How Much Does A Geothermal System Cost?

ThermalTran™
heat transfer specialists

Geothermal Pricing Guide

It's easy to feel frustrated while researching how much geothermal heating and cooling costs. Many articles present extreme price ranges with little insight into the factors that affect the system's price. Without this knowledge, it isn't easy to understand the value of a geothermal installation or feel confident you're paying a fair price.

For example, some online resources only provide the price of the heat pump without factoring in drilling, installation, or trenching—essential components that account for 55% to 75% (or even more!) of the total system price. In short, these numbers can set false expectations for potential geothermal buyers.

The team at ThermalTran created this guide to serve homeowners interested in geothermal, whether you're just browsing, evaluating your options, or in the midst of making a decision. While an energy consultation and site survey are the best way to get an accurate quote, the following information will get you started. If you feel lost, don't let your heart be troubled, we are here to serve you.

Geothermal System Permit Costs

In order to install a geothermal heating and cooling system, you need permission from your local municipality. This review period can last weeks or even months. While it might be inconvenient to wait, the permitting process is a necessary tool municipalities use to regulate what's getting installed and protect the homeowners in their community.

Each permitting application is unique in terms of the required information, the turnaround time, and the application fee. This fee can vary widely between $75 and over $1,000. In general, most permits cost a few hundred dollars. All permitting fees are included in ThermalTran's final installation price.

ALL PERMITTING FEES ARE INCLUDED IN THERMALTRAN'S FINAL INSTALLATION PRICE.

Outdoor Portion Costs

The part that touches the Earth!

THERMALTRAN'S ALL-IN-ONE PRICING

ThermalTran oversees all three stages of geothermal installation: drilling and installing the underground loop, connecting the ground loop to your home, and installing the heat pump where your old air handler or furnace used to sit. Since all these steps are done in-house, we can offer all-in-one pricing, giving homeowners the **best customer experience** and **no cost surprises** as the project is completed.

GROUND LOOP COST FACTORS

- Three closed-loop geothermal systems exist – vertical, horizontal, and pond/lake.
- A horizontal ground loop is installed over a wide area of ground and requires enough space to dig trenches hundreds of feet long and 6-10 feet deep.
- A vertical ground loop is installed in one or more boreholes about 200 to 500 feet deep in the ground. Each hole is 6 to 8 inches in diameter; if you have more than one, they're about 20 feet apart.
- A pond/lake ground loop is installed in a nearby pond or lake with adequate size, depth, and flow. Because this type of ground loop requires a water source on the property, it's relatively uncommon, and we don't discuss it in detail.
- The most appropriate loop type for your home primarily depends on the amount of land available (and whether or not you have a pond on your property!). All three loop types can be equally efficient when installed correctly, but the cost can vary widely due to the factors explored below.

GROUND LOOP SIZE

The ground loop size is based on the geothermal heat pump size, the soil conditions, and the overall climate. The larger a home's heating and cooling load, the larger the geothermal heat pump required and, therefore, the more extensive the ground loop needed.

Soil: Several factors affect soil's ability to transfer heat, including moisture, composition, temperature variation, and density. Moist soil will usually transfer heat more efficiently than dry soil. Heat transfer increases with stable, constant temperatures. Temperatures are more consistent in deep ground and less consistent in shallow ground. Dense rock and clay can hold and transfer more heat than sand.

GROUND LOOP EQUIPMENT

Geothermal ground loops are installed using either drilling or trenching equipment based on the loop type and depth. Because horizontal ground loops are long but shallow, installers use excavators or chain trenchers to dig them. Alternatively, vertical ground loops require a drill rig to drill one or more holes several hundred feet deep and a grout machine to fill in these holes.

