Harvesting Heat

Geothermal heat pumps help homeowners find savings that are already underfoot

By Barbara Sessions

The Oklahoma State Capitol, the “Texas White House” in Crawford and the penguin house at the Tulsa Zoo—what could this unlikely trio of landmarks possibly have in common?

Ground-source heat pumps, or GHPs.Not only are GHPs the answer to this riddle, they are the cost-saving heating and cooling solution for homes, schools and businesses across the country.

Proponents of geothermal systems—an Oklahoma-grown industry—stand firm for the GHP’s ability to provide comfortable buildings that are friendly to the environment and consumers’ wallets.

If, for example, a typical 1,500 square-foot home can be made comfortably warm in winter and cool in summer for $1 a day, who on earth would disagree with them?

Not President Bush. He and his family enjoy geothermal comfort at their “Texas White House” in Crawford.

So do visitors to the Oklahoma State Capitol, the penguin house of the Tulsa Zoo, and the campus of Northeastern State University - Broken Arrow, to name a few of the thousands of homes and buildings across the Sooner State that have been fitted with GHPs over the past 25 years.
GHP technology captures heat for household use from the relatively warm ground in the winter and returns heat from the house to the relatively cool ground in the summer. Heat removed during the summer fuels the household water heater at no additional cost.

GHP is electric-powered, but the electricity is used only to move heat, not produce it. As a result, the pump delivers three to four units of energy for every unit consumed.

A traditional air-source heat pump, by contrast, must remove heat from cold outside air in the winter and deliver heat to hot outside air in the summer. In temperature extremes, it works harder, consuming one unit of energy (in the form of electricity, natural gas, propane, or fuel oil) for every one-two units delivered.

GHP costs a few thousand more dollars to purchase but pays for itself through decreased operating costs. There are substantial comfort, aesthetic and environmental advantages, as well.

In 1993, the U.S. Environmental Protection Agency, after testing GHP alongside high-efficiency gas furnaces and conventional air conditioners, labeled GHP, “the most energy-efficient and cost-effective space conditioning available today.”

One year later the U.S. Department of Energy created a Geothermal Division and, with the National Rural Electric Cooperative Association and private sector companies, formed an industry/government consortium, Geoexchange, to begin spreading the word.

Slowly but surely, the public is hearing the rumbles. While it took until the turn of the century to attain the first million installations, Geoexchange now targets growth at 400,000 units annually.

Currently 1% of the $64 billion U.S. heating market, GHP is expected to grow to nearly 7% over the next ten years.

“I’m glad I lived long enough to see it [popularity of GHP]. There’s no doubt the ground-source heat pump is a good idea and it’s really an Oklahoma product,” said Dr. Jim Bose, a mechanical engineer from Stillwater whose prototype system ignited the emerging industry.
In the 1970s, Bose received the backing of Oklahoma State University to develop his idea for using water circulated through polyethylene pipes buried next to a home or building as the method for gathering heat for the system.

The International Ground-Source Heat Pump Association (IGSHPA), formed on the OSU campus, became the worldwide leader in heat pump research and development. Bose is executive director.

Geothermal technology utilizing Bose’s basic concept has been introduced to 60 countries, with the help of IGSHPA’s international conference in Stillwater each June. Bose expects 300 participants this year, including representatives from China, Korea, and Japan.

IGSHPA pioneered installation training and has accredited thousands of independent contractors, installers, and system designers according to standards written largely under IGSHPA’s tutelage.

Other university-based and industry groups have sprung up over the years as interest in geothermal energy has grown, but the Stillwater program remains on top.

“We (IGSHPA) are still considered the keepers of the keys of ground-source technology,” Bose said.

The manager and member services director of Red River Valley REA in Marietta were looking for cost-saving ideas in 1983, because members were asking how to save money on heating, air conditioning and hot water costs.

After returning from their first IGSHPA seminar, the managers had their answer: the ground-source heat pump.

Then the hunt was on for anyone in the state who sold or installed such systems. At last, RRV found a willing supplier, Cooper Heating & Air Conditioning in Tulsa, and engaged Ditch Witch drillers from Perry to help with the ground preparation.

Failing to find a single heating contractor in the area who knew how to install the in-ground loop pipe, RRV staff jumped into the ditch and connected the first system themselves — learning by doing.

Over the next six years, Red River Valley REA sold and installed 425 residential units, or one per 20 members. In addition, 87 businesses signed up, among them the widely popular McGehee’s Catfish Restaurant near Marietta.

When others saw what was happening, they bombarded Red River Valley REA with inquiries, wanting to know how to copy the success.
It wasn’t long before staff found themselves spending half their days on the telephone, having their brains picked by co-ops and contractors from throughout the country.

They decided to create a subsidiary business wholly owned by Red River Valley REA to market their advice and generate revenue for the co-op.

With the opening of Earth Energy Technology & Supply, Inc. (EET&S) in 1988, Red River Valley REA became the first co-op in the nation to form a full-service GHP business.

“They have developed real expertise over the years and have been a training ground for other successful people in the industry,” Bose said.

EET&S employs eight people and is administered by Dan Willis, special assistant at Red River Valley REA. From an office/warehouse in Marietta, the business concentrates efforts in Oklahoma, Texas, Missouri, Arkansas, and Kansas.

EET&S sells Command-Aire (Trane) ground-source heat pumps, as well as plastic piping and related components. Architects, builders, engineers, and contractors who are contemplating or engaged in GHP installations obtain assistance in all aspects of system planning and activation.

“Installing a geothermal system is not a do-it-yourself project. The pipes are underground, so they need to be designed and fitted correctly, and pressure tested properly. We’re helping customers estimate load requirements, acquire or fabricate the loop system appropriate for the job, become qualified for IGSHPA certification, and gain experience at geothermal installations,” Willis said.

