

# Geothermal Resources in Washington State

## What is Geothermal?

Geothermal refers to underground heat. Nearly everywhere, temperature increases slowly with depth. This is because the center of the Earth is very hot, and because the Earth's crust generates heat from slow radioactive decay of certain elements. In some places, there is above-average heat closer to the surface, perhaps because of nearby volcanism or because of tectonic deformation.



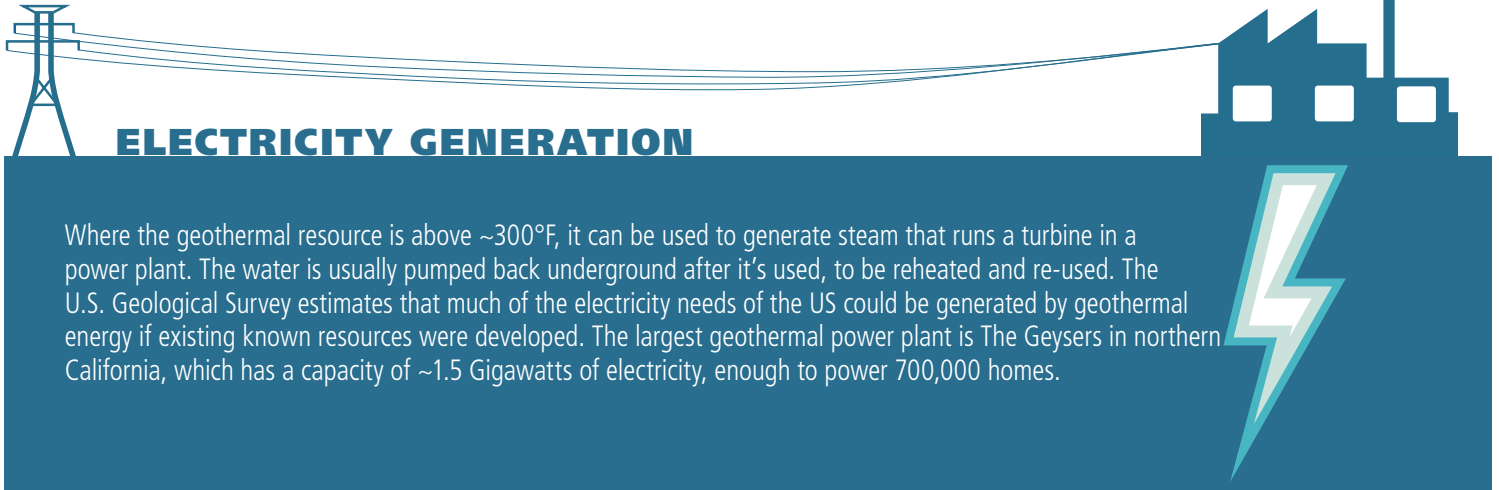
FOUR THINGS ARE NEEDED FOR GEOTHERMAL HEAT TO BE USEFUL TO HUMANS:

1. It must be hot enough to do the needed task
2. The heat must be able to move through fractures or other passageways
3. There must be fluid present, usually water, to conduct the heat
4. The heat must be accessible (shallow and safe to access)

HEAT SOURCE

## APPLICATIONS OF GEOHERMAL RESOURCES

A geothermal resource can be used in a variety of ways, depending on its temperature. Geothermal resources are carbon-free, do not require dams on rivers, and operate 24/7 to provide clean, sustained, and renewable energy. Currently Washington State uses a very small amount of geothermal energy, mostly for heating buildings in central and eastern Washington.

