ASHRAE Philadelphia Chapter

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MEETING COSTS

Fees are based on online reservations and prepayment.

$42 Chapter Member

$42 YEA Member

$42 Student Member

$0 Life Member

$42 Society Member

$42 Non-Member

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QUAKER CITY CLIMATE

Wednesday, February 14, 2024
6:00 PM to 10:00 PM

February Social Event

Philadelphia 76ers vs Miami Heat

$42.00 Standing Room Only

Come watch the 76ers take on Jimmy Butler and the Miami Heat. All are invited to watch the game from the Assembly Room. This is a standing room only ticket with full access to cash bars as well as a kitchen serving area where food can be purchased. There is a large lounge area with fireplaces and plenty of room to relax and enjoy the action with your fellow colleagues.

Tip off is at 7:00 PM.

Click here to register.

Food and drinks are not included with the ticket.
Food and drinks can be purchased in the Assembly Room.

You must have a Ticketmaster account to receive tickets and enter the Wells Fargo Center. Tickets will be emailed out the day before the game. Please be sure to use the email address associated with your Ticketmaster account.

Wells Fargo Center
3601 S Broad Street
Philadelphia, PA 19148

2023-2024

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PRESIDENT'S MESSAGE

Greetings Chapter Members,

2024 is here and in full swing. While the holidays tend to take precedence to all of our busy schedules, the ASHRAE board has organized a packed social and educational calendar for the remainder of the winter and spring coming your way.

In January, the Philadelphia Chapter sent seven (7) student members from local universities to the ASHRAE Winter Conference (AHRI) in Chicago. These students had a full itinerary of educational seminars to attend and were given the opportunity to experience the value of being a member of a professional organization such as ASHRAE.

We are excited to host our February meeting at Wells Fargo Center on Wednesday, February 14th with your Philadelphia 76ers taking on the Miami Heat. Please sign up today through the link on page 1.

In March, we will be hosting an educational seminar over lunch at FoGo de Chao. More details to follow.

On April 29th, ASHRAE will be hosting our annual charity golf outing to raise funds for the Debra H. Kennoy Scholarship (details regarding the scholarship below). We sold out very quickly last year, so please sign up as soon as signups go live in the upcoming days. Please also consider sponsoring the event with one of the various levels of sponsorship opportunities available to choose from. The proceeds will help the Philadelphia Chapter grow our ability to fund this scholarship.

In our latest Board of Governors meeting, we once again discussed issues surrounding the website, chapter dues and the digital directory. Please continue to email us at c021@ashrae.net if you have any issues with event registration, the digital directory, or the website.

The Board and I look forward to engaging with all of you in our upcoming events and moving forward for many more in person meetings.

Sincerely,
Daniel Brown
Philadelphia Chapter President
c021@ashrae.net

Debra H. Kennoy Scholarship 2024

The Debra H. Kennoy Scholarship is intended to encourage female students to pursue studies and seek professions in the heating, refrigeration, and air conditioning industry (HVAC&R). Debbie was known for her exceptional dedication during her 20 year of service to the ASHRAE community. Colleagues within the industry came together to honor and celebrate her legacy through this scholarship. She was a true mentor to new ASHRAE members, especially to female engineers in a heavily male dominated industry, and made them feel welcomed and encouraged their involvement in the society. This scholarship is intended to be awarded to undergraduate students who are studying mechanical engineering, architectural or science & engineering, chemical engineering or other related HVAC&R engineering disciplines that meet the purpose of the Scholarship. While the first opportunity for the scholarship will be given to a female student who has graduated from a high school within the geographic boundaries of the Philadelphia Chapter of ASHRAE and/or attend an institution within these boundaries, all others will also be considered.

The amount of the scholarship award for 2024 will be $5,000. Click here for the scholarship application.

Invest in ASHRAE and Help Shape our Future

ASHRAE's Research Promotion Campaign generates funds to support ASHRAE research, YEA, Education (ALI), Endowed Research through ASHRAE Foundation, YEA Programs, Scholarships, and the General Fund. Research, the backbone of ASHRAE, remains the primary fund of the program with over $2 million raised for this program annually. All contributions received by ASHRAE significantly assist in ensuring that the Society continues to have the resources needed to sustain and expand its work. ASHRAE is very thankful for the support of all our donors and will strive to utilize all resources to better serve our members, the HVAC&R industry and society!

Click here if you would like to support ASHRAE's mission, programs, and member services with a gift through the RP Campaign.

If you have any questions, please contact the Philadelphia Chapter's Research Promotion Chair, Jim Scanlon, at c021rp@ashrae.net.

Thank you for your support!

