

# GEO THERMAL AT A GLANCE



**Geothermal provided less than 1 percent of all energy consumed in the United States in 2022.**

## WHAT IS GEOTHERMAL?

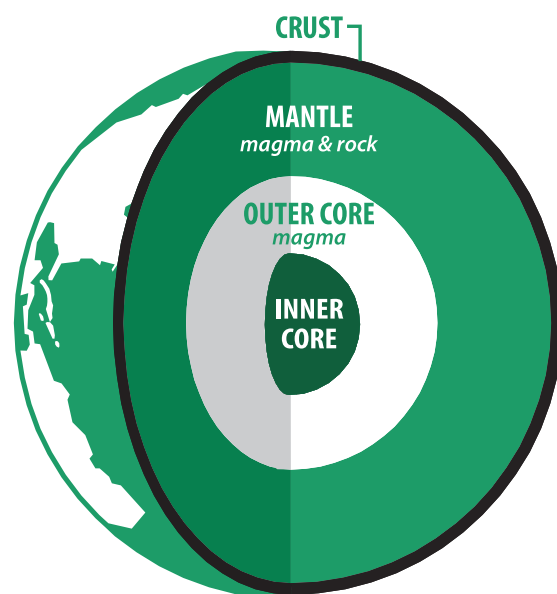
Geothermal energy comes from the heat within the Earth. The word geothermal comes from the Greek words geo, meaning earth, and therme, meaning heat. People around the world use geothermal energy to produce electricity, to heat homes and buildings, and to provide hot water for a variety of uses.

## THE EARTH'S INTERIOR

The Earth's core lies almost 4,000 miles beneath the Earth's surface. The double-layered core is made up of very hot molten iron surrounding a solid iron center. Estimates of the temperature of the core range from 5,000 to 11,000 degrees Fahrenheit (°F).

Surrounding the Earth's core is the mantle, thought to be partly rock and partly magma. The mantle is about 1,800 miles thick. The outermost layer of the Earth, the insulating crust, is not one continuous sheet of rock, like the shell of an egg, but is broken into pieces called plates.

These slabs of continents and ocean floor drift apart and push against each other at the rate of about two centimeters per year in a process called plate tectonics. This process can cause the crust to become faulted (cracked), fractured, or thinned, allowing plumes of magma to rise up into the crust.



## USES OF GEOTHERMAL

Today, we drill wells into geothermal reservoirs deep underground and use the steam and heat to drive turbines in electric power plants. The hot water is also used directly to heat buildings, to increase the growth rate of fish in hatcheries and crops in greenhouses, to pasteurize milk, to dry foods products and lumber, and for mineral baths.

When geothermal reservoirs are located near the surface, we can reach them by drilling wells. Exploratory wells are drilled to search for reservoirs. Once a reservoir has been found, production wells are drilled. Hot water and steam—at temperatures of 250°F to 700°F—are brought to the surface and used to generate electricity at power plants near the production wells.

### TYPES OF GEOTHERMAL POWER PLANTS

#### FLASH STEAM PLANTS

Most geothermal power plants are flash steam plants. Hot water from production wells flashes (explosively boils) into steam when it is released from the underground pressure of the reservoir. The force of the steam is used to spin the turbine generator. To conserve water and maintain the pressure in the reservoir, the steam is condensed into water and injected back into the reservoir to be reheated.

#### DRY STEAM PLANTS

A few geothermal reservoirs produce mostly steam and very little water. In dry steam plants, the steam from the reservoir shoots directly through a rock-catcher into the turbine generator. The rock-catcher protects the turbine from small rocks that may be carried along with the steam from the reservoir.

#### BINARY CYCLE POWER PLANTS

Binary cycle power plants transfer the thermal energy from geothermal hot water to other liquids to produce electricity. The geothermal water is passed through a heat exchanger in a closed pipe system, and then reinjected into the reservoir. The heat exchanger transfers the heat to a working fluid—usually isobutane or isopentane—which boils at a lower temperature than water. The vapor from the working fluid is used to turn the turbines. Binary systems can, therefore, generate electricity from reservoirs with lower temperatures. Since the system is closed, there is little heat loss and almost no water loss, and virtually no emissions.

