March 7, 2011

Digging Up Energy Savings Right in Your Backyard

By LORRAINE KREAHLING

Five years ago, my husband and I walked out of what was left of our historic house after a propane explosion. As the house caught fire, the cat jumped out to safety, too. When we rebuilt, we wanted to avoid burning fossil fuels in our new home, and I remembered reading an article about an architect who drilled geothermal wells to heat and cool his Lower Manhattan town house.

Many people think geothermal energy means tapping the power of geyserlike hot springs from miles underground to turn turbines and generate electricity. They may also associate it with minor earthquakes like those that halted major geothermal deep-drilling projects in northern California and in Switzerland late in 2009.

There is, however, another way to make use of geothermal energy on a much smaller scale. Ground-source heat-pump geothermal systems take advantage of the earth's constant temperature below the frost line to heat and cool buildings.

That line varies according to latitude, but ranges in the United States from about three to six feet. Below that depth the temperature stays around 50 degrees Fahrenheit, give or take a few degrees. That is why a subterranean cave feels warm in the winter and cool in the summer. Wells for this geothermal energy usually go down in the hundreds rather than thousands of feet.

The technology is hardly new. The first successful commercial installation of ground-source heat pumps for climate control was in 1946 in an office tower in Portland, Ore. And the technology is best known in the Midwest and the South where the Department of Energy reports two-thirds of the nation's geothermal systems are located.

The trend is steadily upward, according to Steven Chalk, chief operating officer of the Department of Energy's Office of Energy Efficiency and Renewable Energy. The 115,442 heat pumps that shipped from manufacturers in 2009, the latest year for which statistics are available, Mr. Chalk said, "was triple the number from a decade earlier." He said that 3.5 percent of homes built that year installed geothermal heat pumps.

Heat pumps are based on the same principles as a household refrigerator. The heat pump in a refrigerator transfers heat from food placed inside it to the room outside the refrigerator.

The warmth you feel at the back or base of the appliance is that transferred heat. Geothermal heat pumps extract heat from water brought in from underground, and are more efficient than air-source heat pumps.

There are two methods of getting access to groundwater, and the drilling or excavation required is one reason the systems are expensive. In open-loop geothermal systems, heat pumps extract energy or heat directly from groundwater piped in from wells.

Closed-loop systems are designed to circulate water mixed with nontoxic antifreeze through high-density polyethylene pipes. The tubing can go down in vertical wells or — when there is enough land — the plastic pipes can be laid out horizontally in trenches below the frost line. (Schools sometimes use their football fields for these underground Slinky-like coils.)

One reason the technology has a low profile, industry professionals suggest — only half-joking — is it is underground.

"You see solar panels up on a roof and wind turbines on the horizon," said Jack DiEnna, executive director of the Geothermal National and International Initiative, a nonprofit trade organization. "But if your neighbors missed the day the drillers were in your backyard putting in wells, they don't know about your green heating system."

How green is ground-source heat-pump technology? The only nonrenewable energy used is electricity. The monthly electric

will bill go up, of course, but the system can eliminate a winter fuel bill, as it has ours. Summer utility bills for air-conditioning can be reduced by half or as much as two-thirds.

“Cost savings are specific to the area of the country, and depend on whether you are competing with natural gas or propane or electric resistance,” said Gordon Bloomquist, a retired senior scientist at Washington State University, who has studied, designed and done troubleshooting on hundreds of geothermal projects. “If electricity costs 10 cents a kilowatt, a heat pump will cost you 2.5 cents for the same amount of electric heat,” he said.

Mr. Bloomquist echoed other experts when he said the growth of the geothermal market was hampered by the lack of proficient engineers and installers, which in turn contributed to the high cost of the systems. “We don’t have the an infrastructure with experience in a lot of places, so there is the risk of problems,” he said, “and this helps elevate price.”

Five years ago, my husband and I could find no one on the North Fork of Long Island who had successfully designed and installed a closed-loop system. (This would not be the case today.) We assembled a far-flung team: a designer in Canandaigua, N.Y.; a geologist from Bohemia, N.Y.; a driller from Hampton Bays, N.Y.; and a local HVAC installer who had done a few open-loop systems. I can report that troubleshooting a system with a designer several hundred miles away is not to be recommended.

The federal government is aware of the expertise deficit. The Energy Department dedicated $1,077,500 of Recovery Act funds to create national certification standards for architects, engineers, HVAC specialists, drillers, and other trades involved in geothermal installation, according to John Kelly, chief executive of the Geothermal Exchange Organization, a nonprofit trade organization that will coordinate this effort with the International Ground Source Heat Pump Association at Oklahoma State University.

And $61.9 million of Recovery Act money has been directed to cost-sharing geothermal projects in schools, hospitals, government and commercial buildings in an effort “to show the economic feasibility of ground-source heat pumps,” Mr. Chalk said.

The federal government has also begun to address the other major hurdle faced by consumers who want a geothermal system: the upfront cost. The price tag on the geothermal systems is sometimes twice that of a conventional heating and air-conditioning system. Again, drilling geothermal wells is expensive.

Legislation passed by Congress in 2009 offers homeowners a tax credit of 30 percent of the cost of any geothermal system that is installed by Dec. 31, 2016. Commercial projects may deduct 10 percent.

Many states, including New York State, offer tax incentives as well. And because these systems decrease the burden on the grid in times of peak demand, many utility companies offer rebates.

Four years ago, the three wells required for our three-ton system for our 2,100-square-foot home cost $9,200. The 160-foot “wells” are actually six-inch-wide boreholes. Besides the drilling, the price included sinking the pipe in the wells, grouting it, fusing the three lines into a manifold, and trenching out a six-foot-deep ditch to the foundation for the supply and return lines that connect to the heat pump in the basement. Looking out at our lawn today, none of this subterranean plumbing is visible.

And how is it working out? Our system will most likely pay for itself in the next two to three years. There was a period of tweaking, but we are comfortable now in summer and winter alike. Much as we felt the day we walked out of an exploded house, we feel fortunate — both to have chosen a geothermal system and to not be burning fossil fuels.