Meet Two of Our Corporate Sponsors

Keller Equipment Sales

At Keller Equipment Sales we work with contractors, engineers, architects and business owners to provide the right HVAC systems for their specific applications and project needs, always with a high level of response and service. Customers across Philadelphia, Central Pennsylvania, Delaware and South Jersey turn to us not only for the diverse range of products we sell, but also for our expertise in the design and application of each and every product. For nearly 30 years, our team of field experts and engineers have helped achieve your efficiency, energy and project goals.

https://kellerhvac.com
717-747-5555

National Energy Control Corporation NECC

For more than 44 years NECC has been providing controls and repair parts for commercial HVAC systems to the Philadelphia metropolitan market and beyond. NECC is an authorized stocking distributor for all the major controls manufacturers. Located in Havertown, our in-house inventory of valves, actuators and controls stands ready to supply your company's needs. With a specification archive that goes back to the 1950's we are adept at cross-referencing old parts to new. We provide technical and application support. Our manufacturer partners include: Belimo, Johnson Controls, Schneider Electric, Siemens, Veris Industries, Spartan Peripherals, Honeywell and many more. Find us Monday through Friday from 8:00 AM to 5:00 PM at (**800) 227-9800** or 24/7 at necc-controls.com. NECC is now a part of the Peak Industries family of companies. Our sister companies include Penn Pump and Equipment in Hatfield, PA and Cope Salt/AutoBrine in Lancaster, PA.

Future City Philadelphia 2024

The Future City Philadelphia event took place on Saturday, January 20, 2024 at Archbishop Carroll High School in Radnor, PA .

The mission of the competition is to provide a fun and exciting educational engineering program for middle school students that combines a stimulating engineering challenge with a "hands-on" application to present their vision of a city of the future.

The 2024 Future City challenge was to “Design a 100% electrically powered city with energy generated from sources that keep your citizens and the environment healthy and safe.”

Congratulations to the winner of the ASHRAE Philadelphia Chapter Award for the **Best Indoor Environment** - East Norriton Middle School in Norristown, PA.

Go to www.futurecityphilly.org to see a list of all the winners.





Our Chapter Digital Directory is now available!

ASHRAE Philadelphia Chapter Digital Directory

This digital version has replaced the paper versions from years past. This provides flexibility and allows for access anywhere. It’s easy to use, highly interactive, and always up to date.

The link to the directory is on our home page on the website, or you may click here to advertise or purchase access to the directory!

ASHRAE 2024 ASHRAE Annual Conference

June 22-26, 2024
Indianapolis, IN
Click here for more information.

The Philadelphia Chapter
of the
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

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Hope Silverman
P 610-971-2169
hope@mmco1.com

Material can include letters to the editor, member news, upcoming events, comments on chapter programs or issues, etc.

New Philadelphia Chapter Members

New Chapter Members

Sarah Carlini
Paris Minuto Jr.
Matthew Golden
Joseph Breder
Katherine Comisac
Thomas Boggs
Taylor Bedford
Arvinder Dang
Kawsar Ahmed
Michael Makofsky
Mickey Edmiston
Matthew Wells
Brianna Lynch
Max Feeman
Terry Herr
Andy Bauman
Charles Pierson
Steven Spellman
Sunny Kalra
Adam Philip Lemma
Jeffrey Clemmenson
Natalie Polillo
Christopher Moore

New Student Members

Mahdiyeh Zafaranchi
Sean McGillian
Alyssa Trotman
Daniel George
Ryan Forte
Chima Cyril Hampo
Joseph Appertey
James Coleman
Parthenis Deslis
Quang Hoang
John Vincent Pleckaitis

New Society Members

Stan Harbuck
Jessica Gallagher
Dr Sheng Peng

What are the benefits of paying Philadelphia Chapter dues* ?

Discounts:

$200 Discount for Basic Class
$150 Discount for 90.1 Seminar
Free access to the Digital Directory
And much more!

* Note that Philadelphia Chapter Membership Dues are $35/year.

To receive discounts, please remit you Chapter dues when renewing online or applying for a new membership. Feel free to upgrade online by clicking here or contact c021@ashrae.net for assistance.

Membership Advancement

If you are currently an ASHRAE Associate Member, becoming a full Member is easier than you think! The following count toward the required **12 points** to advance to full membership status. You must update your ASHRAE online biography and send an email to membership@ashrae.org to advance.

Non-accredited degree = 4 points
PE = 4 points
Accredited degree = 6 points
Industry experience = 1 point/year

March 2021

White Paper

Geothermal Heat Pumps

Sustainable, clean, and energy efficient

Preface

This paper focuses on the use of geothermal heat pumps (GHP) for heating, ventilation, and air conditioning (HVAC) applications. It explains the basic elements of geothermal energy and the operating principles of GHP. It also examines different types of GHP and discusses the benefits and challenges of using a GHP system for residential and commercial applications versus implementing a traditional HVAC system.

GHPs can significantly reduce the energy consumption of commercial and residential buildings. They also lower the carbon emissions resulting from a building's energy use by up to 50%.

What is geothermal energy?

The earth contains a large amount of thermal energy, which is stored underground in the form of a temperature sink (see Figure 1). This energy is an abundant source of heat, in addition to being renewable and clean. Geothermal energy can be used for a variety of applications, including electricity generation, direct use (spas or hot springs), and commercial or residential heating and cooling operations. The amount of thermal energy depends on where and how deep one bores into the ground. **Figure 2** shows the average ground temperature for the three main uses of geothermal energy.

