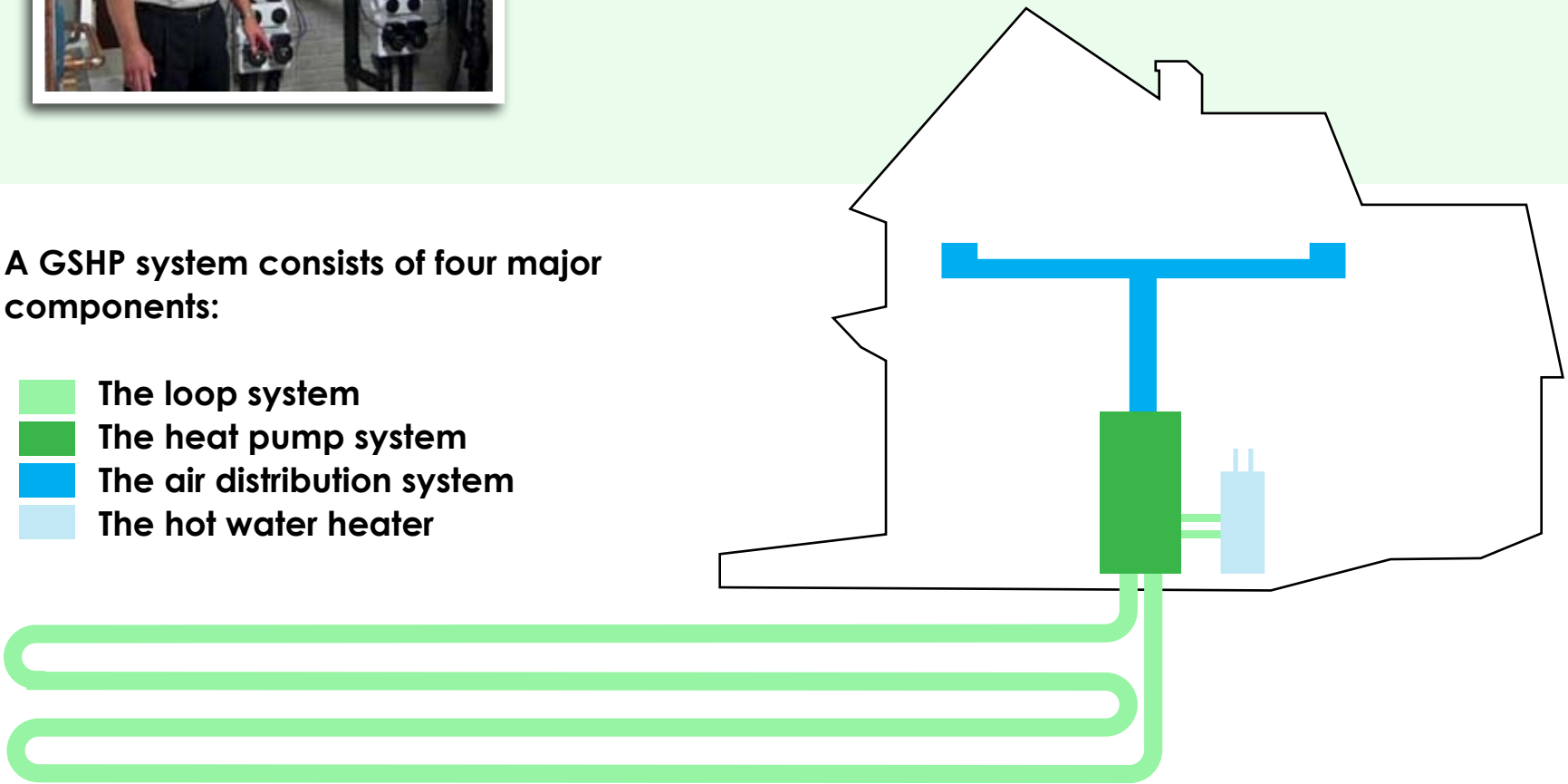


How does GSHP work?

Chuck Gassmann with Bell Brothers Heating & Air Conditioning Inc. located in Des Moines explains how the internal GSHP components work.