Greg Dudley has been with the business for 13 years and now drives throughout western and southern Oklahoma promoting geothermal energy and calling on current and prospective contractors.

“Contractors who are hearing about the ground-source system for the first time have to get excited about it and want to recommend it to their customers. That’s easier to do now because geothermal isn’t just a prospect anymore; it’s a technology proven to save them money. No one who is going out to buy or build a home with a $500-$600 house payment wants to face an electric bill to match it. If you can keep your cooling and heating bill to $1 a day, you’ve made a pretty economical investment with long-term returns,” Dudley said.

Also on staff at EET&S are Vickie Crossland, Bob Evans, George Mechler, Richard Moore, Jerry Smith, Dave Stephenson, and Gwen Wyatt. They have a combined 150 years of experience in the geothermal industry, Willis said.

A concentration of GHPs in a co-op, such as at Cimarron Electric Cooperative in Kingfisher, where a full 10% of residential members now own GHPs, lowers the electric bills for all members. Here’s how: The cost per unit that the co-op pays for its power is based on “peak load requirement,” that period of the year (usually summer) when the most electrical power is expended. By operating so efficiently, GHPs lower the peak load requirement.

Cimarron manager Tom Garrett couldn’t be happier with the results. “Our geothermal program is saving millions of dollars for our members,” he said. “I’ve owned a geothermal system at my own home for over 22 years, and we have owned geothermal at our office for over 20 years. I wouldn’t have anything else.”

Alfalfa Electric Cooperative, through its subsidiary, AEC Services, began in the heating and air conditioning business about seven years ago with an emphasis on geothermal units. AEC currently has three full-time employees, one part-time employee and has installed over 150 GHPs.

One of their largest jobs entailed 45 tons of geothermal heating and cooling at the Cherokee Grade School. School superintendent Lance Miller stated, “We are very pleased with our geothermal system. It replaced natural gas units that were old and requiring a lot of maintenance. Alfalfa Electric Cooperative projected savings with the geothermal units, and this has proved true with a reduction of about 50% on heating and cooling costs.

The well field is located south of the school playground, and if I had not observed the installation, I could not tell you where the wells are located.”
When asked why the co-op got into the heating and air conditioning business, general manager Max Ott said, “We feel that our members deserve the right to choose the most efficient heating and cooling system on the market, and with AEC Services, our members get that opportunity.”

Terry Ryel, director of marketing, sees the direct benefit of GHPs. “I will do eight to ten energy audits each month, and the biggest surprise for the majority of our members is the savings that a geothermal system will make,” he said. “It is not unusual to see the program project a 30-40 percent reduction.”

Barry Haynie of Cimarron Electric Cooperative and Terry Ryel of Alfalfa Electric Cooperative contributed reporting to this article.

Ground-source systems: How do they work?

The Basics

A ground-source system starts with something that is free and constantly renewable: the heat available from the earth beneath our feet, which stays at a stable temperature of about 55-70 degrees throughout the year. It uses a process called heat transfer to:

·Pull heat from the ground in the winter to heat your home.
·Pull heat from your home back into the ground to cool your home in the summer.
·Utilize the extra heat available from these transfers to fire up your water heater.
The ground-source system has three parts:
·An in-ground loop pipe system for extracting heat from the earth in winter or returning it to earth in the summer.
·A heat pump for transferring earth heat to your home in winter or returning it to the pipe system in summer.
·Ductwork for circulating the air in your home year round.

Convenient Installation

Many homes already have ductwork and heat closets. These often can be utilized without change for the ground-source system.
The heat pump is an electric compressor that goes in your heat closet or garage. One unit suffices for both heating and cooling.

No separate outside compressor is required. Gone is the ugly box on the yard or roof , the noise emitted by its interior fan and the risk of damage from exposure or vandalism.

The Pipe System

The in-ground loop pipe system is the most interesting part. It consists of a series of small diameter plastic pipes placed in holes drilled 200-250 feet deep.

The pipes are heat-fused together and filled with filtered water. The pipe system is then connected to the heat pump, which keeps the water circulating at about nine gallons per minute at low pressure and only when the unit is running.

The ground pipe forms a “closed loop.” That means the water in the pipes stays there. None is added or removed after the initial installation; your water system is not affected.

Water is a far more efficient agent than air for extracting heat. To cool off quickly at the amusement park, for example, we seek out the fine mist sprayer rather than the shade tree.

In the winter, the water extracts the free heat available from the earth. The water is then circulated through the heat pump, which converts it to warm air. The duct system circulates the warm air throughout the house. A thermostat in the house lets you adjust the heat, or switch automatically from heat to air conditioning.

In the summer, the heat pump removes heat from your house and transfers it to the pipes. The earth absorbs the heat.
The loop piping is typically guaranteed for 25 years but expected to last 50 years or longer. The indoor compressor has an expected life of 20 or more years. The only home owner maintenance required is periodically changing air filters.

Comfort

GHP owners, including yours truly since 1990, sense an even comfort level, the feeling that every space in the house is saturated with warmth or coolness and just-right relative humidity.

The website of the Geothermal Heat Pump Consortium, Inc. explains why:
“Choosing a heating and cooling system is like Goldilocks sampling the porridge. The air that a furnace system sends through the ducts is heated to as high as 130½ F, and may feel too hot or dry. Most conventional heat pumps circulate air through the ducts at about 92½ F—too cold and drafty for many people. With good construction and proper duct design, Geoexchange systems circulate air heated to about 105-110½ F — just right for almost everyone.”

Ecology

GHP has been called the “organic gardening” of heating, ventilation, and air conditioning systems. It burns no fossil fuel and emits no contaminants into the air. The system recycles Earth’s natural heat throughout the year.