DRILLING COST FACTORS

- **Equipment:** A drill rig is a scarce resource that can only be used in one place at a time. Unlike backhoes or chain trenchers, drill rigs are a significant expense to purchase or lease and require extensive upkeep, labor, and fuel to operate safely.
- **Mobilization Fee:** One of the most expensive and labor-intensive parts of drilling is simply moving the equipment. It can take a full 1.5 days to transport, safely store, set up, and fuel the drill suite. Each piece of machinery must also be well-maintained and serviced after use to keep it in top condition.
- **Geology:** Although rare in Coastal Carolina, if a property is exceptionally rocky or the bedrock is relatively high, some rocks may need to be drilled around, drilled through, or removed entirely. When the bedrock cannot be drilled through or removed, you may need to drill more than one borehole to meet a home's heating and cooling needs.
- **Price Depth:** Drilling costs increase with each foot drilled. Ground loop depth depends on the home's heating and cooling load, the amount of rock, and the local climate. If ground loops are not correctly sized, the geothermal system may not be able to absorb or reject heat adequately. This means the home will use more energy than it otherwise would to reach the temperature on your thermostat.
- **Labor:** A drilling crew usually includes a master driller and 1 to 2 helpers.
- **Materials:** Installing a vertical ground loop requires various materials like fusion piping, grout, heat transfer fluid, bentonite clay, bore headers, drill bits, and more.

TO GET A CUSTOM ESTIMATE FOR YOUR UNIQUE HOME, CONTACT US FOR A FREE HOME CONSULTATION

CONTACT US

Indoor Portion Costs

Geothermal Heat Pump Cost Factors

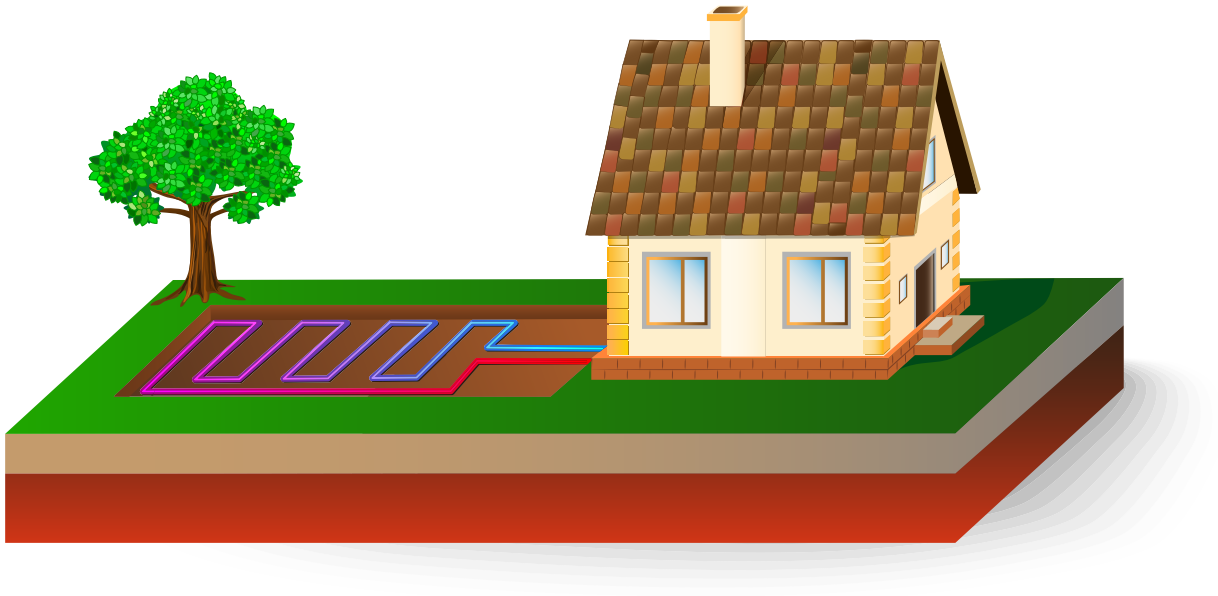
The average geothermal heat pump costs between $1,500 to $3,000 per ton within ThermalTran's service territory, which includes New Hanover, Pender, Brunswick, Onslow, and Duplin counties. While the home's heating and cooling needs dictate the precise heat pump size, a typical single-family 2,500-square-foot home may require/ a 4-ton heat pump ($6,000 to 12,000).

THE ACTUAL HEAT PUMP PRICE IS SCALED UP OR DOWN BASED ON THE VARIABLES ON THE FOLLOWING PAGES

HEAT PUMP SIZE

A geothermal heat pump must be properly sized to meet a home's precise heating and cooling needs.

