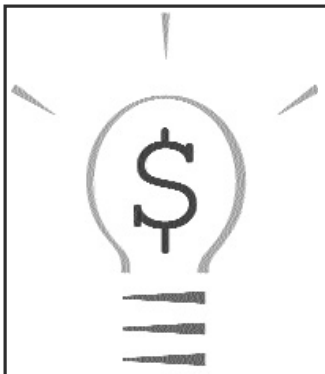

Energy Facts

Geothermal Heating and Cooling

E-2796

An under-appreciated/utilized source of thermal energy is the earth itself – the source of geothermal power, the world's largest power source in common use for centuries. The word "geothermal" means **earth** plus **heat** and it is an environmentally friendly, renewable resource in contrast to fossil fuels mined from the earth that are most commonly used as power generation fuels.

Geothermal energy contributes both to *energy supply*, with electrical power generation and direct-heat uses, and to *reduced energy demand*, with savings in electricity and natural gas usage by using geothermal heat pumps to heat and cool buildings.

Geothermal power plants operate worldwide and show that the earth's thermal energy can be readily converted to electricity in geologically active areas. Facilities can be heated directly with hot water from underground reservoirs and the availability of geothermal heat pumps allows people to tap this abundant source of thermal energy for use in home heating and cooling systems.

How It Works

The earth's core is about 4000 miles deep and scientists estimate its temperature is 7200º F or higher and heat is constantly flowing from the interior to the surface. Wells tap underground reservoirs of steam or hot water and the steam rotates turbines that generate electricity. Water returns to the ground to recharge the reservoir and complete the renewable energy cycle. Hot water can be used directly for greenhouses, spas, fish farms, swimming pools, and home hot water needs. The U.S. Department of Energy reports that the world capacity for using geothermal heat is growing at about 9% per year.

In addition, the earth itself at depths of 5 to 500 feet maintains a constant temperature from geothermal heating. We can use the earth as a heat source or a heat sink by means of a geothermal heat pump. Heat naturally flows from a higher to a lower temperature and heat pumps can force heat flow in the other direction for cooling purposes. In the winter, heat pumps draw from "earth heat" to warm a house and in summer, they transfer heat from the house to the earth as a "heat sink." The subsoil temperature ranges from 50 to 70 degrees depending on latitude.

Advantages of Geothermal Heating

Geothermal heat is much less expensive in general and causes almost no environmental pollution in sharp contrast to traditional power generation plants. Another advantage is that geothermal power is a domestic energy source so its use avoids the political influences of importation and foreign policy difficulties.

For instance, a greenhouse owner decides to use geothermal heat to cut exorbitant energy bills so he can stay in business. He could reduce heating costs by up to 80% and save about 5% to 8% in total operating costs. Or a homeowner installs a geothermal heat pump and for her investment she gets low operating and maintenance costs and usually the lowest life-cycle costs. The heat pump may cost $15 per month more in mortgage payments, but it may save $30 per month on

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the electric bill. And you help reduce the environmental pollution that comes with traditional power generation.

Types of Geothermal Heat

Hydrothermal resources: reserves of steam or hot water, tapped by drilling wells for direct use or electricity generation

Geopressured resources: deeply buried water that contains dissolved methane

Hot dry rock resources: cold water is injected down one well, circulated through hot fracture rock, and drawn off as hot water from another well

Magma or molten rock: extremely high temperature geothermal resources currently not available for heat recovery, but a subject of intense research

Earth energy: use of the heat contained in soil and rocks at shallow depths and accessed by geothermal heat pumps.

Environmental Concerns

Traditional power production costs range from 4 to 8 cents/kilowatt hour. Geothermal production promises a life-cycle energy cost of 3 cents/kilowatt hour. The cost savings is apparent, so let's look at the environmental impacts. The production of geothermal energy involves no combustion so this is a big advantage over fossil fuels that produce greenhouse gasses when burned. Very low levels of air emissions are produced in the use of thermal energy. Geothermal energy production is reliable and efficient and systems need very little maintenance.

Home Heat Pump Installation and Operation

A geothermal heat pump does not create electricity: it greatly reduces the consumption of it. Systems don't convert electricity to heat; rather, they use electricity to move thermal energy from the ground to the building. Electricity use is reduced 30 – 60% compared to traditional heating and cooling systems. This allows a payback on system installation in two to ten years. And surveys show that the customer satisfaction rate with geothermal heat pump systems stands at 95% or higher. U.S. DOE estimates that there are more than 400,000 systems operating in the United States today.

Heat pumps transfer heat from natural heat sources in the ground or water for home heating. For summer cooling, heat is transferred in the oppposite direction from your home to the surrounding soil and air. And sometimes the excesss heat from cooling can be used to heat a home's hot water supply, saving even more money.

Heat pumps work on the principle of vapor compression and heat exchangers. The components are connected to form a closed loop and a fluid circulates in the loop. By pumping a refrigeration fluid through loops of pipe buried underground around the permineter of your home, this system uses the relatively constant temperature (45 - 55°F) of the Earth to transfer heat into buildings in winter and out into the ground in the summer.

The evaporator keeps the temperature of the fluid lower than the temperature of the heat source, and heat flows from the heat source to the liquid. Vapor from the evaporator is compressed to a higher pressure and temperature; hot vapor enters the condenser where it condenses and gives off useful heat.The compressor is driven by an electric motor.

The underground loops can be an open loop system that uses a well and pumps ground water, or a loop-pond system when a pond and a discharge area are available; closed underground loops use the earth's thermal energy as a resource. Loops can be installed either horizontally or vertically, or in a pond or lake. This choice is made based on space, soil and rock types, and ground water/pond/lake availability.

A Renewable and Environmentally-friendly Resource

The U.S. EPA says geothermal heat pumps are one of the most efficient and least-polluting heating, cooling, and water-heating systems available. They are an important technology to reduce gaseous emissions that harm the environment such as carbon dioxide, sulfur dioxide, and nitrogen oxide. And they can save the consumer money on fuel costs. Geothermal energy can be a win-win choice for you and the environment.

Sources of Information:

Geothermal Resources Council, P.O. Box 1350,2001 Second Street, Suite 5,Davis, CA 95617-1350, http://solstice.crest.org/renewables/geothermal/

U.S Department of Energy (DOE), Energy Efficiency and Renewable Energy Network (EREN), www. eren.doc.gov/erec/factsheets/geothermal.html

U.S. Environmental Protection Agency, http://www.epa.gov/epahome/

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