GEOTHERMAL ENERGY

BACKGROUND BRIEF

Geothermal energy is the energy from the internal heat of the earth. It is found in rocks and fluids at various depths including hot springs. Useful heat is extracted by drilling or pumping. Geothermal heat is used directly to heat buildings and to generate electricity. Traditionally, electricity generation was accomplished with steam turbines and required very high temperature resources. Recent technology innovations enable electricity generation at much lower temperatures.

U.S. geothermal energy generation was relatively stable between 2006 and 2013, with an average of three percent annual growth. Most of the country's geothermal generation is in the west (Figure 1).

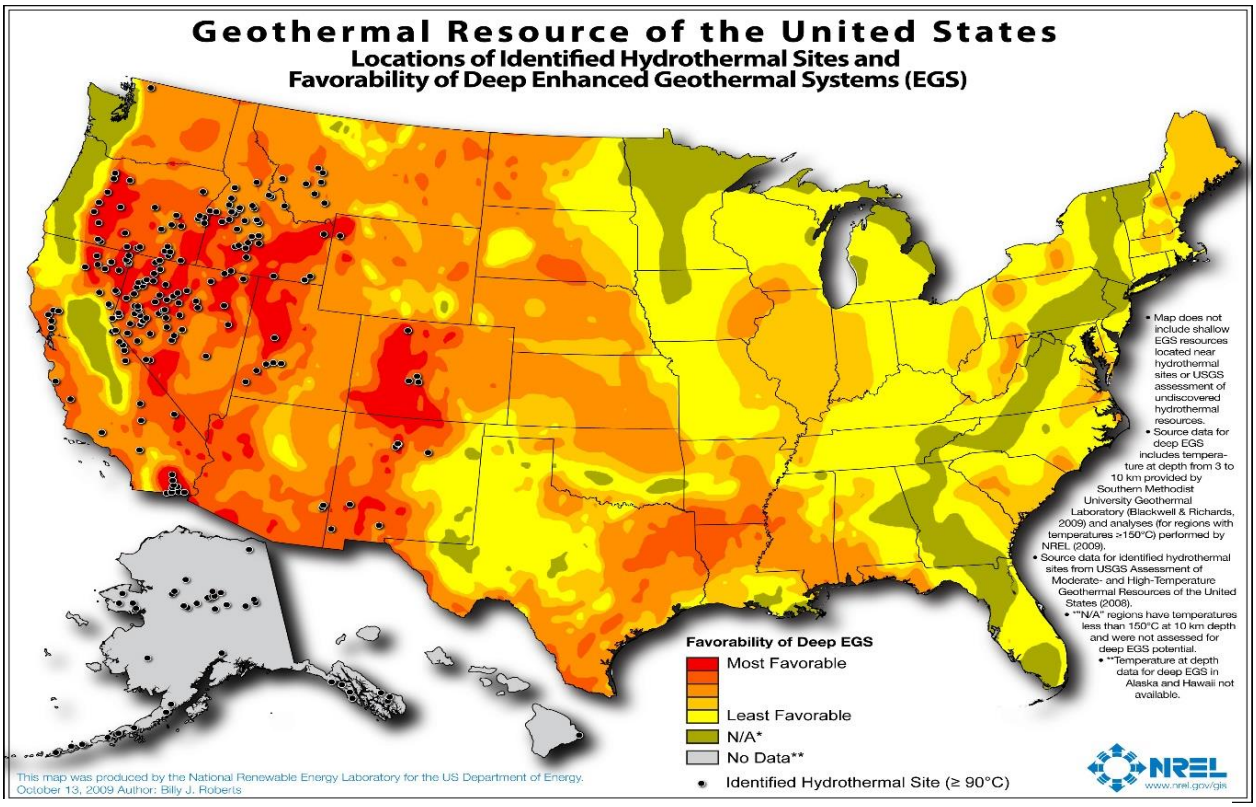

Figure 1: Geothermal resources in the US (National Renewable Energy Laboratory)

Challenges geothermal developers face include high upfront capital expenses, resource uncertainty, and location of some geothermal sources near environmentally sensitive areas.

In Oregon, areas with the greatest geothermal resource potential are located in the central and southeastern parts of the state (Figure 1). The National Renewable Energy Laboratory (NREL) has developed an interactive mapping tool[i] of geothermal resources. Additionally, the Oregon

Department of Geology and Mineral Industries (DOGAMI) has developed an interactive map[ii] of geothermal springs and wells in Oregon.

GEOTHERMAL FOR ELECTRICITY GENERATION

Oregon is ranked fifth in the nation for geothermal electricity generation. As of April 2015, nameplate capacity of installed geothermal power generation was 35 MW, with another 99 MW of planned capacity. Figure 2 below shows the existing and planned capacity of geothermal plants throughout the US.