Reputable contractors perform what's known as a Manual J, the industry standard for calculating a home's heat gain and loss—the amount of heat lost through the home's exterior in the cooler months and the amount of heat gained in the warmer months. Numerous variables affect a home's heating and cooling needs, including home size, insulation, the number of windows, geography, duct leakage, and even orientation to the sun.



THERMALTRAN TECH FACT:

When designing the ThermalTran geothermal heat pump system, we balance quality, efficiency, and cost. Minimally, we recommend installing a 2-stage heat pump because it provides a lot of efficiency without the additional expense of a variable-stage pump. However, if you want the best of the best, a variable-speed heat pump is without rivals. There is nothing more efficient. Nothing can provide better comfort.

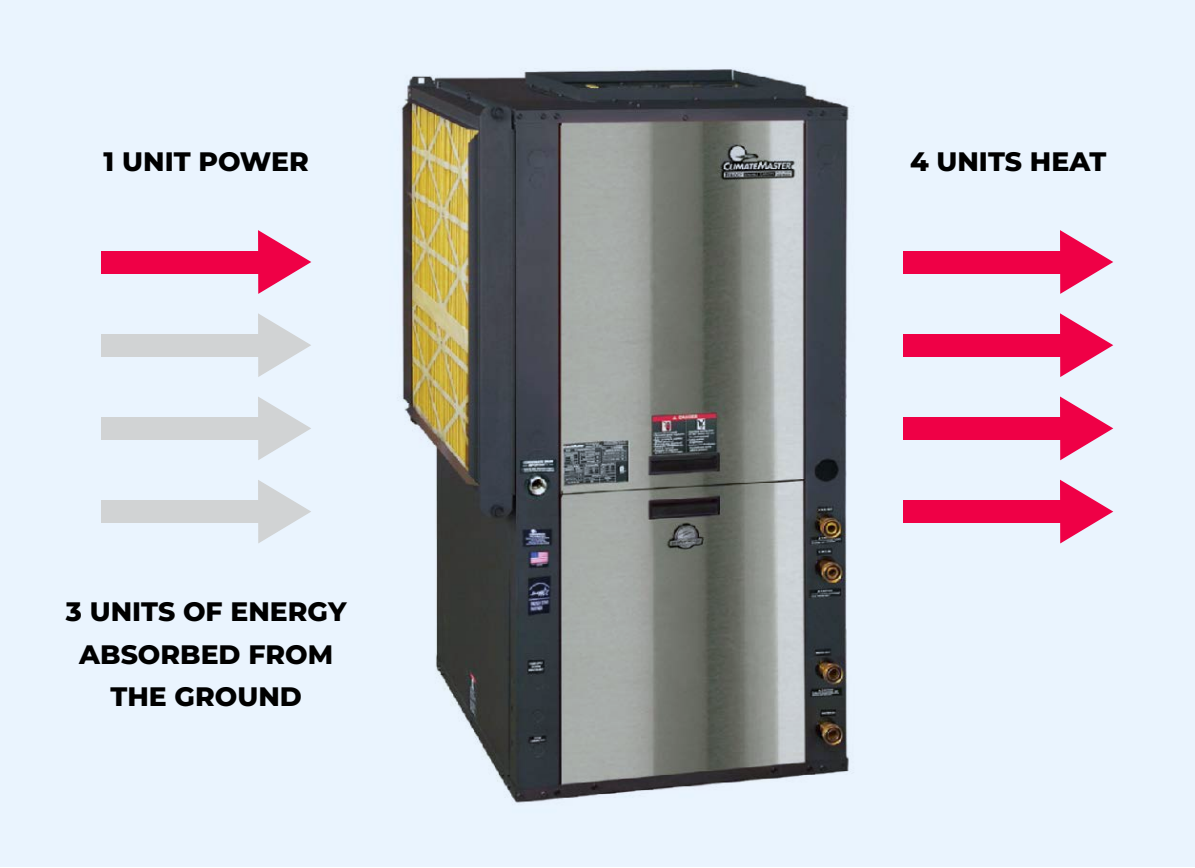
HEAT PUMP EFFICIENCY RATING

Two measurements are used to calculate the efficiency of a geothermal heat pump — Coefficient of Performance for heating (COP) and Energy Efficiency Ratio for cooling (EER). COP indicates the ratio of heat produced to the amount of energy used to produce it, whereas EER indicates the amount of heat removed from your home to the amount of energy used to remove it.