In recent years, GHPs have been given several different labels: Geo-

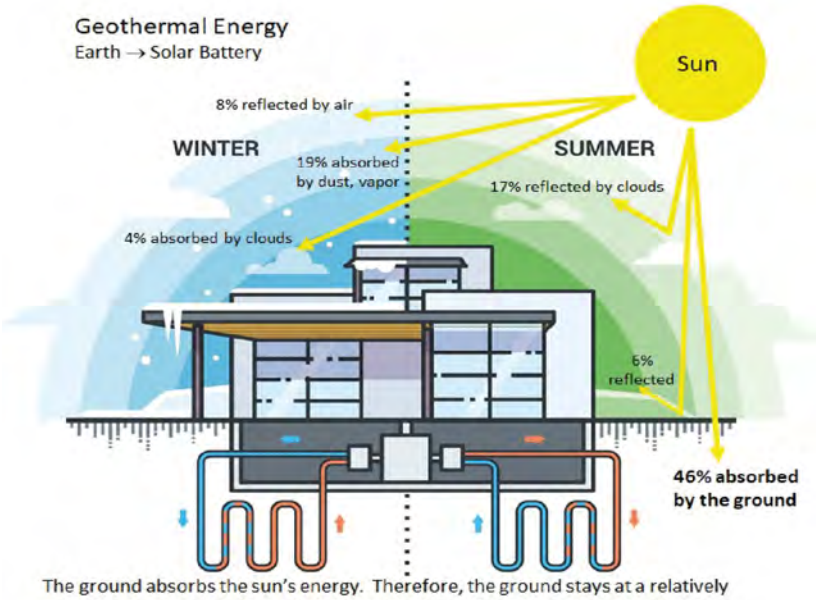


Figure 1: Earth acting as a solar battery



Figure 2: Temperature ranges for various geothermal applications

1. Department of Energy, *Guide to Geothermal Heat Pumps*, p. 1

Geothermal Heat Pumps

Exchange, earth coupled, or ground source heat pumps.[1] GHPs use the shallow thermal capacity of the planet to heat and cool buildings. **Figure 1** shows how thermal energy is absorbed and stored below the earth's surface.

The earth acts as a solar battery that absorbs almost half of the sun's energy. Underground temperatures provide the GHP connected to the building with a heat source in winter and a heat sink (cooling) in summer. The GHP uses a series of underground, liquid-filled pipes to transfer heat from the building to the ground or the ground to the building.

GHPs utilize the lagging effect between ground temperatures and the seasonal air temperatures. Ground temperatures are relatively constant below the earth's surface. Above ground, air temperatures are usually more variable.

Figure 3 shows the contrast between ground temperatures and air temperatures. At a depth of 8 ft (2.4 m), the ground temperature fluctuates between 38°F to 62°F. This data establishes the consistency of undisturbed soil temperatures below the earth's surface at depths of 2 ft (0.6 m), 5 ft (1.5 m), and 8 ft (2.4 m). In summer, the ground acts as a heat sink such that heat from the warm building air can be transferred to the ground. Likewise, the warm ground (45°F (7.2°C)) can be used to transfer heat to the building These ground temperatures can be relied on as sources of clean, renewable energy for heating and cooling throughout the year.



Figure 4: Frost line

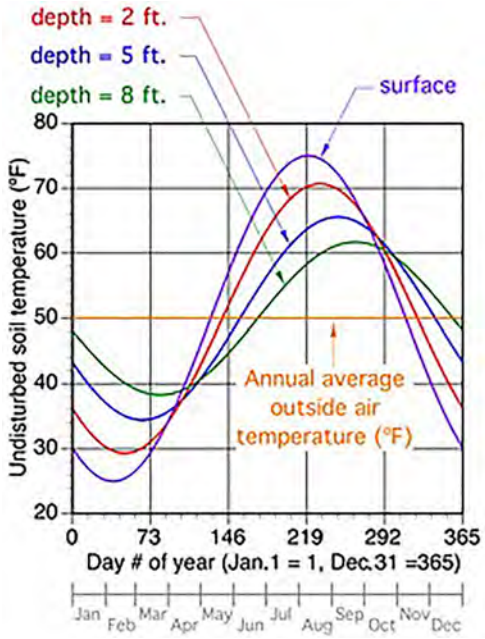


Figure 3: Soil Ambient Temperature (Possible Available Water Temperature)

How GHPs work

A GHP is similar to a traditional water source heat pump. However, instead of using a boiler and/or cooling tower water loop, a GHP uses a ground heat exchanger. A ground heat exchanger consists of high-density polyethylene (HDPE) pipes buried below the frost line in the ground.

The frost line is the depth where the ground temperature will never drop below 32°F (0°C) freeze condition. This depth varies between 0 to 8 ft (2.4 m) across North America. See **Figure 4**.

Below the frost line, undisturbed soil in the ground remains within the desired range of temperatures, which is generally between 40°F (4.4°C) and 85°F (29.4°C). Water circulates through the underground pipes and either extracts or supplies heat to the building.

