Geothermal FAQs

Read the frequently asked questions and their corresponding answers regarding the use of geothermal energy.

What are the benefits of using geothermal energy?

Answer: Several attributes make it a good source of energy.

- First, it's **clean**. Energy can be extracted without burning a fossil fuel such as coal, gas, or oil. Geothermal fields produce only about one-sixth of the carbon dioxide that a relatively clean natural-gas-fueled power plant produces, and very little if any, of the nitrous oxide or sulfur-bearing gases. Binary plants, which are closed cycle operations, release essentially no emissions.
- Geothermal energy is **available 24 hours a day**, 365 days a year. Geothermal power plants have average availabilities of 90% or higher, compared to about 75% for coal plants.
- Geothermal power is homegrown, reducing our dependence on foreign oil.

Why is geothermal energy a renewable resource?

Answer: Because its source is the **almost unlimited amount of heat** generated by the Earth's core. Even in geothermal areas dependent on a reservoir of hot water, the volume taken out can be reinjected, making it a sustainable energy source.

Where is geothermal energy available?

Answer: Hydrothermal resources - reservoirs of steam or hot water - are available primarily in the **western states, Alaska, and Hawaii**. However, Earth energy can be **tapped almost anywhere** with geothermal heat pumps and direct-use applications. Other enormous and world-wide geothermal resources - hot dry rock and magma, for example - are awaiting further technology development.

What are the environmental impacts of using geothermal energy?

Answer: Geothermal technologies offer many environmental advantages over conventional power generation:

- **Emissions are low.** Only excess steam is emitted by geothermal flash plants. No air emissions or liquids are discharged by binary geothermal plants, which are projected to become the dominant technology in the near future.
- Salts and dissolved minerals contained in geothermal fluids are usually reinjected with excess water back into the reservoir at a depth well below groundwater aquifers. This **recycles the geothermal water and replenishes the reservoir**. The City of Santa Rosa, California, pipes the city's **treated wastewater up to The Geysers power plants to be used for reinjection fluid**. This system will prolong the life of the reservoir as it recycles the treated wastewater.
- Some geothermal plants do produce some solid materials, or sludges, that require disposal in approved sites. Some of these **solids are now being extracted for sale** (zinc, silica, and sulfur, for example), making the resource even more valuable and environmentally friendly.

What is the visual impact of geothermal technologies?

Answer: District heating systems and geothermal heat pumps are **easily integrated** into communities with almost no visual impact. Geothermal power plants use **relatively small acreages**, and **don't require storage, transportation, or combustion of fuels**. Either no emissions or just steam are visible. These qualities reduce the overall visual impact of power plants in scenic regions.

Is it possible to deplete geothermal reservoirs?

Answer: The **long-term sustainability** of geothermal energy production has been demonstrated at the Lardarello field in Italy since 1913, at the Wairakei field in New Zealand since 1958, and at The Geysers field in California since 1960. Pressure and production declines have been experienced at some plants, and operators have begun reinjecting water to maintain reservoir pressure. The City of Santa Rosa, California, pipes its treated wastewater up to The Geysers to be used as reinjection fluid, thereby prolonging the life of the reservoir while recycling the treated wastewater.

How much does geothermal energy cost per kilowatt-hour (kWh)?

Answer: At The Geysers, power is sold at $0.03 to $0.035 per kWh. A power plant **built today** would probably require about **$0.05 per kWh**. Some plants can charge more during peak demand periods.

What does it cost to develop a geothermal power plant?

Answer: Costs of a geothermal plant are **heavily weighted toward early expenses, rather than fuel to keep them running**. Well drilling and pipeline construction occur first, followed by resource analysis of the drilling information. Next is design of the actual plant. Power plant construction is usually completed concurrent with final field development. The initial cost for the field and power plant is around **$2500 per installed kW** in the U.S., probably $3000 to $5000/kWe for a small (<1Mwe) power plant. **Operating and maintenance costs range from $0.01 to $0.03 per kWh**. Most geothermal power plants can run at greater than 90% availability (i.e., producing more than 90% of the time), but running at 97% or 98% can increase maintenance costs. Higher-priced electricity justifies running the plant 98% of the time because the resulting higher maintenance costs are recovered.

What makes a site good for geothermal electric development?

Answer: Hot geothermal fluid with low mineral and gas content, shallow aquifers for producing and reinjecting the fluid, location on private land to simplify permitting, proximity to existing transmission lines or load, and availability of make-up water for evaporative cooling. Geothermal fluid temperature should be at least 300º F, although plants are operating on fluid temperatures as low as 210º F.

How much water does a plant require?

Answer: The flow required depends on the temperature of the fluid, the ambient (sink) characteristics, and the pumping power required to supply and dispose of the fluid. Excluding fluid pumping, a closed-loop binary-cycle geothermal power plant would need 450 to 600 gallons per minute (gpm) to generate 1 MW from a 300° F fluid with an air temperature of 60° F. If the fluid temperature were only 210° F, one would need 1,300 to 1,500 gpm to generate the same amount of power. If an evaporative cooling system were used, 45 to 75 gpm of make-up (clean) cooling water would also be required to generate 1 MW.


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