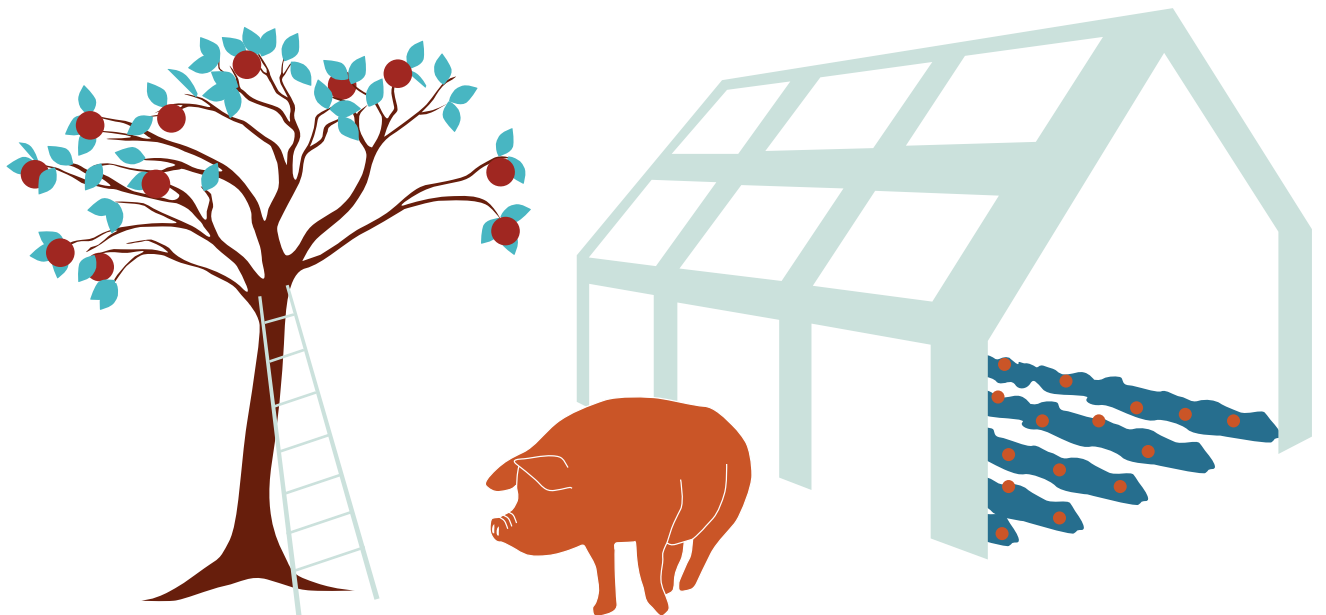
An illustration of a power plant with a lightning bolt symbol on its side and a chimney emitting steam. A power line tower is connected to the plant by a power line. The word 'STEAM' is written above the chimney.

### ELECTRICITY GENERATION

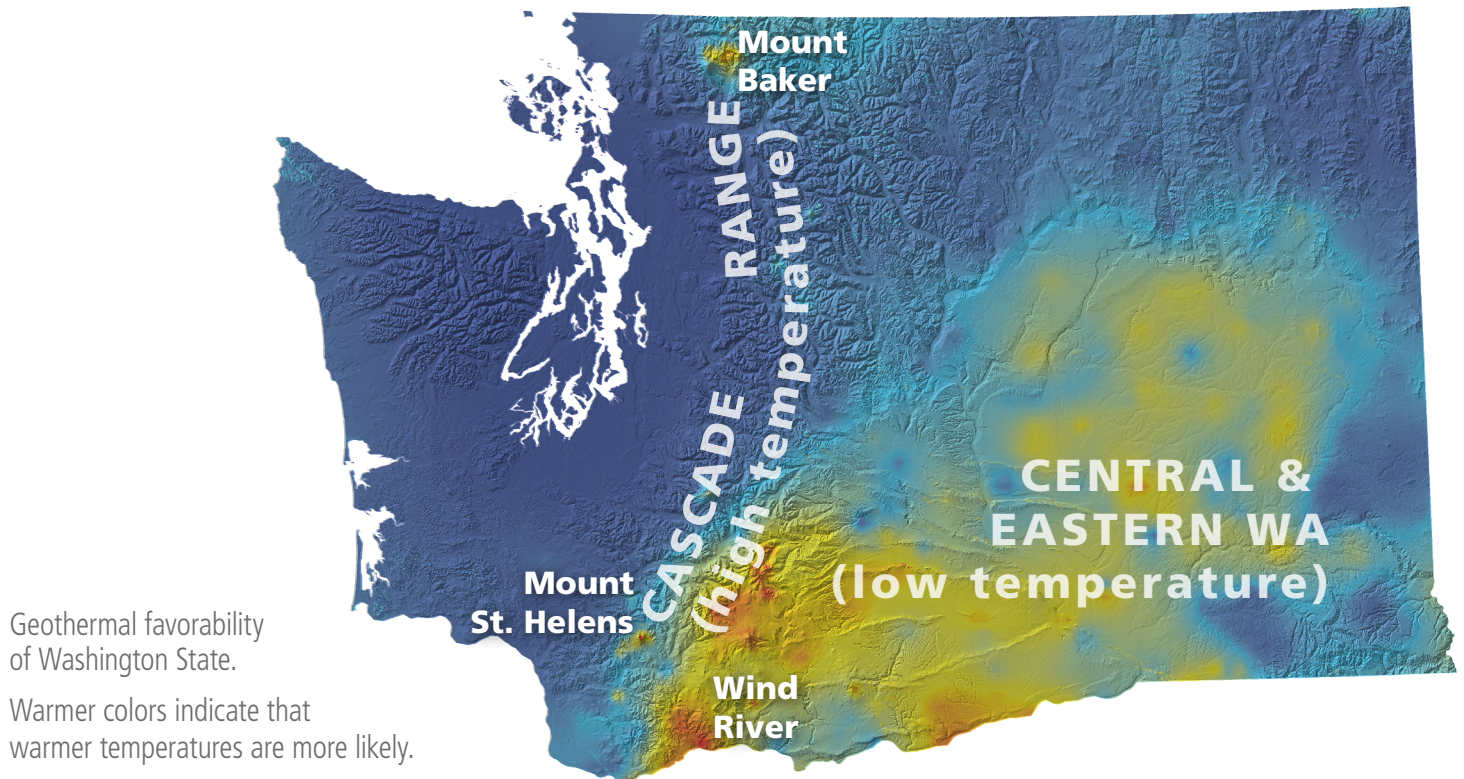
Where the geothermal resource is above ~300°F, it can be used to generate steam that runs a turbine in a power plant. The water is usually pumped back underground after it's used, to be reheated and re-used. The U.S. Geological Survey estimates that much of the electricity needs of the US could be generated by geothermal energy if existing known resources were developed. The largest geothermal power plant is The Geysers in northern California, which has a capacity of ~1.5 Gigawatts of electricity, enough to power 700,000 homes.

