GEOTHERMAL HEAT PUMPS:

A better way to heat and cool your home

By Milt Geiger

As Wyomingites know, our weather is among the most extreme in the country.

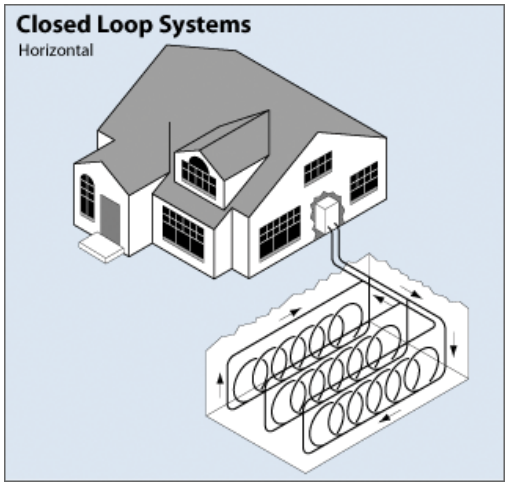
With highs reaching 115°F (at Basin in 1983) and lows plummeting to -66°F (near Riverside in 1933), it can be a significant challenge and expense maintaining a comfortable living and working space.

Geothermal heat pumps (GHPs), also known as geoexchange or ground source heat pumps, can provide a cost-effective and environmentally responsible solution to heating and cooling needs.

Like a Cave … But Better

Those who have ever been in a cave know that, despite variations in the outside temperature, the cave's temperature remains constant. In Wyoming, the subsurface (at least 4 to 6 feet below ground) year-round temperatures average 45°F in colder regions (e.g., Pinedale) to 60°F in warmer areas (e.g., Torrington). Wherever you are, this near-constant temperature can be tapped by a GHP to serve as both a source and sink for heat. In use since the late 1940s, GHPs concentrate this resource in the winter (source) to create heat and diffuse energy in the summer (sink) to create cooler interior temperatures.

To harness the geoexchange resource, piping is placed in the ground (in either a horizontal "slinky" system or through vertical wells). The systems are generally closed-looped, using a pumped fluid (typically water mixed with propylene glycol or methyl alcohol) to extract or insert heat into the ground. The figure above shows an example of a typical residential system with the horizontal slinky system. This fluid is then run through a heat exchanger to supply a forced air, or radiant heat, system similar to a typical furnace or air conditioner. Through the use of a heat pump, the temperature of the delivered air, when in heating mode, is raised to 90-105°F, well-above the ambient temperature of the ground.



Schematic diagram of closed loop residential system. Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy

Although systems can have a relatively inexpensive backup heat source, a well-designed GHP concentrates enough warm or cool air, much like a refrigerator does, that there is generally little need for supplemental heating or cooling.

So Why is it Better?

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, do not have pronounced blasts of hot or cold air, and have small space requirements for interior equipment, which consists of the heat pump and blower. They can also be sized for a range of applications, from residences to businesses to schools, although adequate space for the loopfield or boreholes is required.

Building a large geoexchange field requires large amounts of space. This is at Greybull Elementary School in Greybull, Wyoming. (Courtesy of Creative Energies)

Courtesy of Creative Energies

This small residential geothermal loopfield using a single slinky coil in a trench requires the disturbance of existing landscaping and adequate space. (Driggs, Idaho)

The efficiency and reduced environmental impacts are also important to many homeowners and businesses. GHPs do use electricity to run a circulating pump and heat exchanger, but, because they are moving heat and not creating it, efficiency rates range from 300 to 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- to 96-percent efficient. The energy used by the system is a renewable resource, utilizing solar energy and the natural heat of the earth. The waste heat in the summer, and as available in the winter, can also provide domestic hot water. A GHP could even be powered with renewable energy!

Is Better Expensive?

The high upfront cost of GHPs can be an obstacle, but GHPs also provide long-term savings opportunities. The heat pump and excavation work averages $20,000 for a typical home; this rough estimate is sure to vary based upon site characteristics and system needs. One thing is certain, GHPs cost more upfront than a typical furnace/air conditioner combination. The advantage comes in reduced fuel cost and maintenance over time. With heating bills reduced 30 to 70 percent and cooling 20 to 50 percent compared with conventional systems, the systems generally pay for themselves in three to nine years. It can also remove the need for natural gas or propane service, eliminating the base service fee. The reliance on a relatively small amount of

Money Matters

Many incentives exist for GHPs. A great place to learn about them is the Database of State Incentives for Renewable Energy (DSIRE). It can be found at www.dsireusa.org

electricity for heating and cooling also reduces vulnerability to the price changes of natural gas or propane.

The high initial costs can be daunting, but assistance is available. First, in new construction or renovations, the cost can often be included in a mortgage. In a standard 30-year note, the extra payments resulting from the GHP installation are customarily less than the energy savings from day one.

It cash flows from the start!

There are also federal tax credits and state grants for homeowners and businesses, which can reduce the initial cost by more than 30 percent. Finally, many utilities offer rebates for GHPs, as they help address expensive peak load issues. Contact your local electric utility for details and potential incentives.

So, What's Next?

The number of installers in Wyoming is growing. Many heating and cooling contractors are beginning to diversify into GHPs. In addition, some companies specialize in GHPs and other renewable energy systems. They can help determine if a GHP is a viable option for your property. As always, make sure you are dealing with a reputable supplier and properly trained and certified installer.

The mature technology and current incentives make GHPs a very attractive option for Wyoming residents.

For more information on the GHPs, please visit www.energysavers.gov or contact a local University of Wyoming Cooperative Extension Service office. Contact information is at http://ces.uwyo.edu/Counties.asp.

Quick Tip

Consider energy efficiency in home improvements before installing a geothermal heat pump. This can reduce the energy use of your home and the resultant upfront costs of installation.

Courtesy of Creative Energies

Building the loopfield in a pit or trench is sometimes impractical. In those cases, the coil is pre-assembled, rolled into an orb, and unrolled in the pit. (Jackson, Wyoming)

Courtesy of Creative Energies

A finished heat pump system utilizing a water-to-water heat pump, a water-to-air heat pump, and a buffer (pressure) tank (left). (Jackson, Wyoming)

Cooperative Extension Service and Energy?

The University of Wyoming Cooperative Extension Service, in partnership with the UW School of Energy Resources, can help you understand the opportunities and challenges presented by energy efficiency improvements and renewable energy systems, including biomass, geothermal, small hydroelectric, solar, and wind. Please contact your local educator (http://ces.uwyo.edu/Counties.asp) or energy extension coordinator Milt Geiger at (307) 766-3002 or mgeiger1@uwyo.edu

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