#### HYBRID POWER PLANTS

In some power plants, flash and binary systems are combined to make use of both the steam and the hot water.

### USES OF GEOTHERMAL ENERGY

#### HEATING

The most widespread use of geothermal resources—after bathing—is to heat buildings. Every year, the number of homes and businesses using geothermal for heating and cooling increases about 3 percent. Of the 1.7 million geothermal heat pumps installed in the United States, about 40 percent are in homes and 60 percent are in businesses.

#### INDUSTRY

The heat from geothermal water is used worldwide for drying cloth, drying fruits and vegetables, washing wool, manufacturing paper, pasteurizing milk, and drying timber products. It is also used to help extract gold and silver from ore. In Klamath Falls, OR, hot water is piped under sidewalks and bridges to keep them from freezing in winter.

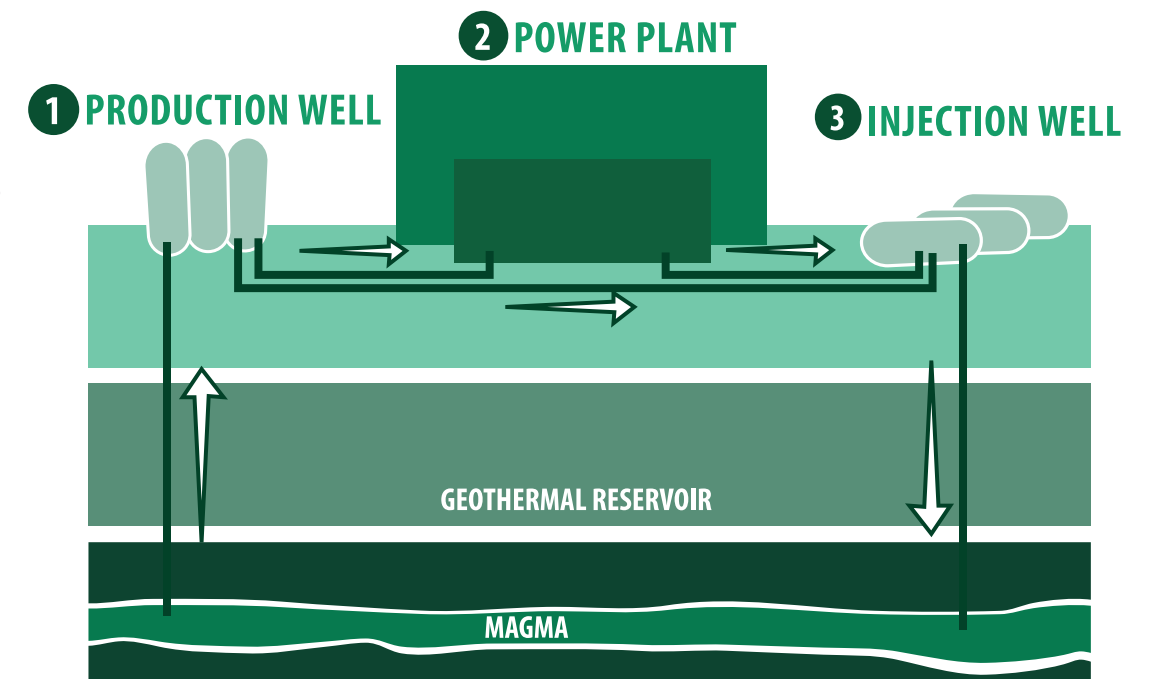
#### HOT SPRING BATHING AND SPAS

For centuries, people have used hot springs for cooking and bathing. The early Romans used geothermal water to treat eye and skin diseases and, at Pompeii, to heat buildings. Medieval wars were even fought over lands for their hot springs.

#### AGRICULTURE AND AQUACULTURE

Water from geothermal reservoirs is used in many places to warm greenhouses that grow flowers, vegetables, and other crops. Natural warm water can also speed the growth of fish, shellfish, reptiles, and amphibians.

## 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.