Geothermal

What is Geothermal Energy?

The word geothermal comes from the Greek words *geo* (Earth) and *therme* (heat). Geothermal energy is heat from within the Earth.

Geothermal energy is generated in the Earth's **core**, almost 4,000 miles beneath the Earth's surface. The double-layered core is made up of very hot **magma** (melted rock) surrounding a solid iron center. Very high temperatures are continuously produced inside the Earth by the slow decay of radioactive particles. This process is natural in all rocks.

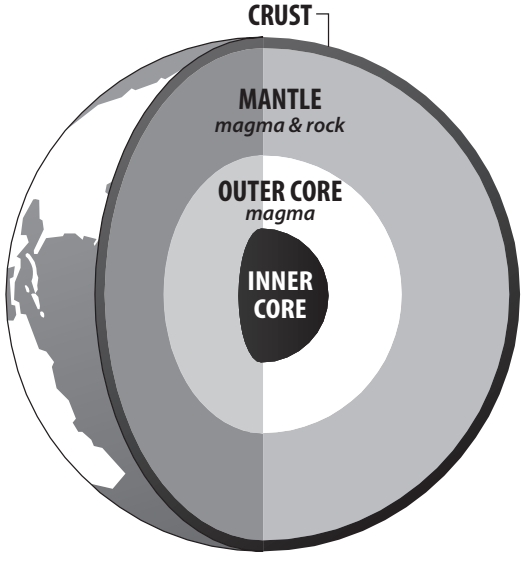
Surrounding the outer core is the **mantle**, which is about 1,800 miles thick and made of magma and rock. The outermost layer of the Earth, the land that forms the continents and ocean floors, is called the **crust**. The crust is three to five miles thick under the oceans and 15 to 35 miles thick on the continents.

The crust is not a solid piece, like the shell of an egg, but is broken into pieces called **plates**. Magma comes close to the Earth's surface near the edges of these plates. This is where volcanoes occur. The lava that erupts from volcanoes is partly magma. Deep underground, the rocks and water absorb the heat from this magma.

We can dig wells and pump the heated, underground water to the surface. People around the world use geothermal energy to heat their homes and to produce electricity.

Geothermal energy is called a **renewable** energy source because the water is replenished by rainfall and the heat is continuously produced deep within the Earth. We won't run out of geothermal energy.

The Earth's Interior



History of Geothermal Energy

Geothermal energy was used by ancient people for heating and bathing. Even today, hot springs are used worldwide for bathing, and many people believe hot mineral waters have natural healing powers.

Using geothermal energy to produce electricity is a new industry. A group of Italians first used it in 1904. The Italians used the natural steam erupting from the Earth to power a turbine generator.

The first successful American geothermal plant began operating in 1960 at The Geysers in northern California. There are now just under 60 geothermal power plants in five states, with many more in development. Most of these geothermal power plants are in California with the remainder in Nevada, Hawaii, Idaho, and Utah.

Finding Geothermal Energy

What are the characteristics of geothermal resources? Some visible features of geothermal energy are volcanoes, hot springs, geysers, and fumaroles. But you cannot see most geothermal resources. They are deep underground. There may be no clues above ground that a geothermal reservoir is present below.

Geologists use different methods to find geothermal reservoirs. The only way to be sure there is a reservoir is to drill a well and test the temperature deep underground.

The most active geothermal resources are usually found along major plate boundaries where earthquakes and volcanoes are concentrated. Most of the geothermal activity in the world occurs in an area called the **Ring of Fire**. This area borders the Pacific Ocean.

Hydrothermal Resources

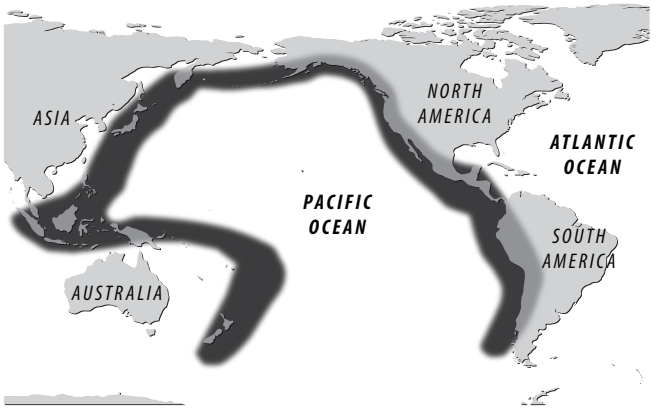
There is more than one type of geothermal energy, but only one kind is widely used to make electricity. It is called hydrothermal energy. **Hydrothermal resources** have two common ingredients: water *(hydro)* and heat *(thermal)*. Depending on the temperature of the hydrothermal resource, the heat energy can either be used for making electricity or for heating.