Below the frost lines at depths of 250 ft (76.2 m), the ground temperatures can provide a relatively constant water temperature for HVAC design purposes.

A GHP can also provide supplemental heat to a domestic water tank if it is equipped to do so.

In principle, GHPs function like conventional heat pumps in a traditional HVAC system. However, there is a fundamental difference. Traditional air source HVAC systems collect and remove heat using the outside air. GHPs transfer heat through a network of underground pipes connected to a building.

Sustainable, clean, and energy efficient

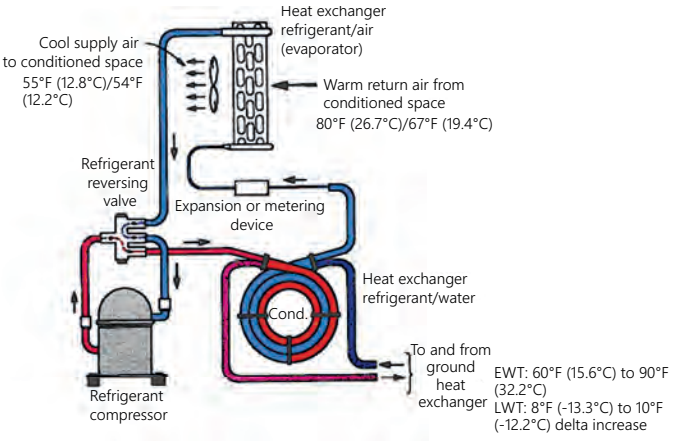


Figure 5: Refrigeration cycle: cooling water loop

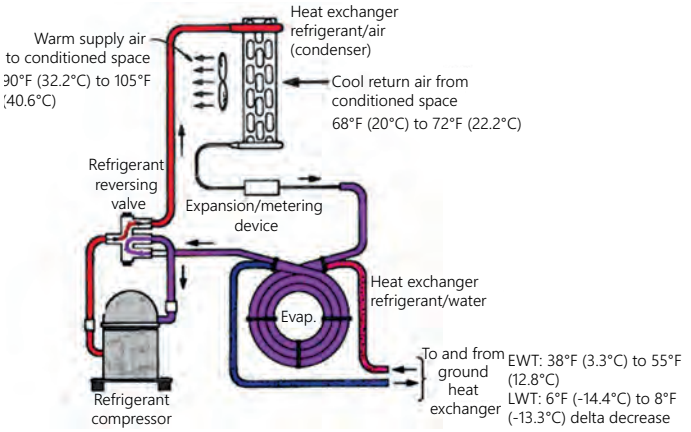


Figure 6: Refrigeration cycle: heating water loop

Figure 5 shows the cooling cycle of a GHP. **Figure 6** shows the heating cycle of a GHP. Unlike traditional air-source heat pumps, GHPs find it comparatively easy to extract or disperse heat through the liquid—typically 40°F (4.4°C) heating design and 85°F (29.4°C) cooling design temperatures—circulating in their underground pipe network.

These temperatures lead to a key product requirement - piping insulation. In the heating mode, the leaving water temperatures can drop below the ambient space dewpoint inside the cabinet (35°F (1.6°C)).

Therefore to prevent piping and heat exchanger condensation which can cause water damage, all piping should be insulated in the cabinet. In general, some type of antifreeze is added to these systems to prevent freezing. In addition, the water freezestat must be lowered from its normal trip point to around 30°F (-1.1°C) before unit shut down.

A GHP only needs 1 kilowatt-hour (kWh) of electricity to produce 12,000 British thermal units (BTUs) of cooling and heating. A standard air-source heat pump uses 2.2 kWh to produce the same number of BTUs on a day when air temperatures rise to 95°F (35°C). Therefore, geothermal systems are twice as efficient as the top-rated air conditioners and almost 50% more efficient than the best gas furnaces.

Types of GHPs

Open loop systems

Open loop systems employ groundwater heat pumps that use water from a well, lake, or stream as a heat source or heat sink. Water temperatures are linked to climatic conditions and may vary between 41°F (5°C) and 77°F (25°C). This application must meet all local groundwater codes and regulations.

Closed loop systems

There are two types of closed loop systems: a ground loop and a pond/lake loop.

A ground loop system uses a brine-to-air heat pump to propel brine (anti-freeze) solution through a piping loop below the earth's surface. The system uses the piped solution to transfer heat from the ground to the building or the building to the ground.

The heat exchange loop may be in vertical bores or in horizontal trenches. The installation costs of closed loop systems are higher than conventional HVAC systems because of the size of the pipes and the expense of boring into the ground.

The general equation use to determine pipe length is :

$$q = L^* (T_g - T_w)/R$$

Where

q = Heat Capacity (btu/h)

L = Pipe Length (ft)

T = temperature of ground and water (°F)

R = Resistance (h•ft•°F/btu)

The resistance value R is evaluated as a function of time related to soil type, pipe material, water flow, soil temperatures and piping geometry. The industry often uses 250 ft (76.2 m) of pipe per ton of cooling with 15 ft (4.6 m) to 20 ft (6.0 m) of space between pipes.

