

Islanders tap geothermal energy – the heat beneath their feet

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By Janet Hefler – February 22, 2007

When it comes to alternative energy choices, some Islanders look no further than the ground beneath their feet. Geothermal energy provided by heat absorbed in the earth from the sun offers them a free, clean, renewable energy source for heating, cooling, and water heating in their homes and businesses.

Two of the Island's biggest geothermal enthusiasts are Brian Nelson and David Sprague, co-owners of Nelson Mechanical Design.

In addition to a geothermal system in Mr. Nelson's Vineyard Haven home, they designed and installed a combination geothermal and solar energy system in a home in Edgartown and are working on a geothermal system proposed for the Oyster Bar Restaurant in Oak Bluffs.

"The sun will never send you a bill, and peak sun, unlike peak oil reserves, is still billions of years away," Mr. Nelson says with a smile. As he explains the basics of how a geothermal system operates, it sounds too good to be true.



Alex Parris, Dave Sprague, and Jeff Craig
Loops of copper tubing that will collect heat from the earth for a geothermal energy system stretch across a 2,500 square-ft. area where Alex Parris, left, Dave Sprague, and Jeff Craig put it all together. Photos by Janet Hefler

The ins and outs of geothermal

About 6 to 10 feet underground below the frost line, the temperature remains at an average of about 50 degrees year-round. A geothermal or ground source heat pump system uses that constant temperature to heat, or cool, a building, depending on which way the system is run. Heat is absorbed or discharged through a series of looped pipes buried in the ground nearby.

The only electricity needed is for moving the heat between a building and the ground. Geothermal systems work well in below-zero temperatures, and are efficient in both northern and southern climates.

Although geothermal systems may not be familiar to many in the U.S., geothermal heat pumps have been in use since the late 1940s. Mr. Nelson said the U.S. Department of Energy has recognized them as the best way to heat a house since 1994. The systems are clean, odorless, and use little electricity. There are no moving parts, other than the pump.



The intricate network of copper piping comes together in a manifold to carry solar-generated heat from the earth to the heat pump in the house. Photos by Janet Hefler

Heat pumps earned a bad reputation in years past for being ineffective in colder northern climates. However, Mr. Nelson said that because those old-style heat pumps extracted heat from the air rather than the earth, they were only efficient in temperatures down to about 60 to 65 degrees.

Two types of geothermal systems are water-based and direct-exchange, Mr. Nelson said. The decision on which one to use depends on soil conditions, space constraints, and other properties at the site, Mr. Nelson said.

Water-based systems use a black plastic pipe below the frost line containing a water/antifreeze mixture pumped by a circulator to and from the ground to the building. This heated liquid is then sent to a heat pump inside where a refrigerant loop moves the heat from the liquid into the building. In summer, this process is reversed.

A direct-exchange system uses copper tubing containing refrigerant in the ground outside the building. A heat pump inside the building sends the refrigerant into the loops outside in the ground to collect or discharge the heat, then sends it back inside to heat or cool the building.

Higher initial investment costs made geothermal systems less competitive until recently, when energy prices soared. "The geothermal folks who have been doing this forever are excited it is finally catching on in America," Mr. Nelson said.

A master plumber like Mr. Sprague, Mr. Nelson also holds a master's degree in mechanical engineering. Last summer, he and Mr. Sprague attended an international geothermal convention in Albany, N.Y., held by the International Ground Source Heat Pump Association (IGSHPA), a source of training and certification for the geothermal industry worldwide.

Mr. Nelson completed extensive training to qualify as a certified geo-designer and Mr. Sprague as an accredited installer. "It cost us at least \$10,000 for training and to attend," Mr. Nelson said. "Basically, we took a gamble. We know the market is there, and it's important to get trained."



Dave Sprague and Brian Nelson
Dave Sprague, left, and Brian Nelson tweak the settings for controlling the combination geothermal, solar, and conventional energy system in the home of Sarah and Bruce Nevin in Edgartown. Photos by Janet Hefler

The IGSHPA and Association of Energy Engineers administer the licenses, which have been awarded to only a few in Massachusetts, Mr. Nelson said.