▪ Low Temperature Resources: Heating

Hydrothermal resources at low temperatures (50 to 300 degrees Fahrenheit) are located everywhere in the United States, just a few feet below the ground. This low temperature geothermal energy is used for heating homes and buildings, growing crops, and drying lumber, fruits, and vegetables.

In the U.S., geothermal heat pumps are used to heat and cool homes and public buildings. In fact, each year about 50,000 geothermal exchange systems are installed in the U.S. Almost 90 percent of the homes and businesses in Iceland use geothermal energy for space heating.

Ring of Fire



Most of the geothermal activity in the world occurs around the Pacific Ocean in an area called the Ring of Fire.

▪ High Temperature Resources: Electricity

Hydrothermal resources at high temperatures (300 to 700 degrees Fahrenheit) can be used to make electricity.

These high-temperature resources may come from either dry steam wells or hot water wells. We can use these resources by drilling wells into the Earth and piping the steam or hot water to the surface. Geothermal wells are one to two miles deep.

In a dry steam power plant, the steam from the geothermal reservoir is piped directly from a well to a turbine generator to make electricity. In a hot water plant, some of the hot water is turned into steam. The steam powers a turbine generator just like a dry steam plant. When the steam cools, it condenses to water and is injected back into the ground to be used over and over again.

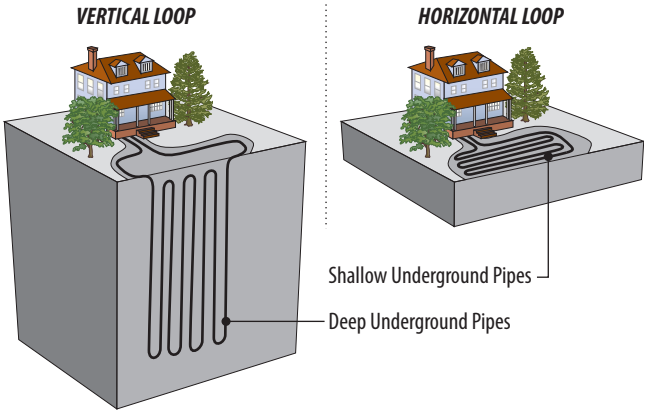
Geothermal energy produces only a small percentage of U.S. electricity. Today, it produces almost 16 billion kilowatt-hours, or less than one percent of the electricity produced in this country.

Geothermal Energy and the Environment

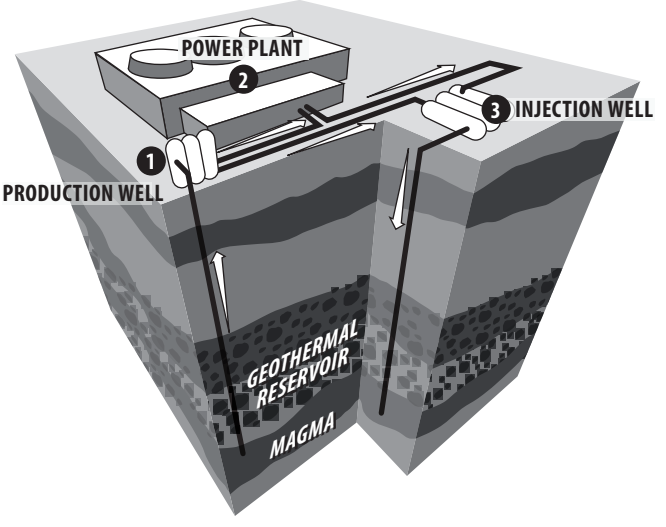
Geothermal energy does little damage to the environment. Another advantage is that geothermal plants don't have to transport fuel, like most power plants. Geothermal plants sit on top of their fuel source. Geothermal power plants have been built in deserts, in the middle of crops, and in mountain forests.

Geothermal plants produce almost no emissions because they do not burn fuel to generate electricity.

Residential Geoexchange Units



Geothermal Power Plant



1. **Production Well:** Geothermal fluids, such as hot water and steam, are brought to the surface and piped into the power plant.
2. **Power Plant:** Inside the power plant, the geothermal fluid turns the turbine blades, which spins a shaft, which spins magnets inside a large coil of wire to generate electricity.
3. **Injection Well:** Used geothermal fluids are returned to the reservoir.