A GSHP system consists of four major components:

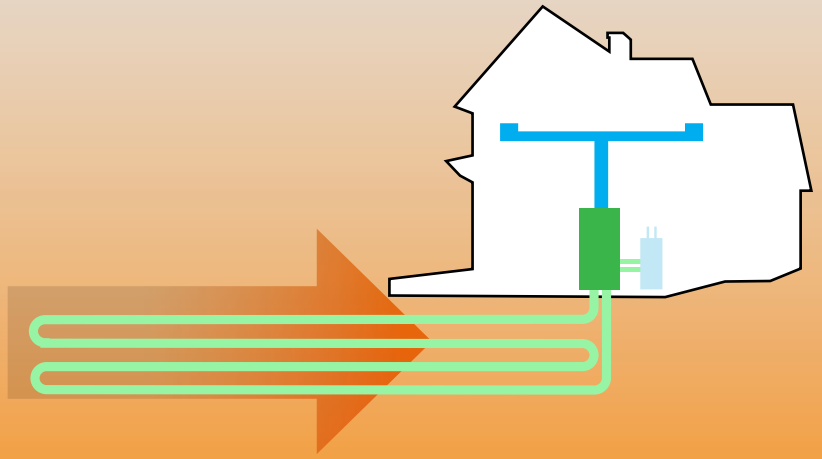
- **The loop system**
- **The heat pump system**
- **The air distribution system**
- **The hot water heater**



How does GSHP work?

Using heat from the ground to heat a building

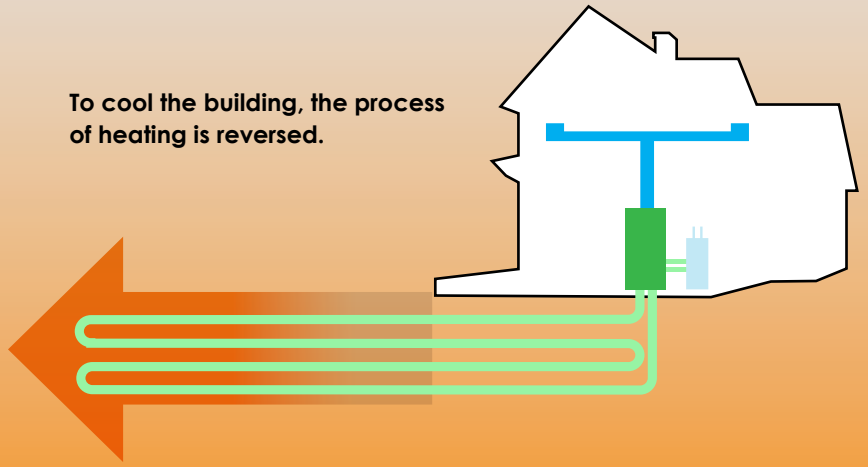
1) The fluid in the loops absorbs the heat from the ground.
2) The fluid circulates into the indoor heat pump.
3) The heat exchanger concentrates the heat.
4) The heat is distributed throughout the structure via the duct work.
5) Part of the heat is also distributed to the hot water heater to preheat the water going into it.
6) The fluid constantly cycles back through the loops, where it reheats and the process repeats itself.

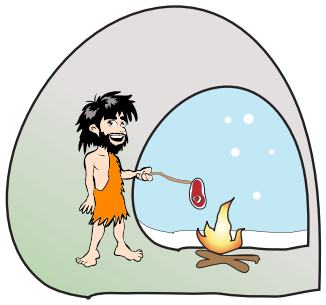


Moving heat to cool a building

1) Heat and humidity are extracted from the structure via the ductwork.
2) The heat is concentrated and directed to the water heater or is circulated back into the ground via the loops.
3) The heat in the loop is absorbed into the ground.
4) The cool air that remains is distributed throughout the structure using the same ductwork.

To cool the building, the process of heating is reversed.





So easy a caveman can do it. The concept of transforming ground heat to room heat may seem like something best described by Bill Nye the science guy, but in fact it's quite simple. Cavemen lived in caves because of the heat the ground provided during winter months. GSHP systems harness this heat and redistribute it.

There's opportunity in the Earth

Did you know…

The Earth is a giant solar collector?