Heating and cooling account for the majority of a building's energy costs. Now, with the rising prices of utilities such as electricity and natural gas, it makes sense to choose a system that mitigates these costs as much as possible.

Designers can use bores that are 400 ft (121.9 m) to 500 ft (152.4 m) deep to decrease this footprint. This reduces the number of wells, and also lowers the amount of piping needed to connect the wells together.

Most electric companies that provide tax rebates for GHPs specify ground loop temperatures must remain between 40°F (4.4 °C) and 90°F (32.2°C). Temperatures usually fall outside this range at a depth of 200 ft (60.9 m). However, one can achieve the correct temperature range at a depth of 150 ft (45.7 m) in certain parts of the United States. Consequently, local geological conditions are a vital consideration for closed loop system costs.

Pond/lake loop systems

This is an alternative form of closed ground loop that uses a heat exchanger submerged in a pond or lake. The water source must be resistant to drought. It is considered mid-range in terms of costs.

Typically, one can expect to achieve 25 to 50 tons of heating and cooling for every acre of the water's surface area. Pipes may be arranged in a slinky orientation, as shown in **Figure 7**, to reduce installation costs and boost the performance of the heat exchanger.

This type of closed ground loop can also be configurated to use lake plates. In this setup, a series of perforated metal plates are submerged in a body of water. These are installed parallel to one another and connected by a series of pipes used to transfer heat from the water. These solutions are excellent options for buildings situated close to suitable bodies of water and are a great option for building owners.

Benefits of GHP Systems

Geothermal systems offer numerous benefits to building owners looking to replace traditional HVAC applications in older buildings or install innovative, energy-efficient solutions in new builds.

Energy Efficiency

GHPs are significantly more efficient than traditional air source or water source heat pumps despite operating in a very similar way. Estimates show that GHPs can reduce energy consumption by 25 to 50% when compared to air source heat pumps. On cold winter nights, GHPs may reach energy efficiencies as high as 300 to 600%.[2]

Figure 8 shows the efficiencies of GHPs. You use a small amount of electricity to run the system. 1 kWh of energy purchased from the grid is combined with a significant amount of free energy absorbed from the ground (3 to 4 kWh). Therefore, the efficiencies yielded are three to four times the amount of energy it takes to run the system.

