POTENTIAL WYOMING APPLICATIONS

- ***Buildings with both heating and air-conditioning loads*** – A GHP can serve both needs and actually improve overall system efficiency by storing heat from the summer in the ground for use in the winter.
- ***Currently use propane, fuel oil, or an electric furnace*** – GHPs offer an alternative to these high-cost fuels. Significant retrofits, primarily the installation of ducts, can be required if electric baseboard systems are replaced.
- ***Rural small businesses eligible for USDA grant funding*** – With tax credits, accelerated depreciation, and USDA grant funding, a GHP is a very cost-effective investment.
- ***New construction (both business and homes)*** – Adding a GHP during initial construction when excavation is required can significantly lower initial costs.
- ***Coupled with solar electric*** – GHPs can be coupled with on-grid solar electric (photovoltaic) to power the pump and compressor. This makes the system entirely reliant on carbon-free renewable energy!

WHERE TO FIND AN INSTALLER:

UW Cooperative Extension maintains a regularly updated list of International Ground Source Heat Pump Association (IGSHPA)-accredited installers on our "Renewable and Efficient Energy – Solutions for Wyoming" website. Please see the back cover for the link.

WANT MORE INFORMATION?

More information on how GHPs work, incentives, economic feasibility, and potential applications in Wyoming can be found at UW Cooperative Extension Service's

"Renewable and Efficient Energy – Solutions for Wyoming" at

http://www.uwyo.edu/renew-energy

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Images: Courtesy U.S. DOE/NREL

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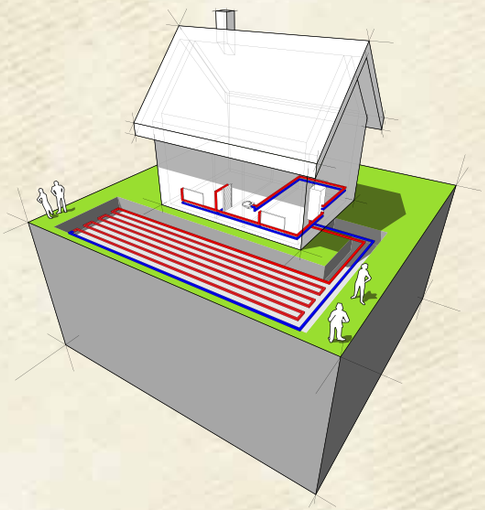
UNIVERSITY OF WYOMING
COOPERATIVE EXTENSION SERVICE

Heating and Cooling with RENEWABLE ENERGY



An Introduction to Geothermal Heat Pumps

By Milton Geiger and Tina Russell

May 2011 MP-125

Also known as a ground-source pump, geo-exchange system, or simply an earth energy system, geothermal heat pumps (GHPs) are a central heating and/or air conditioning system that principally utilizes solar energy stored in the ground. Geothermal systems use the ground as either a source of heat in the winter or as a cooling agent in the summer. Like a cave, the subsurface ground temperatures stay warmer than the air in the winter and cooler than the air in the summer. GHP technology harnesses this readily available natural resource and uses it to heat and cool buildings. GHPs do not create heat; instead, they merely transfer energy from one place to another by pumping heat to or from the ground.

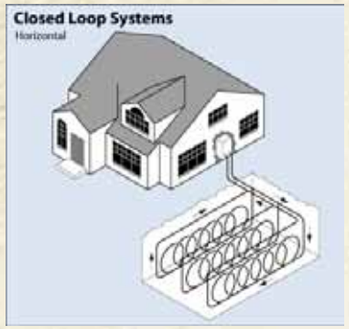
HOW THE TECHNOLOGY WORKS

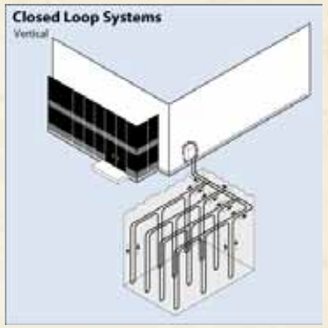
A geothermal heat pump system works by passing fluid, either available groundwater or a benign antifreeze solution, through underground pipes where heat is absorbed (or rejected) from the ground and then converted by a compressor and heat exchangers into hot or cold air (depending on the season) to be distributed throughout a home or other building. Similar to a refrigerator, a pump and compressor drives the transfer of heat, and, just as in a regular forced-air system, warm or cool air is circulated by ductwork. The waste heat in the summer, and as available in the winter, can also provide domestic hot water through a "desuperheater."