Geothermal systems generally have COPs between 3-5 and EERs between 15-25. A heat pump is also the only heating and cooling machine with a COP above 1! The higher the COP and EER, the less electricity (and money!) used to operate the machine, but the higher the upfront cost to purchase it.

On average, geothermal heat pumps are **400% efficient**. That means for every 1 unit of energy used to power your geothermal system, four units of heat energy are supplied to your home. Energy is not created as part of this process - when one unit of electricity is consumed to deliver four, it means that three units of energy are absorbed from the ground.

Combustion-based systems like natural gas, propane, or oil furnaces, however, cannot even reach 100% efficiency because they always deliver less energy than they consume.



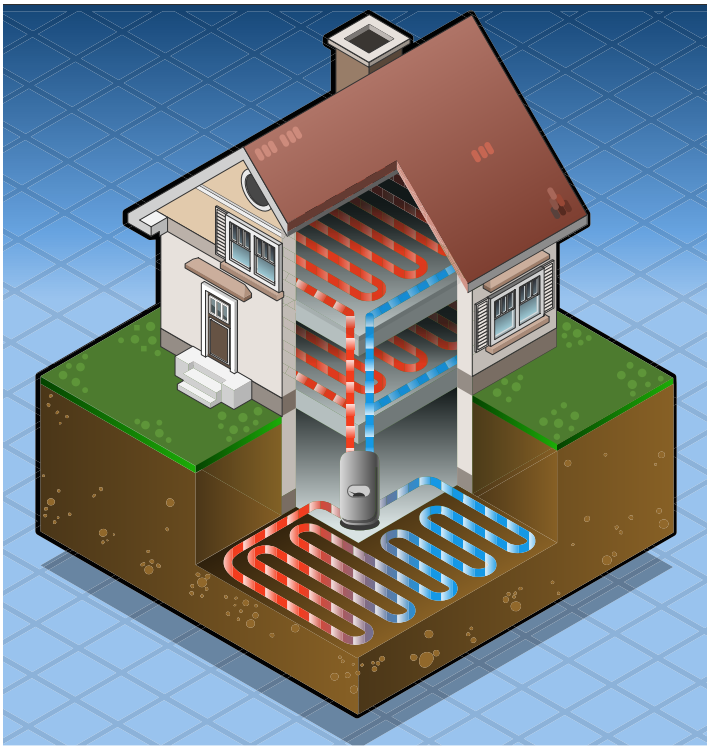
PACKAGED SYSTEM VS. SPLIT SYSTEM

A geothermal heat pump contains three primary components: Evaporator Heat Exchanger, the compressor, and the Condenser Heat Exchanger. One heat exchanger interacts with the outdoor ground loop, one heat exchanger interacts with the indoor ductwork or hydronic distribution system, and the compressor keeps the heat moving from one part to the other.

When these components are contained in a single box, it's called a "packaged" unit. If you split the pieces into separate boxes and install them in different places in the house, it's called a "split" system.

Split systems are more complex to install than packaged units. A packaged unit has all the pieces that need refrigerant in one place, so it's easy to "charge" the system with refrigerant at the factory where it's manufactured. Split systems, however, must have these pieces connected on-site with copper tubing where they're brazed together and, finally, charged with refrigerant.

Because of a split system's additional equipment, complexity and labor, they are typically more expensive than packaged systems. However, they have the added benefit of more flexibility concerning where the heat pump and air handler are located in your home.



HEAT PUMP COMPRESSOR TYPE

There are three types of heat pump compressors: single-stage, two-stage, and variable-speed.

Single Stage Compressors

A single-stage heat pump has only one setting – full blast!