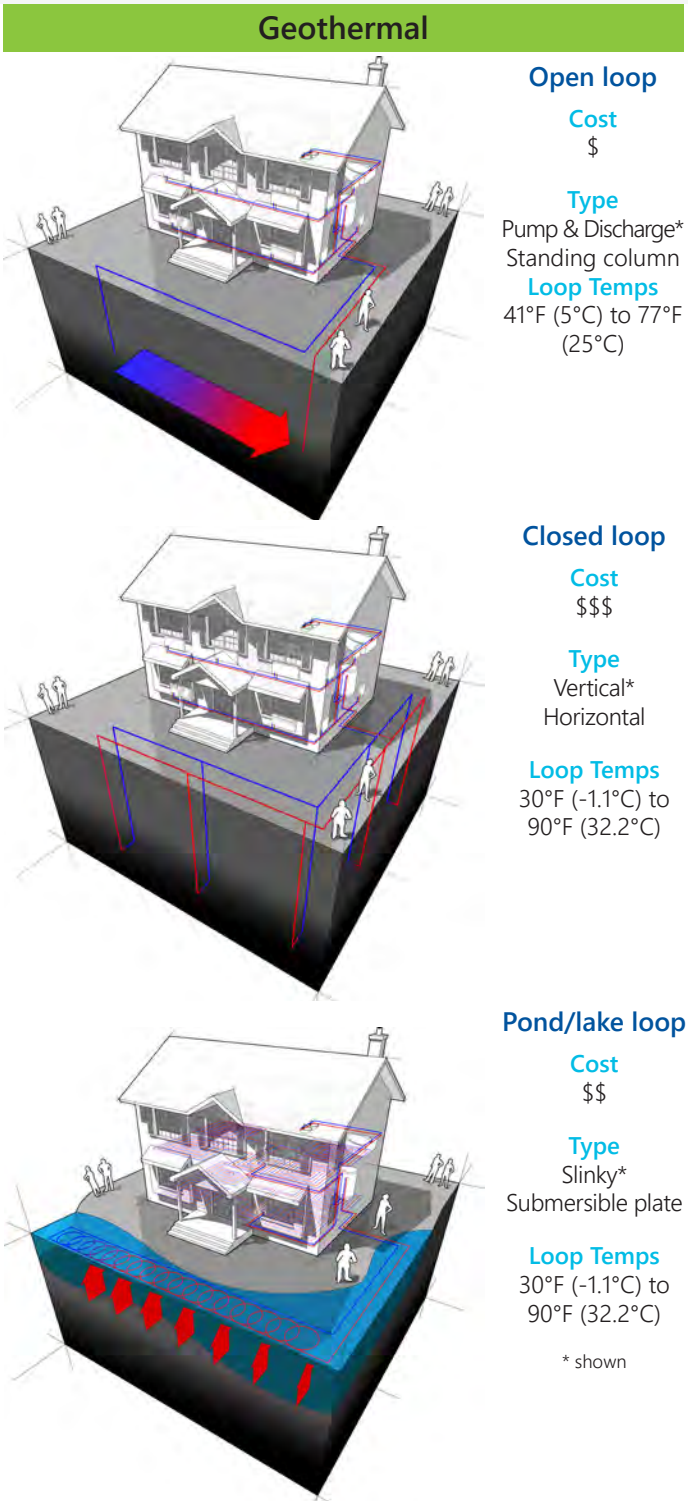


Figure 7: GHP Configurations

2. Department of Energy
3. Myers, "As Cities Begin Banning Natural Gas, States Must Embrace Building Electrification via Smart Policy."
4. Ivanova, "Cities are Banning Natural Gas in New Homes, Citing Climate Change."
5. GeoExchange, "Geothermal 101."

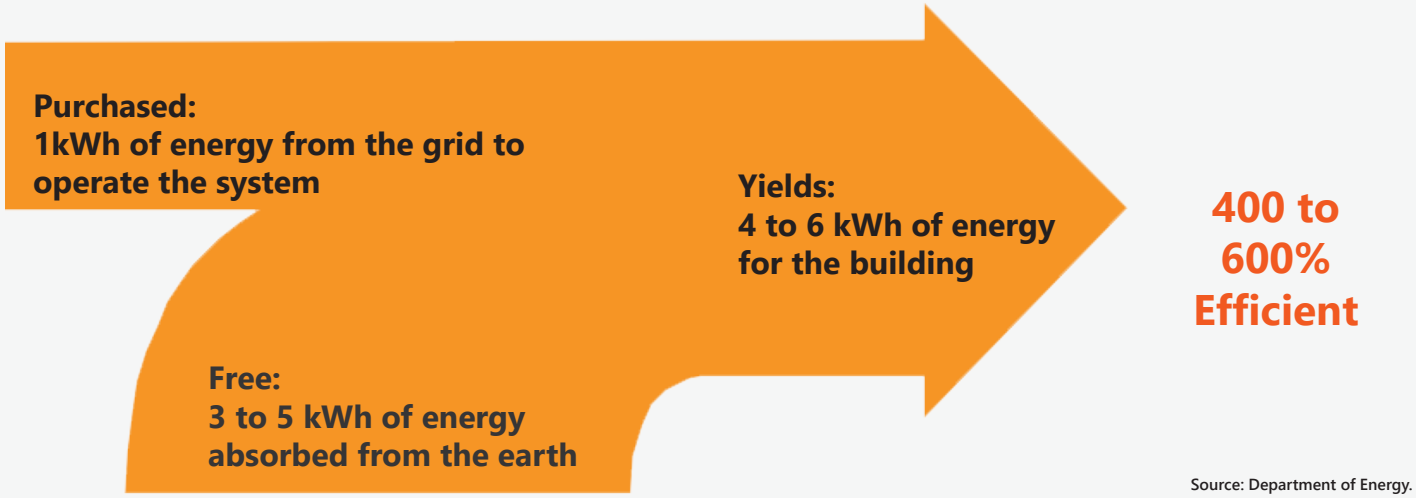


Figure 8: Transfer heat efficiency of GHPs

Heating and cooling account for the majority of a building's energy costs. Now, with the rising prices of utilities such as electricity and natural gas, it makes sense to choose a system that mitigates these costs as much as possible.

There is also an increasing focus on carbon-reduced alternative energy in the United States. Several municipalities have banned the use of fossil fuels for heating. Since June 2019, many councils have prohibited the installation of natural gas equipment in new buildings.[3]

Recently, half a dozen other jurisdictions in the United States have passed laws to encourage electric-only buildings. These are buildings that only use electric, not natural gas or other fossil fuels. For example, the town of Brookline, MA with a population of 58,000 people has banned the use of natural gas for all newly constructed buildings and major renovations starting January 2021, per article 21 of the local ordnances.[4]

Overview of benefits from GHPs
Reduce energy - 20 to 25%
Cut carbon emissions from a building's energy use by up to 50%
Heat pumps have a life expectancy of more than 20 years, while underground components may run more than 50 years
Save money with commercial and residential tax and utility rebates

These challenges are not confined to commercial buildings. Organizations such as GeoExchange have assessed the energy requirements of a typical home and discovered that heating and cooling