DIFFERENT SYSTEM TYPES

There are two types of geothermal heat pump systems that can be utilized in Wyoming: closed and open loop. Systems can also have horizontal, vertical, or pond/lake loop fields.

- **Closed loop –** In closed loop systems, an antifreeze solution is circulated through buried pipes, which collects heat from the ground in the winter and pull heat away in the summer placing it back into the ground.
- **Open loop –** Open loop systems operate in a similar fashion except they can be installed in areas that have an easily accessible ground water supply where open discharge is possible.
- **Loop field orientation –** As displayed in the cover image and the images above, piping for GHPs can be installed in a variety of orientations. For homes, open loop (where available), horizontal, and pond/lake loop fields are often the least expensive. Vertical fields are generally most expensive, but they can be used in areas with limited space or for commercial facilities with significant heating and cooling requirements.





COST OF GEOTHERMAL SYSTEMS

The cost of a GHP varies greatly by application and design. As a general rule of thumb, GHPs cost about $2,500 per ton of capacity to install or approximately $7,500 for a 3-ton unit, which is the size most commonly fitted to the average residential home. In contrast, other classic heating and cooling systems such as air conditioners and furnaces generally cost around $4,000. One must also consider the cost of drilling/trenching the pipes that could run anywhere from $10,000 to $30,000 depending on site-specific factors. Therefore, expect to spend between $15,000 to $25,000 on a 3-ton GHP for a typical home.

GEOTHERMAL BENEFITS AND DRAWBACKS

There are numerous advantages to GHPs, including performance, environmental impacts, and cost. The most important factor for a heating or cooling system is, "Does it work?", and GHPs do. GHPs have few moving parts, making them reliable and quiet, durable (typically 50-year warranty on loops), no pronounced blasts of hot or cold air, and have small space requirements for interior equipment. The efficiency and reduced environmental impacts are also important to many home and business owners. GHPs use electricity to run a circulating pump and compressor, but, because they are moving heat and not creating it, efficiency rates range from 300-600 percent. The high efficiency rates reflect that, for every one unit of energy (electricity) used by the heat pump, between three and six units of energy are made available for heating or cooling. As a comparison, the best natural gas-fired furnaces are 95-96 percent efficient.

With any benefit, there are drawbacks. With GHPs, the primary obstacles are the high upfront cost, need for loop field space, and incompatibility with some existing heat distribution systems. The high initial cost has already been discussed, but the need for loop field space can also be a deterrent. Some city lots do not have adequate space for a horizontal loop field and must resort to a more expensive vertical loop field. GHPs also deliver a lower temperature resource, from 90° to 105°F, than most fossil fuel-based systems. Some existing air handling systems (ducts) are undersized for this lower temperature resource, requiring expensive upgrades. Additionally, hot water heating systems often require a higher temperature resource.

INCENTIVES AND FINANCING

Incentives and financing help reduce the "sticker shock" of GHPs. The incentives are generally divided into those appropriate for homeowners and businesses.

Homeowners —

- **Federal tax credit** – 30 percent of the total GHP equipment and installation cost (through 2016). The tax credit can be carried forward up to five years.
- **Energy efficient mortgages** – GHPs often cash flow immediately when financed as part of a 30-year mortgage.

Businesses —

- **Federal tax credit** – 10 percent of the total GHP equipment and installation cost.
- **USDA Rural Development REAP grants** – 25 percent of project cost for eligible small, rural business. All areas of Wyoming except Cheyenne are considered rural.

Homeowners and businesses —

- Utilities value the efficiency benefits brought by GHPs, and many Wyoming electric utilities pay incentives ranging from $200-$3,000^{+}.
- With these incentives, GHPs can offer relatively reasonable economic feasibility with simple paybacks ranging from 3-10^{+} years depending upon system design and fuel alternatives.