## HEATING

Geothermal energy that cannot be used for a power plant can be used to heat large buildings, provide hot water for industrial processes, or be used for recreational purposes like resorts or swimming pools. Even in areas where the temperature of geothermal resources is relatively 'low' (<150°F), there are many uses such as: heating greenhouses, keeping livestock warm during cold winters, ensuring orchards and vineyards do not freeze, drying agricultural products, maintaining water temperature for aquaculture, and heating residential homes.



## GEOHERMAL RESOURCES IN WASHINGTON STATE



## GEOHERMAL RESOURCES IN WASHINGTON

### Cascade Range

The Cascade Range is composed of a series of volcanoes formed by the ascent of molten rock from great depths. This process has likely increased the temperature underground in a large swath along the Cascades. The presence of hot springs throughout the Cascades indicates that water is being heated at depth and is able to flow to the surface, suggesting that a geothermal resource may exist.

### Central and Eastern Washington

A broad region of central and eastern Washington contains lower temperature geothermal resources. Although we know less about the heat source, there are many agricultural and municipal wells that tap into relatively warm water. These warm wells suggest that there must be a heat source somewhere beneath them.

## WGS GEOHERMAL EXPLORATION IN WASHINGTON

Finding geothermal resources is challenging because it's difficult to see underground. Additionally, the surface is covered with lots of vegetation, and there is abundant rainfall and snowmelt in Washington, which can mask signals of potential resources. One method of exploration is to simply go out and drill many holes and measure the Earth's temperature. However, drilling is expensive and time consuming. Exploratory drilling in the 1980s was not very successful in locating resources, perhaps because they drilled only a few hundred feet deep, which did not penetrate beyond the effects of Washington's rainy climate.

In 2014, the Washington Geological Survey (WGS) was awarded a grant from the U.S. Department of Energy to prospect for geothermal resources. The Survey gathered data from geology, drill holes, and other exploration methods and combined them to create a favorability map. Three areas with high favorability stand out—an area south of Mount Baker, an area north of Mount St. Helens, and along the Wind River valley—because the analysis indicated that heat and fluid flow were probably present.

In late 2017, the U.S. Department of Energy awarded additional funds to WGS to validate areas that may hold large-scale geothermal resources by drilling three vertical test holes during the summers of 2018–2019 in the regions of highest favorability. The final technical report provides additional details: [https://fortress.wa.gov/dnr/geologydata/geothermal/wgs\\_play-fairway\\_final\\_report\\_04NOV2021.pdf](https://fortress.wa.gov/dnr/geologydata/geothermal/wgs_play-fairway_final_report_04NOV2021.pdf).

## WHAT STILL NEEDS TO BE DONE?

### Comprehensive Data Gathering and Compilation

More information still exists in disparate locations. Compilation of all existing relevant subsurface information could inform geothermal exploration.

### New Geophysical, Geological, and Seismic Data Collection

In areas of known high geothermal potential, there are still data gaps that limit targeted exploration. New information gained across the state will help to identify additional areas with geothermal potential.

### Exploratory Drilling

Where data gaps remain, additional exploration boreholes provide critical direct measurements of temperature and subsurface conditions.

### Geothermal Modeling

Information gained from new and existing data permit three-dimensional prediction of geothermal potential to inform commercialized development of the resource.



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