- The sun offers 500 times more heat than humankind can use.
- 47 percent of the sun's energy is absorbed by the ground.
- The amount of energy the Earth receives from the sun in one hour is more energy than humanity requires in one year.

The temperature of the Earth's surface remains relatively constant?

- The temperature of the ground at a shallow depth remains stable throughout the year.
- This thermal stability can be used by GSHP systems to heat and cool a home.

Ground heat is a renewable energy resource. On the other hand, once a fossil fuel is burned in a conventional furnace, it's gone forever. That's probably what happened to the dinosaurs.

GSHP benefits at a glance

Efficient and environmentally friendly

- Moving heat is five times more efficient than creating heat.
- According to the International Ground Source Heat Pump Association, GSHP provides heating efficiencies that are 50 to 70 percent higher than other heating systems and cooling efficiencies that are 20 to 40 percent higher than air conditioners.

Comfortable indoor environment

- Because GSHP systems use the thermal stability of the Earth's surface, there is less temperature fluctuation when compared to traditional heating and cooling systems.

Safe, clean and quiet

- GSHP systems require no flames, fumes, flues or outdoor condensing units.

Top five financial reasons to install a GSHP system:

1) The Federal Renewable Energy Tax Credit provides buyers with a one-time 30 percent tax credit through 2016. No cap!

2) According to the Environmental Protection Agency, GSHPs have the lowest lifecycle cost of all heating systems.

3) GSHP systems can provide up to 70 percent savings in monthly utility costs.

4) Many utility companies offer incentives for installing a GSHP.

5) Installing a loop is a long-term investment in a property, potentially increasing resale value.

6) Who doesn't like saving money?
Alright, we added an extra one, but it's true!

Market drivers

GSHP, while not a new technology, has seen tremendous growth in the last decade, both in the United States and abroad. The global market for GSHP systems has grown 10 percent annually over the last 10 years.

What is driving growth in the U.S.?

- Commercial and residential growth is being fueled by the availability of attractive incentives. The Federal Renewable Energy Tax Credit provides buyers with a one time 30 percent tax credit through 2016. No cap.

- Government-owned buildings such as public schools, hospitals and post offices now have federal money available for renewable energy projects due to the Federal Energy Management Program.

Everyone is jumping on this bandwagon, which disproves this theory.

- **Over 80,000 units are installed annually in the United States, accounting for 56 percent of global installations.**
- **GSHP systems are installed in more than 33 countries.**
- **Europe accounts for 39 percent of global installations.**
- **Asia accounts for 5 percent of global installations.**

Get in the loop about loops

There are a few main loop systems typically being used — horizontal, vertical and steep angle closed-loop systems.

With any of these installation methods, each hole will contain a single loop of polyethylene pipe that has a U-bend at the end. Once the pipe or loop is installed into the hole, it is surrounded with a specially designed grout to secure the pipe to the ground and help enhance conductivity. The series of loops then connect to a supply line that feeds to the heat pump inside the structure.

Horizontal closed-loop systems — Loops are installed horizontally when there is adequate yard space to do so. Generally, 400 to 600 feet (121.9 to 182.9 m) of pipe (total) per ton of load is required for a typical residential system. These loops are installed in a series of bores that can range from 200 to 250 feet (60.9 to 76.2 m) in length.

Pros:

— Horizontal loops can be installed under driveways or buildings, making them an ideal choice for new construction.

— Installation can be completed with a wide range of equipment, including a horizontal directional drill, trencher, backhoe or compact excavator.

Cons:

— Horizontal loops require a considerable amount of land, which often makes retrofit installations impossible.

Get in the loop about loops

Vertical closed-loop systems — Loops are installed vertically when limited space is available or when the building requires large heating and cooling loads. Because these loops are typically installed 150 to 200 feet (45.7 to 60.9 m) below the ground and with a relatively small footprint, there is a reduced likelihood of encountering underground utilities when compared to horizontal loops, provided the utilities are properly located.

Pros:

— Vertical loops cause minimal ground disturbance, making them an ideal choice for retrofit applications.

— Less land and pipe are needed when installing vertical loops.

Cons:

— Deep installation increases the chance of encountering rock formations.

