

As Energy Prices Go Up, Vermonters Are Looking Down

By Jim Ashley

Increasingly, Vermonters suffering from energy sticker shock have stopped looking around and are looking down at the huge solar thermal battery under their feet — the Earth. Almost 50% of the sunlight striking the Earth is absorbed resulting in earth and ground water temperatures of 47 to 50 degrees in Vermont. Working like a high-efficiency refrigerator, some of the best geothermal heat pumps can take four units of heat from the ground while utilizing only one unit of work energy from the electrical panel, resulting in five units of heat for the price of one. That makes geothermal heating the least costly of all heating sources cur-

rently available in Vermont. Geothermal is also the least costly way to air condition in the summer. Geothermal heat pumps have EERs as high as 30 compared to air-to-air units which have SEERs of only half of that.

HOW DO HEAT PUMPS REALLY WORK?

As we do not have high-temperature ground water or ground temperatures in Vermont, we must upgrade the heat we do get from the ground. A heat pump accomplishes this with three principle parts. First is the heat exchanger. This is a helix coil surrounded by cold vaporized

refrigerant through which we can pump water from the ground. Heat moves easily from the water to the refrigerant. Then a high-efficiency compressor compresses the refrigerant gas to usable temperatures of 110 to 120 degrees or more. This hot compressor gas can then be converted to hot water through a heat exchanger to be used in a radiant floor installation or to hot air through a radiator or air coil to provide a hot air-heating system. Because this source temperature is lower than in a traditional heating system that burns a fuel, the hot air system requires larger air ducts than a traditional system to provide the same heating. However, these larger ducts are

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...Can provide space heating by taking thermal energy from groundwater with a heat pump.

Based on data from the Vermont Department of Public Service, space heating by geothermal systems will have operating costs equal to:

- 23% of propane
- 25% of electric
- 31% of fuel oil
- 50% of pellets
- 71% of cordwood

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AND HEAT LOSS ANALYSES

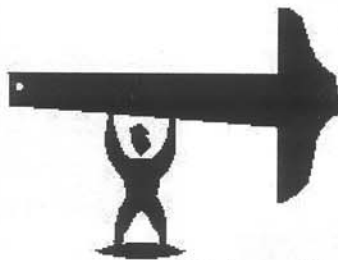
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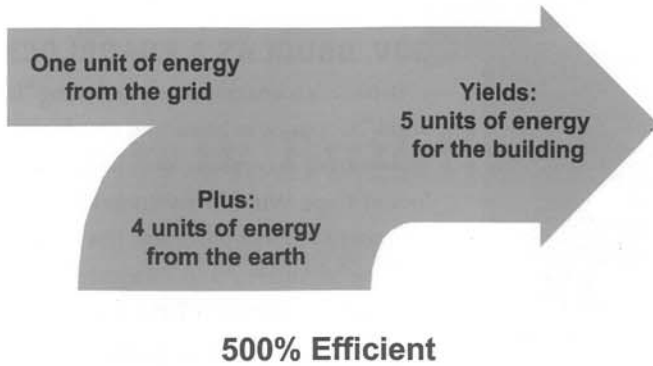
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Geothermal Heat Pump Efficiency



Source: Climatemaster

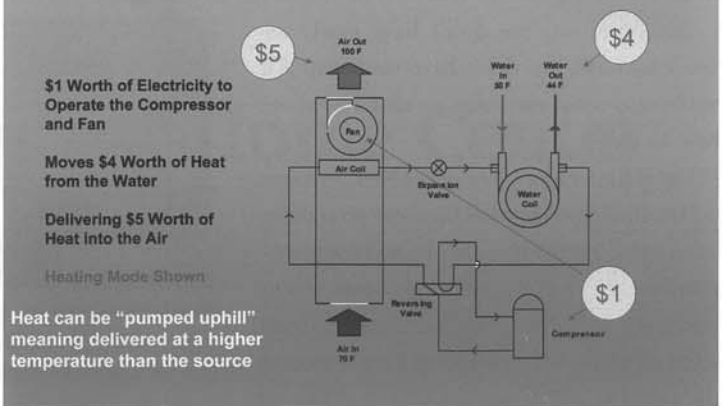
just right to provide air conditioning. Air conditioning can be provided by a reversing valve, which delivers the cold refrigerant to the radiator, and then delivers the highly compressed hot refrigerant to the ground water-exchange coil where the cool ground water easily absorbs the heat creating a very efficient air conditioning system!

Access to the heat of the Earth can be through either closed loop systems or an open loop. In the first case plastic pipes are buried horizontally or put in vertical drill holes, which are then grouted shut with special high-temperature grout. Sometimes pipe loops can be put in ponds. With open-loop systems, a well is drilled. A special type of well called a standing column well is similar to a water well, but the water from the heat exchanger is then returned to the top of the water column in the well. As the water moves down to the pump, heat is exchanged between the bedrock or casing surface and the water in the well. By the time the water has returned to the pump the water should have returned to its original temperature. This process is enhanced if this standing column well is also the water supply well, as water pulled into the well from the rock fractures moves heat in from the surrounding area and refreshes the well. During periods of high usage the well can be further refreshed by bleeding off some of the return water, thereby causing more

new water to enter the well, refreshing the thermal mass of the bedrock.



The standing column well appears to have a number of advantages over either the horizontal or vertical closed-loop systems. Because the SCW can be refreshed and has better heat exchange with the surrounding rock, it can usually maintain the normal ground-water temperature. The closed loops tend to have a gradual temperature degradation throughout the heating season so that they may be operating at temperatures of 32 degrees or less during critical periods. As a result, manufacturers such as ClimateMaster lower their ratings for some of their equipment by 23%

Geothermal Heat Pumps Exchange Heat between Air and Water



when operating with closed-loop systems. Coefficients of performance (COPs) may also drop from 4.8 to 4.0! Two other big advantages for the SCW is that far less drilling is involved for each ton (12,000 BTUs) of capacity, and that much of the drilling may already have occurred if the well is also to be used as a water well.

The change from \$.99 heating fuel oil has helped Vermonters understand what EPA said in 1993 and that people throughout the world have already known that geothermal can create "the most energy-efficient environmentally clean and cost-effective space-conditioning system" available. ■





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