Putting geothermal to the test

His expansion into geothermal systems came at the right time for Sarah and Bruce Nevin when they decided to put an addition on their Edgartown home last year that utilized renewable energy. When they asked Mr. Nelson about incorporating solar energy into the plans, he suggested adding geothermal energy to the package.

The result, a computer-controlled mechanical system that manages a combination of solar, geothermal, and conventional energy sources, is the first of its kind on the Island.

The home's primary energy sources are solar and geothermal, with a conventional boiler for baseboard heat in the original part of the house and as a backup system. Solar collectors on the south-facing roof generate hot water year-round and provide the first stage of heat in the radiant floor heating system.

The geothermal system kicks in during the winter and on non-sunny days to produce hot water, also used in the radiant floors. In the summer, the heat pump switches over to cooling and produces chilled water for the radiant floors. Mr. Nevin estimated that over the next 10 years, he could save \$50,000 by using the combination of solar hot water and geothermal radiant heat.

A direct digital control (DDC) system, which looks like a large-sized fuse box, provides the brains of the whole operation. It constantly monitors the different energy sources, staging solar power, geothermal energy, and the propane-fired boiler as needed.

If the DDC detects changes or anything abnormal in the system's settings, it can send routine or emergency calls to an e-mail address, cell phone, or land line, an enticing care-taking feature that might appeal to the Island's seasonal homeowners.

To install the geothermal system's copper tubing, excavating contractor John Keene dug out an area in the Nevins' yard about 2,500 square feet to a depth of six feet. About one square foot of ground heats one square foot in the house, Mr. Nelson said. The specially coated tubing, designed to last at least 50 years, was laid in a carefully configured looped grid pattern horizontally along the bottom of the pit and then buried.

A geothermal system can be adapted for use in any size building, Mr. Nelson said. He estimated a five-ton system would be good for a 3,000-square-foot house, at a cost of about \$25,000. "It would pay for itself in about five years, and then you'll be getting your energy for about a quarter of the cost," Mr. Nelson said.

Home and business applications

Homes with traditional heat delivery systems, excluding radiators, can be retrofitted with a geothermal system, Mr. Sprague pointed out. One such project is underway in Oak Bluffs, where Benjamin Kelley, owner of Building Shelter, partnered with Mr. Nelson to install a geothermal system in a house he is renovating.

After talking with Mr. Nelson about geothermal energy, Mr. Kelley did some research and agreed it would be a good addition to the "green building" options he already offers. In addition to renovations, additions, and custom work, Mr. Kelley builds new homes.

He likes the fact that a geothermal energy system is unobtrusive. "It's just perfectly applicable in a lot of ways, because there are a lot of architecturally conservative people on the Island, and this is not going to affect the looks of your Colonial," Mr. Kelley said. "You can have a traditional style home and still be environmentally sensitive in reducing emissions and living in a more healthy home."

In addition to Mr. Kelley, Mr. Nelson is working with Sullivan O'Connor Architects on plans for installing a geothermal system in the proposed Oyster Bar Restaurant project. The system's copper tubing would be placed vertically in the ground under the basement, where the refrigeration and cooling units will be located. Geothermal energy will be used to heat the building, and to run refrigeration and freezer units as well.

As a testimony to his belief in geothermal energy systems, Mr. Nelson put one in his own home, and will track his utility expenses online on his company's web site, www.nmdgreen.com. Tomorrow he is hosting an open house from 12:30 to 4:30 pm for those interested in learning about the geothermal system in his home at 35 Skiff Avenue in Vineyard Haven.

Mr. Nelson also has been exploring the possibility of expanding the geothermal concept to utilizing stored solar energy from the ocean. Similar to a lake version already used in the U.S. Coast Guard's Chicago Marine Safety Station, he envisions building oceanfront geothermal systems for use by businesses and residences on or near the shore.

Last year, Mr. Nelson proposed the idea of using a computer-controlled heating system at Oak Bluffs School, which was put on hold by the school committee because of concerns about costs and contract terms. With what he has learned about geothermal systems in schools in other states, Mr. Nelson hopes to explore that option with Oak Bluffs School, as well.