— Vertical loops can be more expensive than horizontal and require a driller's license to install in most states.

— Installation generally requires a vertical well-drilling rig, but some horizontal directional drills can complete steep angle or vertical bores.

When drilling vertically, it's amazing how many different types of soils — topsoil, clay, gravel and sand — you can drill through in a single bore. *Like your parents always said, "Jimmy, you can bore anything you put your mind to."*

Get in the loop about loops

Steep angle or diagonal closed-loop systems — Loops are installed at a steep angle or diagonally when there is limited yard space available or where minimal disruption to the existing landscape is desired. A single pit is used and the bore holes are shot from this center location, reducing the number of entry areas.

Pros:

— Set and shoot from a single pit.

— Avoid deeper and more challenging ground formations by completing multiple shot from a single location.

Cons:

— Encounter more varying ground formations, as compared to horizontal installations.

Do loops last? Well, do they?

Top five loop facts to put your prospects at ease:

1) Loops are made of high-density polyethylene plastic, typically 0.75 inch (1.9cm) or thicker in diameter.
2) Loops are built to withstand stretching up to six times their original length before the occurrence of stress fractures.
3) All pipe connections are made through heat fusion at 500° F (260°c).
4) Many manufacturers offer 50-year warranties on their loops.
5) In areas of freezing, environmentally safe antifreeze solutions are used to protect the pipes.

Steady growth = challenges = opportunities

The steady and sometimes rapid growth of the GSHP market has created a shortage of experienced loop installers. But this growth is also creating opportunities for underground contractors to expand their service offering into the GSHP market as a loop installer.

Underground contractors already have a lot of the equipment — horizontal directional drills, trenchers, compact excavators or backhoes — needed to install horizontal loops. The biggest opportunity is in the residential retrofit market as these are typically easier and smaller projects to tackle early on.

The use of GSHP systems is also increasing in commercial (business, schools, church, etc.) applications. In these instances, the loops can be installed using much of the equipment already in your fleet. However, vertical loops may be required in some cases due to land mass restrictions. In these cases a well drilling rig may need to be used.

Listen as Mike Kapps, vice president of U.S. government and international sales with WaterFurnace, provides an overview of what is driving the interest in GSHP systems.

What's a retrofit?

While your uncle's polyester bellbottoms may have a retro fit, we're talking about something entirely different.

When a homeowner needs to replace their existing furnace, they may decide to install a GSHP system. This is possible assuming the residence has ductwork or the ability to add ductwork, and ample space for the installation of the GSHP system components. The residence also needs to have the land mass available to either install vertical or horizontal loops.

Before you take the leap

While the GSHP market may look appealing, don't jump in too fast.

With any new market, contractors need to research the pros and cons to their business. Also, certain regions of the United States have a shortage of loop installers, while others have an abundance. Just because this is a growing market, doesn't mean it's the right market for your company.

Step 1 – Reach out to other contractors involved in GSHP loop installations. Ask them to share their experiences and insight. Don't know of any in your area or state? Visit the International Ground Source Heat Pump Association for a directory of accredited loop installers by state.

Step 2 – Visit with HVAC contractors to get a feel for how GSHP systems are accepted in your area. Ask them about the industry, challenges they face with loop installations, what percentage of work is commercial and residential, what percentage of residential is retrofit and new construction, who is currently installing loops and are they satisfied with their work. Also ask what they are paying per foot to have loops installed and what type of lead times are they experiencing. For a list of HVAC contractors who install GSHP systems visit the WaterFurnace International, Inc. website.

Step 3 – Check state and local permitting procedures and licensing requirements as they can vary from one county to the next. Also investigate the geology of the area — what's under the surface. Soil profiles can vary greatly, which in turn can have a big impact on the drilling fee you charge. However, the market can only bear a certain price point so keep that in mind as well.

Continued ...