The state's first geothermal power plant began operating in 2010 at the Oregon Institute of Technology **(OIT)** in Klamath Falls, with an initial electricity-generating capacity of 280 kilowatts. A second plant at OIT generates 1.2 megawatts of power. In 2012, U.S. Geothermal Inc. brought online a 22 megawatt facility at Neal Hot Springs near the eastern Oregon town of Vale. In 2015, a 3.1 megawatt geothermal power plant began operation in Paisley, Oregon. Additional geothermal opportunities are being explored at Crump Geyser and Glass Butte in Lake County.

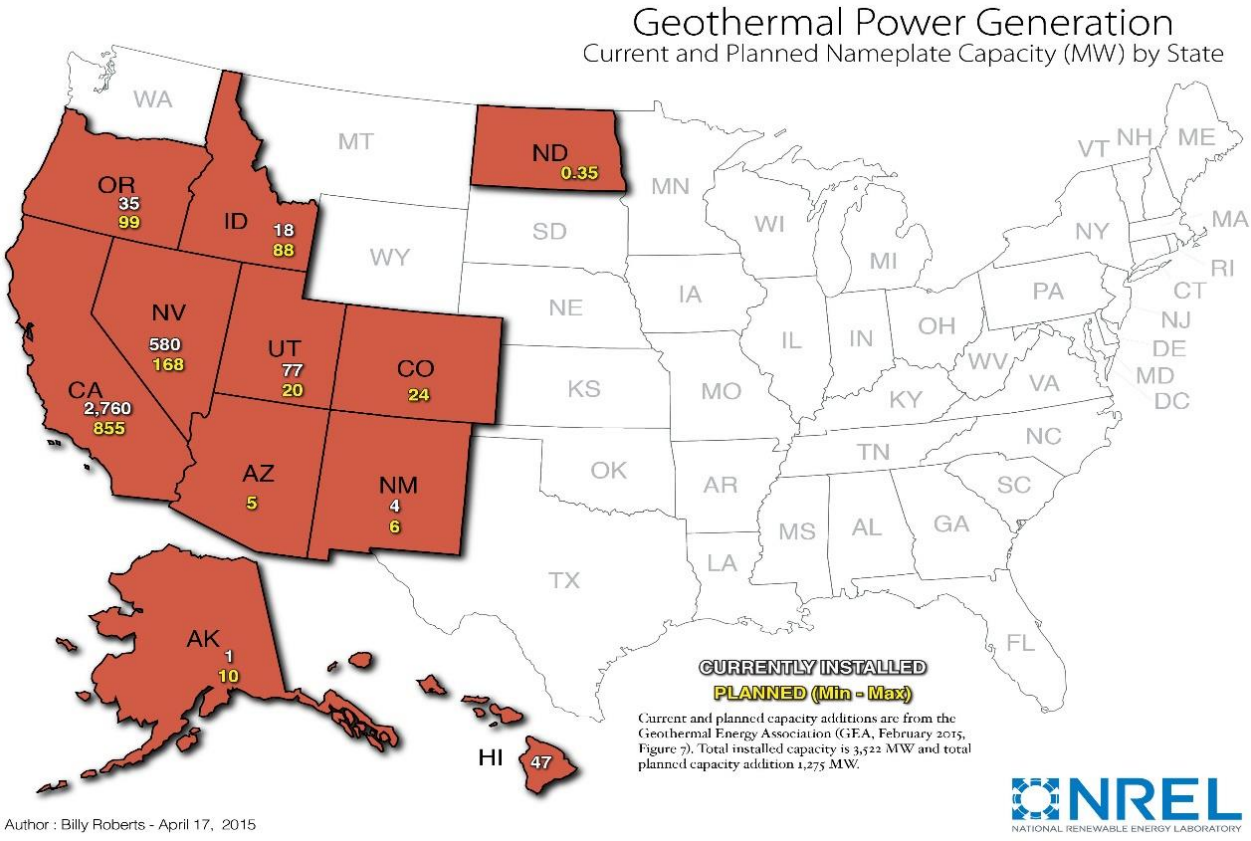

Figure 2: Current and Planned Geothermal Power Plants in the US (National Renewable Energy Laboratory)

GEOTHERMAL FOR HEATING

The City of Klamath Falls uses geothermal energy to heat buildings, residences, pools, and even melt snow. In Lakeview, a geothermal well system is now being used to heat school properties and hospital

buildings. Other examples of direct use of geothermal heat in the state include drying agricultural products, aquaculture (raising fish), heating greenhouses, and heating swimming pools at spas and resorts. Hot springs resorts are widespread in Oregon, including Ashland, Belknap, Breitenbush, and Hot Lake.

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[i] NREL's Geothermal Prospector:http://www.nrel.gov/gis/tools_gt_prospector.html
[ii] DOGAMI's Geothermal Information Layer for Oregon:
http://www.oregongeology.org/sub/gtilo/#