

Geothermal Energy

Background

Geothermal energy uses the natural temperatures in the earth or water to heat and cool buildings. The word “geothermal” comes from the Greek words *geo* (earth) and *therme* (heat). Geothermal energy may be used directly for electricity generation or indirectly by heat pumps (also known as geexchange systems or ground source heat pumps).

In agriculture, geothermal energy may be used for heating greenhouses, for fish farming and algae production (aquaculture) and for heating the soil in open-field plant root systems.

Most direct-use geothermal relies on high temperature groundwater to either heat buildings directly or to generate electricity. Direct-use geothermal heating is limited to areas that have naturally-occurring hot springs or easy access to high temperature ground water in the 100 – 250°F range. This water is good for use in spas, greenhouses, or building heating systems. In some cases it can be used to heat entire portions of cities.

Geo-exchange systems—or geothermal heat pumps—are the most commonly-used form of geothermal energy used in homes and commercial buildings. These systems use the ambient temperature in the earth or water to heat or cool a building. Heat is removed from a substrate during the winter to heat a building and then during the summer the heat is removed from the building and put back into the substrate. The substrate is usually the earth but can also be water. A mix of water and antifreeze is used as the heat transfer fluid.

The Oklahoma State Capitol uses more than 600 geothermal heat pumps to heat and cool the building. Oklahoma is a center of ground source heat pump research and development, although it is not a major consumer of geothermal energy. The International Ground Source Heat Pump Association was formed in Oklahoma and is based on the campus of Oklahoma State University in Stillwater.

The United States has significant geothermal resources but several factors have limited the growth of geothermal generating capacity:

- Technology costs. New technology, referred to as enhanced geothermal systems (EGS), which may allow greater use of geothermal resources in other areas, is now in early development. Current cost estimates for EGS are generally higher than those for conventional geothermal plants and other more mature renewable technologies like wind power.
- Location—Geothermal plants can be very site-specific, and have generally been limited to areas with accessible deposits of high temperature ground water.
- Transmission access—Lack of access to transmission lines limits growth.
- Completion lead times—Completing a geothermal power generating project takes four to eight years, longer than completion timelines for solar or wind.
- Risk—Even in a well-known resource area, there is significant exploration and production risk, which can result in high development costs.

Vocabulary

accessible— capable of being reached

agriculture— the science or occupation of cultivating the soil, producing crops, and raising livestock

ambient— surrounding on all sides

antifreeze— a substance added to a liquid (as the water in an automobile radiator) to prevent freezing

consumer— a person who buys and uses up goods or services

conventional— following, agreeing with, or based on a custom or a way of acting or doing things that is widely accepted and followed

deposits— accumulations in nature

energy— the capacity (as of heat, light, or running water) for doing work

enhanced— increased or improve in value, desirability, or attractiveness

generation— the action or process of bringing into existence

geothermal— of, relating to, or using the heat of the earth's interior

greenhouse— a glassed enclosure for cultivation of plants

groundwater— water within the earth that supplies wells and springs

heat pumps— devices for heating or cooling a building by transferring heat contained in a fluid to or from the building

natural— not made or changed by humans

renewable— capable of being replaced by natural ecological cycles or sound management procedures

risk— possibility of loss

spa— a resort area with mineral springs

substrate— an underlying layer

technology— the use of science in solving problems (as in industry or engineering)

transmission—the act of passing or causing to pass through space or a material