Before you take the leap

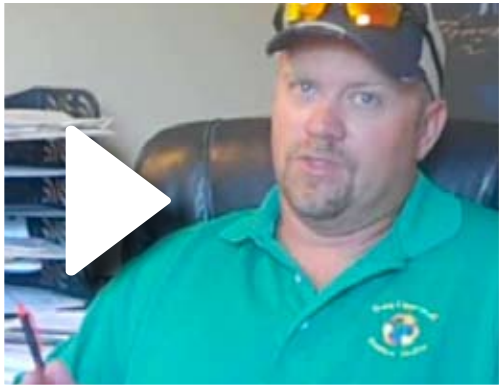
Step 4 – Participate in industry training programs. Many HVAC contractors will require that you are accredited by the International Ground Source Heat Pump Association (IGSHPA) and licensed by the state. If they don't care, consider working with a different HVAC contractor.

Step 5 – If you decide to enter the market, dedicate resources to properly train and equip your team. Commit to it as a business segment — it's a must to get a return on your investment.

Step 6 – Market yourself. Competition abounds and you need to market your services and build relationships with HVAC contractors in your area. Give them a call or make a personal visit. It's also a good idea to exhibit at home shows and network with suppliers.

Step 7 – Align yourself with reputable HVAC contractors. They are the face to the customer and if they mess up, it will affect your reputation as well.

Tim Huttman and Jay Hazelwood with Geothermal Green Team provide tips on how to network and market your loop installation services.



Hit the books

Installing a GSHP system requires training, accreditation and certification.

There are multiple sources for training in the industry to help contractors better understand how a GSHP system works and how to properly design and install one. Consider this — would you want someone with little or no training to install your $20,000 to $25,000 GSHP system? Didn't think so. Knowing more will lead to a better end product, which will help the industry as a whole.

— The Accredited Installer Program— developed by IGSHPA — is a three-day workshop that covers all aspects of the GSHP installation process. Topics covered include the basics of designing the system, to loop installation, to installation of the mechanical equipment inside the residence or building.

— If that's a bit more detailed than you desire, then IGSHPA has a more focused training program just on loop installations. The Accredited Driller's Training Program covers all aspects of the loop installation process. It's really designed for underground and water well drilling contractors who are interested in installing vertical loops.

Listen to John Clapp with the International Ground Source Heat Pump Association as he provides an overview of their training programs.

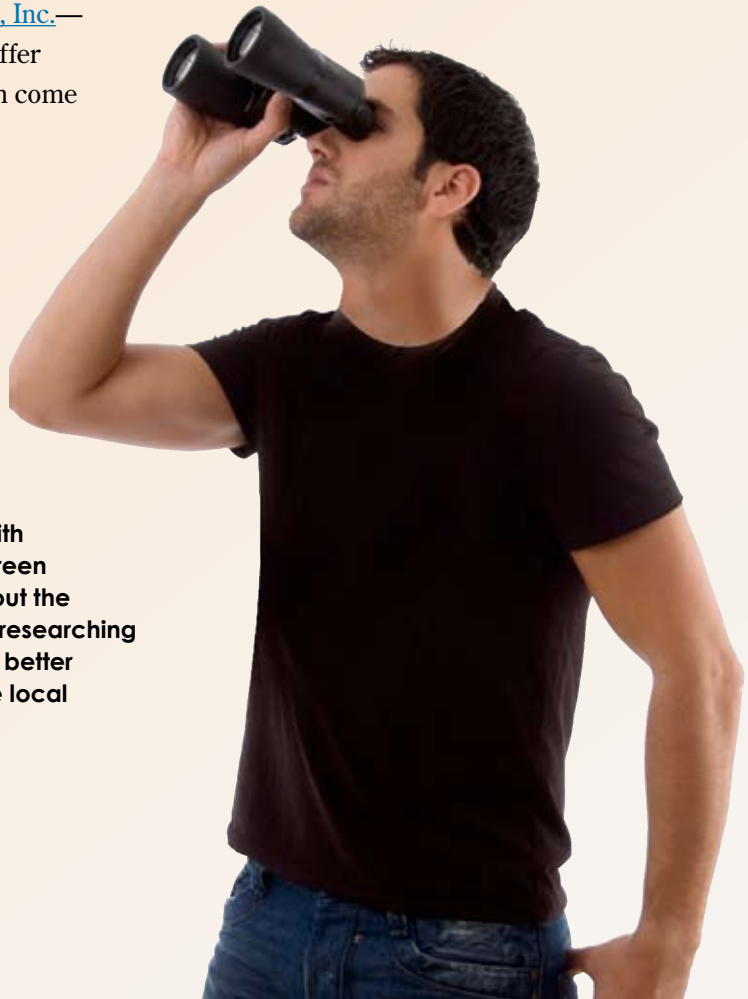
"We are seeing a number of contractors entering the ground source heat pump installation market," says John Clapp with the International Ground Source Heat Pump Association, based in Stillwater, Okla. "Many of these individuals and companies have the best intentions in mind, but just don't have the right training and experience to install loops."