- Once your desired temperature is reached, the unit will switch off. This means single-stage heat pumps don't have the ability to operate at lower, more efficient speeds and frequently shut on and off. These short run times lead to less uniform temperature distribution throughout the home and a higher likelihood of hot and cold spots.
- Single-stage heat pumps are simple, which means they cost less to purchase and repair. Because of their simplicity, however, they have higher operating costs than two-stage and variable-stage heat pumps due to the frequency with which they cycle on and off.

Two-Stage Compressors

A two-stage heat pump has two intensity levels – high and low.

- A two-stage compressor will cycle on and off at low speed (first stage) for most of the year until it gets frigid/hot outside, and it needs to jump to high speed (second stage) to keep up. It switches between stages automatically as dictated by the thermostat control. Two-stage units consume less electricity in low speed (making the system more efficient) and run for more extended periods of time. These long run times circulate and mix the air in the home, making it more uniform and dehumidified throughout. This extra air circulation eliminates the likelihood of hot and cold spots.
- Once the home has reached its desired temperature, the system will switch to the lower stage and continue to run. This fluctuation allows the home to efficiently maintain a steady, even temperature. Two-stage heat pumps typically cost more than single-stage heat pumps but less than variable-stage heat pumps while achieving moderate to excellent efficiency levels.

Variable Speed Compressors

A variable-stage heat pump can vary its levels of intensity incrementally.

- These units rarely shut off while maintaining a consistent temperature and excellent efficiency. Variable-speed heat pumps cost more than single or two-stage heat pumps.
- Variable-speed heat pumps offer the pinnacle of technology, comfort, and dehumidification as every system component communicates in harmony with a single aim – keeping your home ideally comfortable while using the lowest quantity of energy in the process.
- The variable-speed system is the most expensive option, but it has some significant benefits! Variable-speed equipment is always selected for ThermalTran clients that want the best performance available.

WATER-TO-AIR HEAT PUMP OR WATER-TO-WATER HEAT PUMP

A water-to-air heat pump is suitable for homes that use ductwork for heating or cooling. In contrast, a water-to-water heat pump is compatible with homes that use water-based heat distribution systems like radiators or in-floor radiant heating. Water-to-water distribution systems are generally more complicated and thus more expensive. In the Coastal Carolina region, very few homes rely on hydronic systems that would require a water-to-water heat pump.

Older homes generally have distribution systems designed to deliver heat with the high-temperature water you get from a boiler (180°F). Water-to-water geothermal systems can only deliver up to about 120°F water temperatures, which usually means the old distribution system (radiators, etc.) need to be replaced or abandoned altogether. These costs quickly add up.

Thankfully, most of our Coastal Carolina homes are forced air systems with ductwork, so these kinds of heat pumps are rarely installed.

DUCTWORK COST FACTORS

In some cases, a home's existing ductwork is in poor condition or needs other modifications. ThermalTran professionals can assess your ductwork to ensure it is sufficient for the new equipment. If your original duct system was designed correctly and is in good condition, few changes are required to adapt to a geothermal heat pump.

If a home does not have any ductwork, adding it can cost between $5,000 to $20,000 or more, depending on the home size, complexity, and other factors.

ELECTRICAL UPGRADES

Installing a geothermal heat pump is often part of 'electrifying' a home. That is, transitioning away from using fossil fuels on-site to using electricity for all of the home's needs. Electrifying a home increases the total amount of electrical power pulled, which can sometimes strain the main line or panel that handles the home's power.

In these cases, the line and/or panel must be increased in size. This increase is sometimes minor and relatively common so the cost will be lower. Some homes require a significant increase, however, which comes at a cost-premium.

Tax Incentives

What Federal and Utility incentives apply to you as a homeowner?

Geothermal, or ground source heat pumps, are the most energy-efficient way to heat and cool your home and significantly reduce your energy bills and reliance on fossil fuels.

With $1,000s in rebates available from the federal government and utilities, it's never been easier—or more affordable—to switch to the most efficient and eco-friendly technology available.

In 2022, the federal tax incentives known as the Investment Tax Credit (ITC) rose to 30% of a ThermalTran geothermal system. However, the percentage covered by the ITC will decrease to 26% in 2033 and to 22% in 2034.

