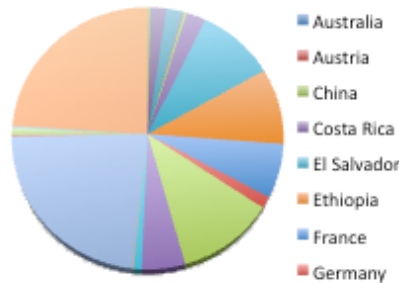


Types of Power Plants

- **Flash Steam:** Hot water flows up through wells and turns to steam that can be separated from the liquid water and used to power a steam turbine. This is the most common type of geothermal power plant.
- **Dry Steam:** Steam is pumped up from underground wells to power turbines.
- **Binary Steam:** The heat from underground wells is used to boil another fluid at a lower temperature in a heat exchanger that subsequently powers a turbine.

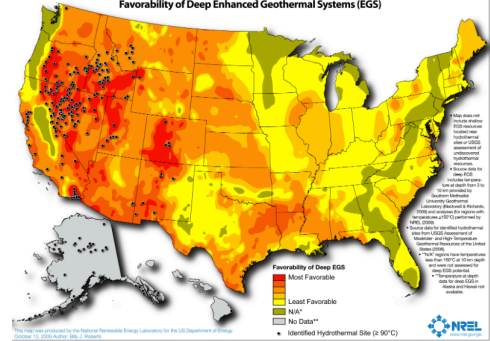
Global Geothermal Generating Capacities in 2003



Land Use

- A geothermal power plant uses 404 m² of land per GWh as compared to a coal facility which uses 3632 m² of land per GWh
- Based on the US electricity demand of 14.89 Quad, we would need 1.76*10⁹ m² of land to power the entire country with geothermal power plants

Geothermal Resource of the United States



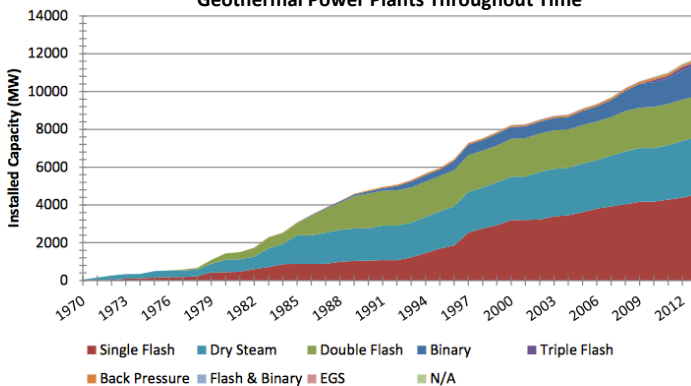
Only the Western US is currently utilizing geothermal resources for electricity for:

- Commercial purposes
- Sold to consumers at ~\$0.03 per kWh

Projected Future Geothermal Electrical Generation Development in the US

State	Commercial Development by 2015 (MW)	Commercial Development by 2025 (MW)
Alaska	20	150
Arizona	20	50
California	2375	4703
Colorado	20	50
Idaho	855	1670
Montana	20	50
Nevada	1473	2880
New Mexico	80	170
Oregon	380	1250
Utah	230	620
Washington	50	600
Wyoming	20	50

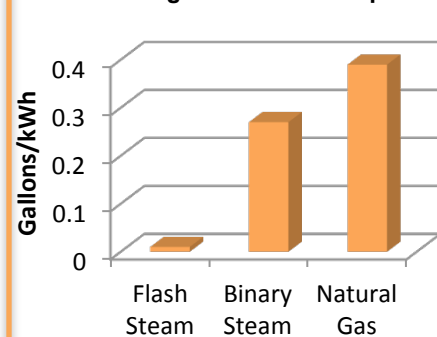
Geothermal Power Plants Throughout Time



The Future for Geothermal Energy

- Small-scale resources can potentially account for deficiencies in the grid
- Increased drilling efficiency is allowing for greater usable steam supplies
- More binary cycle power plants
- Geothermal energy to heat homes

Average Water Consumption



Estimated Emissions (lbs/MWh) Compared to Plants of Other Energy Sources

	Dry Steam	Flash	Natural Gas	Coal
CO ₂	59.82	396.3	861.1	2200
CH ₄	0	0	0.0168	0.2523
SO ₂	0.0002	0.35	0.0043	18.75
N ₂ O	0	0	0.0017	0.0367
Particulate Matter	0	0	0.12	0.72

Environmental Consequences

- Release of hydrogen sulfide from wells
- Wells are potential threats to local groundwater
- Land subsidence at well sites
- Greater risk of seismicity as a result of drilling
- Discharging waste waters can lead to contamination issues
- Binary plants release essentially no emissions

Geothermal Electricity Fact Sheet Sources

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"Geothermal Energy Basics." *NREL: Learning About Renewable Energy*. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 30 May 2012. Web. 10 Apr. 2014. <http://www.nrel.gov/learning/re_geothermal.html>.

Sander, Marietta. "What Is Geothermal Energy?" *International Geothermal Association: What Is Geothermal Energy (en)*. International Renewable Energy Alliance, 22 Mar. 2013. Web. 11 Apr. 2014. <http://www.geothermal-energy.org/geothermal_energy/what_is_geothermal_energy.html#c347>.

Map from:

"Geothermal Energy Basics." *NREL: Learning About Renewable Energy*. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 30 May 2012. Web. 10 Apr. 2014. <http://www.nrel.gov/learning/re_geothermal.html>.

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"Geothermal Energy." *Renewable Energy for America: Geothermal*. National Resources Defense Council, n.d. Web. 11 Apr. 2014. <<http://www.nrdc.org/energy/renewables/geothermal.asp>>.

Data for pie chart was collected from:

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Data from:

Kagel, Alyssa, Diana Bates, and Karl Gawell. *A Guide to Geothermal Energy and the Environment*. Rep. Washington, D.C: Geothermal Energy Association, 2007. Print.

Calculation based on the assumption that the national grid requires 14.89 Quad of electricity and that the average geothermal power plant requires 404 square meters of land per giga-Watt hour of electricity generated.

Data from:

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Information compiled from:

Williams, Collin. "Geothermal." *Other Energy Studies*. U.S. Geological Survey, 17 Jan. 2014. Web. 7 Apr. 2014. <<http://energy.usgs.gov/OtherEnergy/Geothermal.aspx>>.

"Geothermal Energy." *Renewable Energy for America: Geothermal*. National Resources Defense Council, n.d. Web. 11 Apr. 2014. <<http://www.nrdc.org/energy/renewables/geothermal.asp>>.

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