Check it out first

Don't forget to check with your state, as some require a well drilling license if you plan to install loops beyond a specific depth — mainly required in vertical loop applications. Also note that installation regulations can vary from one country to the next, so take the time to understand what's expected, and save yourself some headaches down the road.

— GSHP manufacturers — like WaterFurnace International, Inc.— also provide loop installation training programs. They also offer after-training support to answer your questions and will even come into the field and provide on-the-job training.

Tim Huttman with Geothermal Green Team talks about the importance of researching your market to better understand the local needs.



IGSHPA

IGSHPA is a membership organization that represents the ground source heat pump industry and creates installation practice standards for the industry. The standards are formulated by individuals and representatives from pipe manufacturers, grout manufacturers, equipment manufacturers and installation equipment manufacturers. These standards were used to create their training programs.

What's in your toolbox?

There are a number of equipment options to install horizontal and vertical loops, ranging from well-drilling rigs, to excavators and trenchers, to horizontal directional drills. However, horizontal directional drills have become the equipment of choice for horizontal installations, while well-drilling rigs have been used exclusively in vertical-well applications. Technology is always changing and some manufacturers are developing crossover products.

Well-drilling rigs

While well-drilling rigs are well-equipped to bore a vertical hole in an efficient manner, they lack the compact stature to be used in some residential retrofit applications. In some cases, the rigs are quite large, and trying to maneuver them into the backyard of an established home can result in significant landscape restoration costs.

These machines also take some training to operate. It's somewhat of an art to get the most efficient production from them. In any case, you will need to obtain a well-drillers license from the state.

Horizontal/flex angle directional drills

Horizontal directional drills are used to install horizontal loop fields in both residential and commercial applications. The compact size of directional drills makes them ideal for tight spaces — like a backyard. They also work well in commercial applications where the loops can be placed under a parking lot.

Until recently, horizontal directional drills were capable of installing only horizontal loops. However, manufacturers have answered the call for a compact and versatile machine that can complete both vertical and horizontal loop installations. These new drills can complete steep-angle or vertical bores at ground entry angles between 18 and 90 degrees.

Trencher, backhoe or compact excavator

Using a trencher, backhoe or compact excavator is an efficient way to install horizontal loop fields. However, this equipment is not ideal in a retrofit application. Most homeowners with an established yard are not going to be thrilled to have their landscape dug up. It's a better option for new construction applications.

What's grout all about?

Grout is used to enhance thermal conductivity between the soil and loop, as well as protect the ground water and aquifers.

Grout comes in many forms, and what grout you use can depend on state and local regulations, as well as the ground formation. So do your homework and make sure you have the right product for your situation.

A tremie (French for "hopper") is a line used to deliver grout from the mixer to the borehole.

The tremie line is inserted into the borehole at the same time as the loop and pulled back out slowly as the grout is pumped into the borehole. Basically, you are sealing the borehole from the bottom to the top.

It's in your court

As you can tell, there's a lot that goes into installing a GSHP loop system and a number of items you need to consider before jumping into this market.

We hope this e-book has provided you with a better understanding of GSHP systems. In many cases, having a strong partner to help navigate uncharted waters is beneficial.

Vermeer is committed to the growth of the GSHP market and in helping you make the best decision for your company. This e-book may not answer all of your questions, so we encourage you to contact us and our partners for more information.

Vermeer
www.vermeer.com

WaterFurnace International, Inc.
www.waterfurnace.com

International Ground Source Heat Pump Association
www.igshpa.okstate.edu

Baroid
www.baroididp.com

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