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[Business](#)
[Home](#)

[Media &
Advertising](#)

[World
Business](#)

[Your
Money](#)

[Markets](#)

[Company
Research](#)

[Mutual
Funds](#)

[Stock
Portfolio](#)

[Columns](#)

Heat From the Earth to Warm Your Hearth

By **BARRY REHFELD**

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RUSS ROOT made an efficient move last year - to a new home he had built in Goshen, Conn. While it is considerably bigger than his former house, in Chenango Forks, N.Y., it will cost far less to cool and to heat. That is because he did something he had thought about ever since he built his last house, 15 years earlier: he installed a geothermal system instead of an oil-guzzling boiler.

Now all the heat to warm his house is supplied by the earth beneath him. It's pumped up, through plastic piping, in water circulating in his backyard six feet underground - where the temperature stays at about 45 degrees - and distributed by a fan through the house's ductwork as air warmed to around 95 degrees.

The bill for Mr. Root's geothermal pump, its ground loop of piping and the house's ductwork was just over \$21,500. While a geothermal system, including labor, typically costs more than a comparable furnace and air-conditioning system, the price was about the same for Mr. Root, because the extra expense of digging and looping - \$1,500 in his case - was more than offset by a \$2,000 rebate from Connecticut Light and Power.

"I was in the black from the day I moved in," said Mr. Root, who is a lineman for the utility, which treated him as it would any customer.

The water circulates through the geothermal pump over coils containing refrigerant, which absorbs its heat. The refrigerant is then raised to the higher temperature under pressure by a compressor. In the summer, the method is reversed. His home is cooled by circulating hot air out of the house - a process that is similar to the operation of a refrigerator, an appliance that his basement pump resembles.

The system is quiet, clean and odorless, and uses little electricity. Maintenance consists of cleaning a filter every few months; the pipes are guaranteed to last 50 years. There are virtually no moving parts other than the pump. After living for more than a year in the 2,900-square-foot home, a third bigger than his old house, Mr. Root finds that his energy costs are running about 20 percent less than the \$2,700 he used to spend, or about 40 percent less per square foot.

And he is likely to reap added benefits when he sells the house. A 1998 study commissioned by the Environmental Protection Agency found that a home's value rises an average of \$20 for each \$1 decrease in the annual utility bill



Russ Root checks the geothermal system at his home in Goshen, Connecticut, with his daughter, Mackenzie, last month. He said the unit had reduced his energy costs by 20 percent.

PHOTO: NY TIMES NEWS SERVICE

Although the notion of tapping the earth's heat has been around forever and the basic technology has existed for decades, the many advantages have only recently begun to win widespread attention. The big reasons are concern for the environment and, more to the point, money. Geothermal systems are becoming increasingly competitive, even for homes in which an old furnace and air-conditioning system must first be removed.

After a decade in which installations grew 20 percent a year, a million American homes - both old and new - now have geothermal heat pumps, said Jessica Commins, a spokeswoman for the Geothermal Heat Pump Consortium. And a growing number of celebrity homeowners who use them - like the country music star Toby Keith, the [Home Depot](#) co-founder Arthur Blank, the actor Ed Begley Jr. and President Bush - have helped to raise the technology's profile.

Energy legislation last summer increased the financial support for these systems. The law provides for \$300 in federal tax incentives and includes a provision allowing for a \$2,000 federal incentive for home improvements that reduce energy costs by more than 50 percent. Geothermal systems can trim 30 percent to 75 percent of the cost to heat and cool, so many installations would qualify.

But the biggest driver is the cost of fossil fuel. With the Energy Department predicting huge jumps in residential oil and natural gas costs for winter heating - 27 percent for oil and 41 percent for gas - shipments of geothermal pumps doubled during the last three months, Ms. Commins said.

Now, "the front-end costs are within reach," said Roy Mink, director of the Energy Department's geothermal program. At the same time, he said, "there's more competition for geothermal business, and that's driving down the price of installing them by 10 percent."

The payback period depends on a variety of factors, including the type of system, the installer and the location and size of the house. Typically, it takes 3 to 10 years before fuel savings equal the cost of the pipes and placing them in the ground; indoors, the cost of traditional and geothermal systems is roughly the same. Of course, the greater the heating and cooling needs and the higher the fuel costs, the quicker the payback. A 2,500-square-foot home in New York City with a standard furnace and central air costs \$3,200 a year, on average, for heating, cooling and hot water, versus \$1,800 for a geothermal system; in Los Angeles, the figures are \$1,600 and \$800.

Installers generally stick to one brand of pump to get better pricing from the manufacturer, so the installer and pump tend to be a package deal. The standard for installers is certification by the International Ground Source Heat Pump Association; the most desirable pumps carry an Energy Star efficiency rating. Among the brands earning that rating are WaterFurnace, ClimateMaster, Trane, Hydro Delta, McQuay and Econar.

"Water Furnace is the Cadillac," said Steve Brown, co-owner of Carl Franklin Homes in Dallas, a builder of homes with geothermal systems. "But there are a lot of good pumps, and it's more important who puts in the system. You have to shop around to get the best deal."

Installers generally recommend three types of systems: those with horizontal, open vertical and closed vertical loops. A horizontal loop system, typically an E-formation that requires about a half-acre, is recommended when homeowners have the space, as Mr. Root did. It is generally the least expensive, and its costs fall further if it is part of new construction, because its installation can be combined with the laying of the foundation.

The cost of a loop varies greatly, from about \$1,000 for a horizontal loop connected to a modest house in the West, where geothermal systems are more common and homeowners have more options, to \$50,000 or more for a vertical closed loop attached to a mansion atop New England bedrock.

A vertical loop, generally two or more connected branches extending more than 200 feet into the ground, is the urban choice; it requires less surface area but is likely to cost more because of the drilling expense.

THERE are also open vertical systems, which are drilled in much the same way as a water well and may be used when there is access to an aquifer. These may do double duty in rural areas by providing homes with drinking water.

Steve Toma has an open system in his new 7,000-square-foot home in Mendham, N.J., that taps a well 1,400 feet down. Because of its unusual depth, it was expensive to drill. He also has extras like filtration equipment and a radiant-heat grid, which add significantly to the cost. His system cost more than \$135,000, roughly 30 percent more than an equivalent traditional oil or natural gas installation; he expects to earn back the difference in about eight years.

"It's a big investment, but there's the green aspect," he said. "You can't put a dollar on it."

For a relatively few lucky homeowners, there is an option that delivers the best of both green worlds. It's the pond loop, for homes near a body of water that is at least eight feet deep year-round. There are no digging or drilling costs, just the cost of a Slinky-like tubing coil and the labor of placing it at the bottom of the pond or lake.

"It's generally the cheapest," said Kirk Bellanca, a co-owner of Enviro-Tech, an installer in Staatsburg, N.Y. "You should get permission from the town, but they're almost always very supportive. The fish like it, too. It becomes part of their habitat."

In a sense, two comfortable homes for the price of one.