30% THROUGH 2032

26% THROUGH 2033

22% THROUGH 2034

CURRENTLY, DUKE ENERGY IS OFFERING A $300 REBATE FOR INSTALLING A GEOTHERMAL HEAT PUMP!

DUKE ENERGY®

$300 REBATE

Increase Your Home's Value

The home-buying process is complicated and often time-consuming, and buyers typically want the smallest ongoing maintenance cost (unless it's a fixer-upper, of course). Recently updated floors, appliances, or tile work can attract buyers when selling a home. Simplicity is a powerful selling point, and with geothermal, simplicity is the name of the game. A geo system offers this value in two ways—by being **extremely compact** and delivering **significant savings**. Since the unit handles heating, cooling, and hot water, homeowners can worry less about keeping track and maintaining three separate units. Instead, they have a single, multi-function package that can last well over 25 years!

The savings are the second piece to the puzzle, with the average geothermal owner saving 30%-70% on their annual heating and cooling costs upon installation of the system. If the typical U.S. family spends $2,060 a year on their heating, cooling, and hot water bills, a ThermalTran geothermal homeowner could see up to $1,442 in savings per year.

Studies show that for every $1 decrease in annual utility bills, a home's value increases by $20. So, for the average American homeowner, a ThermalTran geothermal unit can increase the value of their home by $28,840 in the current market. The increase in home value, coupled with the real-time savings and up-front financial incentives, make geothermal a lucrative option for the discerning homeowner.

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Replace Your Air-Source Heat Pump or Furnace

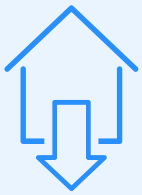
Performance Matters!

In terms of efficiency, durability, environmental impact, and overall performance, Ground Source Heat Pumps are far superior to Air Source Heat Pumps.

HOW DOES A HEAT PUMP WORK?

In contrast with furnaces and boilers which generate heat from the combustion process, a heat pump moves heat from the outside of the building to the inside (or the reverse in cooling mode). It is the same technology used in refrigerators and air conditioners.

THERE ARE TWO TYPES OF HEAT PUMPS



Ground Source Heat Pumps (Geothermal):

Ground Source Heat Pumps (GSHP) use the 58-64 degree temperature found in the ground in the Coastal Carolina area as a heat source (or heat sink in cooling mode).

Air Source Heat Pumps:

Air Source Heat Pumps (ASHPs) work by transferring heat absorbed from the outside air to an indoor space. This means when it's 25 degrees outside, an air-source heat pump needs to work much harder and uses more energy to reach the desired temperature than a ground-source heat pump.

EFFICIENCY AND SYSTEM PERFORMANCE

Overall, both types of heat pumps are 2-8 times more energy efficient than traditional oil furnaces and conventional air conditioners. Both systems use the same core heat pump technology, but Ground Source Heat Pumps have a considerable advantage in cold winter and hot summer weather climates since they pull and push heat from a stable source below the surface of your yard.

THERMALTRAN GROUND SOURCE HEAT PUMP	VS.	CARRIER OR TRANE AIR SOURCE HEAT PUMP
4.8 COP	Coefficient of Performance	2.6 COP
5.7 COP	Coefficient of Performance at 0°F Outside	1.0 COP
28.2 EER	Energy Effieciency Ratio	13 EER
Not Needed	Backup Fuel Source (heat strips or gas)	Needed for defrost and supplemental heat on cold days

When it is 0°F outside, an Air Source Heat Pump will require about 3.6 times as much electricity as a Ground Source Heat Pump to deliver the same amount of heat. The air source heat pump will perform at 1.0 COP when the temperature drops below 0°F, while the Ground Source Heat Pump will be able to maintain a 5.7 COP at a 0°F outside temperature. Ground Source Heat Pumps provide significantly more energy savings as they are much more efficient at heating a home in the coldest winters, no matter the bitter temperatures outside.

Geothermal Heat Pump FAQ

All You Need to Know About Home Geothermal Heating & Cooling

HAVE YOU HEARD OF HOME GEOTHERMAL HEATING AND COOLING?

It's an HVAC system that can save homeowners serious money on utility bills. Unfortunately, many people have never heard of home geothermal, or they don't understand it. Many people think it has something to do with capturing heat from volcanoes or geysers. (It'd be cooler if it did!)