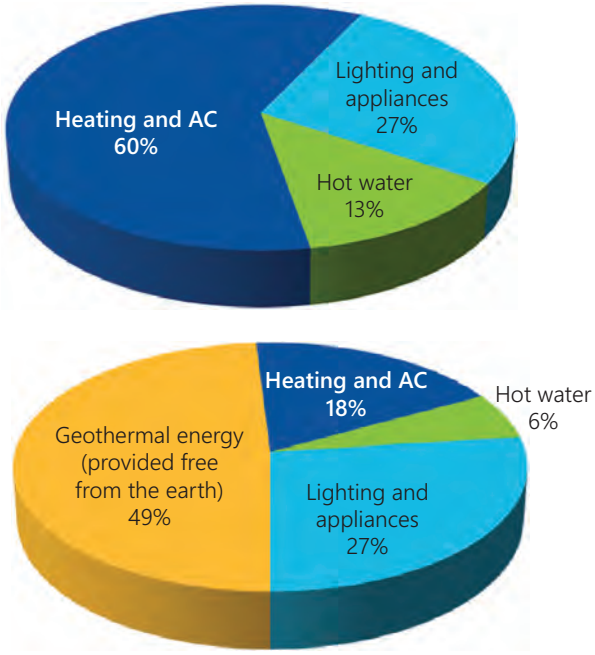


Figure 9: Cost of a conventional HVAC system vs a GHP system

consumes more than 70% of the energy. GHPs cut these energy bills in half because the ground supplies a large amount of free energy. Building owners can also expect to see a decrease in their utility bills for hot water if the system is properly equipped to heat their standard water supply.

Reduced carbon footprint

GHPs cut the carbon emissions resulting from a building's energy use by up to 50%.[5] GHP systems reduce oil consumption in 100,000 residential homes by 2.15 million barrels a year. GHPs release virtually no emissions onsite. Overall, GHPs have the lowest emission levels of all HVAC applications.

6. Department of Energy.
7. Internal Revenue Service, "About Form 3468, Investment Credit."
8. Oklahoma Gas & Energy Company, "OG&E Presents Gulfport Energy with $237,000 Rebate."
9. ENERGY STAR. "Renewable Energy Tax Credits."
10. ENERGY STAR. "ENERGY STAR Certification for Your Building."

Extended service life

The expected service life of GHPs can vary. However, components such as the heat exchanger and overall infrastructure of the GHP operate underground and may run successfully for 25 to 50 years. The heat pumps, which are not exposed to any outdoor elements, have an expected service life of more than 20 years.[6]

Tax rebates

Commercial tax credits

Federal tax credits are available for commercial buildings that use geothermal systems. The building is eligible for this rebate in the United States if construction on it began before January 1, 2022. The tax credit is equal to 10 % of the total system cost, with a five-year Modified Accelerated Cost Recovery (MACR) system depreciation on a total system and cost basis. There is no limit to the amount of the total credit. Tax credits claimed against the costs of GHPs can be combined with the credits for wind and solar energy.

For more information, or to apply for these tax credits, please refer to Internal Revenue Service form 3468.[7] Utility and energy companies offer sizable tax rebates for customers that implement energy efficiency projects. Rebates are substantial if commercial buildings use GHPs to deliver significant savings.

These rebates provide two benefits. Firstly, a customer is able to make significant cost savings on their utility bills by switching to clean electricity. Secondly, the electricity company is able to procure new business.

Electric utility companies experience much lower demand in the winter when many buildings switch over to fossil fuels for heating. Electric utilities offer incentives for GHPs because this offers them steady demand throughout the year. In addition, the high efficiency of geothermal systems reduces their peak demand in the summer. There are very high costs for electric utilities to support peak demand in the summer. Importantly, GHPs help to preserve and maintain the environment of each municipality.

Case study: Gulfport Energy, Oklahoma (2017)

In April 2017, Oklahoma Gas and Electric (OG+E) presented Gulfport Energy with a rebate of $237,000. The rebate was granted for the cost savings Gulfport Energy achieved as a result of energy-efficient projects at their newly constructed corporate headquarters in Oklahoma City.[8]

Gulfport Energy's headquarters take advantage of GHPs to drive savings and ensure an optimal work environment. Their building uses 168 geothermal wells to provide 430 cooling tons and more than 2 million annual kWh savings. This dramatically reduces the amount of electricity that the building needs for heating and air conditioning.[8]

Residential tax credits

Homeowners in the United States can benefit from tax credits courtesy of the Energy Policy Act of 2005. This allows households to claim a tax credit against what they spend on a GHP system.

This tax credit expired in 2016 but was reinstated in February 2018, retroactively including any geothermal system installed on or after January 1, 2017. The tax credit was initially set at 30%, however the credit was reduced to 26% through 2022 and stepping down to 22% in 2023.[9] The incentive is set to expire after December 31, 2023.

Buildings need to meet one of the following conditions to qualify for these tax credits. First, the GHP system must be installed between October 3, 2008 and December 31, 2023. Second, the Environmental Protection Agency (EPA) must certify that the home is an ENERGY STAR building.

ENERGY STAR buildings save energy and help to protect the environment by reducing greenhouse gas emissions. The EPA will certify a home as an ENERGY STAR building if it earns a score of 75 or higher. The score verifies that the home performs better than at least 75% of similar buildings nationwide.[10] The information submitted in the certification application must be verified by a licensed professional engineer or registered architect to be eligible.

