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Geothermal Energy

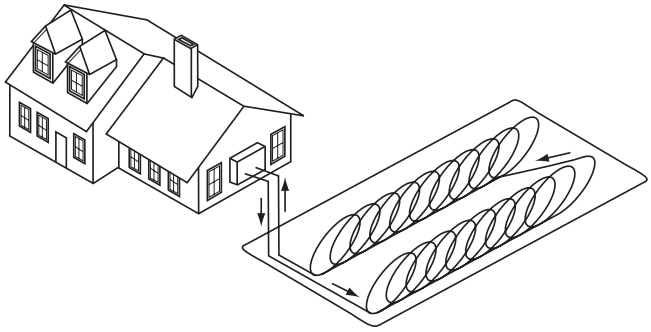
Inside the earth is a large heat source that can be used for geothermal energy. Evidence of this heat and energy is steam or lava that comes out of volcanoes. In locations where this heat source is close to the earth's surface, it can be used for electric power generation. Low-temperature geothermal energy is available to everyone with a heat pump system that utilizes the ground temperature just below the surface which remains around 50 to 60 degrees (F) all year.

The Technology

The three main uses of geothermal energy are direct use, electricity generation and space heating with heat pumps. Direct use and electricity generation are used in areas where the earth's heat is near the surface, typically near volcanic activity. Natural hot springs or steam vents are created when the earth's magma is not very far underground. The heat from these hot water sources and steam vents can be used by nearby homes or businesses. Some have also been used for tourist attractions, like the bath houses in Rome or Old Faithful in Yellowstone National Park.

For electricity generation the heat is used to generate steam that can turn the blades in a turbine generator. In dry steam plants the geothermal energy is hot enough to create high pressure steam that can be used directly in the turbine. In locations where geothermal energy cannot create high pressure steam, pumped high pressure water is heated to high temperatures and then used to create steam from low pressure water. These are called flash steam or binary-cycle power plants. California, Hawaii, Nevada and Utah all have geothermal power plants that produce about 2,200 megawatts (MW) of electricity using all three types of systems.

A geothermal heat pump utilizes the constant temperature of the ground to bring heat into the home during the winter and get rid of heat to the ground in the summer. The system has pipes that are buried under the ground in a vertical or horizontal manner to create a loop for water to flow. The water is circulated with a pump, and a heat exchanger inside the house transfers heat between the inside air and water in the loop. Because the ground temperature is constant all year, the heat pump can provide both heating in the winter and cooling in the summer from the same system. Although the system will need an extra source of energy for extremely hot or cold days, it can provide a large fraction of the heating and cooling at little cost while creating no pollution.



Horizontal configuration of a ground source heat pump

Global Example (www.philippines.hvu.nl)

The Philippine islands are part of the "ring of fire" along the Pacific Rim where the Philippine plate is forced into the Eurasian plate. This creates a lot of volcanoes and earthquakes as well as a large geothermal resource. Geothermal heat is used directly for fish processing, salt production and drying coconuts and fruit. The first geothermal electric power plant was started in 1979. There are now power plants on four islands that produce nearly 2,000 MW of electricity, close to that of the U.S. For this small nation, that amounts to 27% of the entire country's electricity production. The geothermal electricity produced by these plants is cheaper than fossil fuels and it eliminates the pollution from burning coal or natural gas.

Here in North Carolina

This state does not have the geothermal resources to create electricity, but many homes, schools and businesses are starting to use ground source heat pumps. These can provide 30 to 60 percent of the heating and cooling requirements, which can save money. We could significantly reduce our fossil fuel consumption and would create far less pollution.

Related Concepts/Topics

- Plate tectonics, earth's layers
- Volcano and earthquake activity
- Soil & ground thermal properties
- Pumps and water circulation
- Pressure, temperature and water properties
- Steam turbines
- Heat exchangers