However, That would be pretty tricky to pull off for most homeowners, and it would seriously limit the number of people who could take advantage of geothermal energy.

Thankfully, you don't have to live anywhere near an active volcano to have an effective, money-saving home geothermal system installed.

Home geothermal heating and cooling is actually reasonably simple. Here's a great video from the team at Bosch that teaches the basics:

VIEW YOUTUBE VIDEO

HOW DOES HOME GEOTHERMAL ENERGY WORK?

The earth's temperature in the Coastal Carolina area 6 feet below surface level is a constant 58-64 degrees Fahrenheit year-round. For simplicity's sake, we'll assume the average ground temperature in the area is 63°F since that temperature is most common in our area. Thus, when the air outside your home is below freezing, just 6 feet below the snow-covered ground, it's still 63 degrees. Or when summer brings 96-degree weather, the earth beneath your house remains steady at 63 degrees.

You have probably experienced this phenomenon in homes with basements without even realizing it. When you go into a basement on a hot day, it's nice and cool down because the earth on the other side of the foundation is, you guessed it, 63 degrees.

In the winter, even an unheated basement in North Carolina stays relatively warm because of that consistent 63-degree insulation from the surrounding earth. Geothermal systems, such as those ThermalTran installs, take advantage of this naturally occurring constant. They harness the steady temperature surrounding any home to heat or cool it as needed.

Although it's referred to as geothermal energy, geothermal and other home geothermal systems don't make electricity. They use the sustained temperature of the ground to heat or cool your home.

WHAT ARE THE DIFFERENCES BETWEEN GEOTHERMAL SYSTEMS?

Though many geothermal systems are similar, there are differences between them. Some used a closed or open loop system, pond loops, or slinky coil ground loops.

There are pros and cons to the various loop configurations for geothermal home heating. ThermalTran designers and engineers use closed-loop systems most frequently. They see them as the most efficient and safest option for homeowners.

When a ThermalTran geothermal system is installed, closed-loop pipes filled with pure water are buried in the ground beneath your home. “Closed loop” means the pipes are connected to only your house. They aren’t connected to a larger infrastructure and won’t interact with any fluid outside your system.

As water circulates through your heat pump’s pipes, the water within the pipes changes temperature. In the wintertime, this 63-degree water is warmer than the outside air. ThermalTran designs a system that pulls this warm water through the pipes and uses a heat pump to warm the air in your home. This flexibility allows you to adjust the air in your home to whatever temperature you desire.

The same principle works in reverse in the summertime when your geothermal system uses the temperature of the ground to cool the air in your house. It doesn’t matter if it’s a crisp 35 degrees or a toasty and humid 88 degrees outside. Your geothermal system makes it easy to get comfortable at home.

IS GEOTHERMAL REALLY WORTH IT?

Installation of a ThermalTran system can save homeowners up to 50% on their heating and cooling bills every month. It’s a wise investment that leads to long-term savings, all while keeping your home comfortable all year round.

In the U.S., heating and cooling residential and commercial buildings contribute about 11 percent of the nation’s total carbon dioxide emissions.

Home geothermal systems create zero carbon emissions. Over the course of a year, using one geothermal system reduces enough carbon emissions to equal removing two cars from the road.

These engineering wonders are also safer for your home than traditional heating and cooling systems. With ThermalTran geothermal, there’s no risk of explosion or carbon monoxide leaks to endanger your family.

GEOTHERMAL HEATING AND COOLING COST

While the price of electricity, oil, or natural gas fluctuates, the cost of operating a geothermal system will remain relatively the same. The electricity costs of a geothermal system are low and seldom vary from month to month.

Despite their many advantages, installing a conventional geothermal system for a typical home used to cost up to $50,000 or more. However, engineers and installers set out to drive those costs down. Thanks to their ingenuity, geothermal systems are now affordable to more homeowners.

A complete ThermalTran Mechanical home geothermal system typically costs $18,000 to $29,000 when adding a ground loop for the first time on an average-sized house. ThermalTran has no-money-down financing plans allowing homeowners to install a geothermal system with no upfront cost.