Rebates are frequently an option for both installing new GHPs and replacing old HVAC systems. Some utility companies offer their customers as much as $1,000 for every ton of heating and cooling installed. This is a major incentive for homeowners who want to install GHPs in their homes.

Additional Benefits of GHPs

Geothermal heat pumps have several unique benefits over a traditional water source heat pump. A GHP pump is typically designed to handle a wider range of water loop temperatures (30°F (-1.1°C) to 90°F (32.2°C)) as compared to a regular WSHP (65°F (18.3°C) to 85°F (29.4°C)), which means that heat can be extracted from or transferred to the water in a variety of conditions. This can aid in a higher overall efficiency. While there is a high upfront construction cost associated with GHP infrastructure, there is no need to install a boiler or cooling tower, eliminating the cost of maintenance associated with that equipment. Overall HVAC system lifespan is another consideration. The lifespan of a GHP system is typically longer than a traditional air source heat pump because most of the system components are located inside the building or underground.

Considerations for using GHPs

GHPs provide many benefits in terms of energy efficiency and emissions reduction, but our building owners and designers must take certain considerations into account before choosing these systems.

Initial costs

The main obstacles to installing GHP systems are the upfront capital costs. However, payback periods along with innovative business models and financing help to reduce the financial burden and risk for consumers. The initial cost of installing a GHP can be several times that of a conventional HVAC system but this additional cost is returned in energy savings within 5 to 14 years.[13]

Overall, the installation costs of a ground loop system can be high. Alongside the components of a GHP, one must factor in the cost of excavation for the network of underground pipes. However, if the installation costs are part of the mortgage for a new building, savings are realized immediately because utility savings offset the increase in mortgage repayments.

11. Taylor, "HVAC Contractors Dig into the Ground, Building One 'Geo Hood' at a Time."
12. Whisper Valley, "What is a Zero-Energy Capable Home?"
13. Department of Energy, *GeoVision: Harnessing the Heat Beneath Our Feet,* p.35
14. Halozan, "Direct Exchange Ground Source Heat Pumps." p.26
15. Bais and Gupta, *U.S. Geothermal Heat Pump Market Size by Product, by Application, Industry Analysis Report, Regional Outlook Application Potential, Competitive Market Share & Forecast, 2018-2024.*
16. LEED credits are assigned to buildings by the non-profit U.S. Green Building Council (USGBC). LEED credits are comprised of a set of rating systems for the design, construction, operation, and maintenance of sustainable buildings, homes, and neighborhoods. These rating systems are designed to assist building owners and operators be environmentally responsible and use resources effectively.

Geological concerns

Certain areas may prevent the installation of GHPs due to geological constraints such as unfavorable properties in the soil or rock.

Load imbalance

Based on their location and designed purpose, some buildings are heating or cooling dominant. This can present challenges for a geothermal system, because it is important to design the ground loop to avoid significant escalation or deescalation of ground temperatures based on annual heat exchange patterns. This problem is easily corrected with a hybrid system. A hybrid system supplements the heating and cooling capacity of a geothermal loop with a boiler or water tower. Hybrid systems offer greater flexibility than standalone GHPs.

Geothermal energy - past and future

Geothermal energy dates back to 1912. Heinrich Zoelly, a Mexican-Swiss engineer, was the first person to utilize the thermal energy stored in the ground as a source of heat for HVAC systems. The United States and Germany were conducting more research into ground source heat pumps and direct expansion (DX) systems by the 1940s. However, ground source heat pumps were not fully commercialized until the 1970s.[14]

The market share of DX heat pumps is currently less than 5%, which is partially due to the limited space and land available to horizontal ground collectors.[14] This accounts for the lack of public awareness of geothermal energy as compared to other renewable energy sources such as wind, solar, and nuclear power.

GHPs in the sustainable energy market

According to a report published by Global Market Insights, the market for GHPs is projected to exceed $2 billion in the United States by 2024.[15] Builders and developers are expected to fuel this increase in demand as they try to obtain Leadership in Energy and Environmental Design (LEED) credits and reduce energy costs.[16]

Globally, Europe is the driving force behind the growth of the geothermal energy market. Sweden, for example, has made it mandatory to eliminate oil usage and has a large focus on renewable energy, including geothermal.

The number of GHPs installed in the United States is increasing every year. While currently lagging behind Europe, the U.S. market is becoming more favorable for GHPs. States like California, New York, and Vermont have implemented strict energy codes and are committed to reaching certain climate goals while also encouraging residents to use air source and water source heat pumps.

The United States military will also implement geothermal technology in many new installations or remodels of existing facilities.

Heat pump products are becoming more advanced and efficient. The rapid adoption of variable speed compressors, connected devices, and building automation systems creates further incentives for customers to tap into the renewable energy market and upgrade their older systems.

Overall, geothermal heat pumps are proving to be a compelling premium-efficiency heating and air-conditioning solution aligned with decarbonization macro trends. The numerous benefits of GHPs are making them a viable option for a variety of customers. With unmatched energy efficiencies, low environmental impact, long service life and flexible heating and cooling applications, GHPs can help people create comfortable and sustainable places to live, work and play.

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