National GEOTHERMAL Collaborative

Common Questions About Geothermal Energy

1. How much does electricity from geothermal energy cost?

The price of electricity generated at new geothermal power plants currently ranges between $0.05 and $0.08 per kilowatt-hour (kWh). Once capital costs for the projects are recovered, the price of power can decrease to below $0.05 per kWh. Recent federal legislation qualifies new geothermal power plants for a production tax credit of $0.018 per kilowatt hour for each of the first five years of service. This credit has been a major factor in the growth of the domestic wind industry in recent years. If applied to geothermal energy, this incentive would decrease the price of electricity generated at geothermal power plants. (for more on this see Question 9). Most of the costs associated with geothermal development are related to exploring and defining the resource and plant construction. Drilling for resources can account for as much as one-third to one-half of the total cost of a project. Geothermal power plants also have ongoing operating costs such as royalties paid for using the geothermal resource, property taxes and plant personnel.

2. Where are geothermal resources located?

Generating electricity using geothermal energy requires high-temperature resources that currently are most accessible in the western states. Advances in both drilling and power plant technologies could enable developers to more affordably tap geothermal resources in a larger portion of the country and expand the use of geothermal power.

Lower temperature resources that are sufficient for direct-use applications are located over a larger area and support agricultural activities such as fish farming, commercial greenhouses, mineral extraction, and space and district heating in various western, southwestern and southeastern states. According to the Geo-Heat Center at the Oregon Institute of Technology, more than 400 communities in 16 western states are located within five miles of a geothermal resource that is suitable for district heating. Geothermal heat pumps that simply transfer heat between the ground and buildings are practical nearly everywhere. (For more information and a map see "Location of Geothermal Resources" at www.geocollaborative.org/publications.)

3. Is geothermal energy an intermittent resource like wind or solar energy?

Unlike wind and solar energy, which generate power when the wind blows or the sun shines, geothermal power plants provide electricity almost constantly; this is commonly referred to as baseload power. Another benefit of geothermal power plants is that most can adjust their electrical output to follow customer demand as it rises and falls throughout the day. Geothermal power plants in the United States are available to operate and produce power nearly 98 percent of the time and experience very few unplanned outages. Such high percentages make them competitive with fossil fuel and nuclear power plants that operate between 75 percent and 90 percent of the time, depending on the technology and age of the equipment.

4. How dependable are geothermal resources?

Geothermal resources can provide electricity for decades. The key to successful geothermal development lies in managing the resource. Use of geothermal energy to generate electricity dates back 100 years. The world's first geothermal resource developed to generate electricity was tapped in Italy in 1904, and that reservoir is still producing. The geothermal field at The Geysers, established in 1960 in northern California, powered the first geothermal plant in the United States. Although the pressure of that resource has diminished, water injection techniques are helping to stabilize the pressure and the field now is expected to produce for many more years. Using geothermal energy to generate electricity for many years would require replacing aging power plant equipment and may require drilling new wells if the productivity of older ones diminishes over time. Recent technological advances—such as improved turbine design—allow developers to maximize resources and minimize drilling.

5. Are there other uses for geothermal energy besides generating electricity?

Certain low temperature geothermal resources are also practical for direct-use applications such as growing flowers, fish farming, and heating buildings. Four large commercial greenhouses in southern New Mexico, which at times currently employs approximately 200 people, use geothermal heat to grow a variety of plants. A one million square-foot greenhouse in rural Utah uses geothermal heat to grow flowers and employs between 80 and 120 people throughout the year. Geothermal-heated water also is used for fish farming operations in California, Colorado, Idaho, New Mexico and in some southeastern states from Georgia to Louisiana. The district heating system in Klamath Falls, Oregon, provides approximately six megawatts of heat to 20 commercial buildings and for melting snow over nearly 105,000 square-feet of sidewalks and bridges. The Oregon Institute of Technology uses this system to heat nearly 700,000 square-feet of space in 11 different buildings. This operation saves approximately $300,000 per year on heating bills.

(Con't.) ▶

Direct-use systems in the United States currently provide approximately 600 thermal megawatts (MW) of heat, enough to heat 115,000 average houses. (The power from direct-use systems is measured in megawatts of heat; power plants measure power in megawatts of electricity.) Generally, direct-use projects use fluids at temperatures of between 70ºF and 300ºF.

Geothermal heat pumps, which are not considered a form of direct use, are practical across the country. Heat pumps use the constant temperature of the earth at a certain depth to transfer heat to a building in the winter, and from a building to cool it in the summer. More than one million geothermal heat pumps (with a total capacity to generate approximately 8,600 MW of heat) are operating in states across the country. (For more information see "Geothermal Direct-Use" at www.geocollaborative.org/publications.)

6. What are the environmental effects of developing geothermal resources?

Geothermal energy is considered a clean source of energy because geothermal power plants, depending on the technology, emit at most very small amounts of particulate matter, nitrogen oxides, sulfur dioxide and carbon dioxide. Geothermal plants also are compatible with agricultural and industrial land uses, can be designed to blend in with surrounding areas, and occupy small amounts of land. The agriculturally productive Imperial Valley in southern California is home to several geothermal power plants, and the Mammoth Lake power plant, near California's famous ski resort, is designed to blend into the scenery. The short-term effects of drilling include noise and the visual effects of the drilling equipment. In an operating power plant, noise is minimal under normal conditions. Finally, geothermal fluids contain dissolved minerals and sediments that are controlled to avoid contaminating local water resources. (For more detailed information see "Geothermal Power and the Environment" at www.geocollaborative.org/publications.)

7. Is geothermal energy really a renewable resource?

Yes. Geothermal energy refers to the constant and limitless heat of the earth; water or steam is simply the medium that transmits this heat. After it is used, the water is injected into the ground where it is replenished with heat and used again. Some consider geothermal resources more finite than other renewable resources because of concerns regarding water use. While the heat of the earth remains constant, the water or steam has to be replenished and effectively managed to ensure sustainability of production. Experience at existing fields shows that production can continue indefinitely if resources are properly maintained. Also, most states that have a renewable portfolio standard recognize geothermal energy as a renewable energy resource.

8. Why is geothermal energy not more widely used?

The three main barriers to more widespread use of geothermal resources involve the location of resources, economics and permitting challenges.

Geothermal resources that are suitable for generating power using today's technology are located mostly in western states, Alaska and Hawaii. Resources that are practical for direct-use applications are more widespread, but also are located predominately in the west.

Technology and public policy greatly influence the economics of geothermal energy. Locating geothermal resources is expensive and risky just as in oil and gas exploration. However, once a reservoir has been identified, the success ratio for developing commercial resources increases to approximately 80 percent. The resource identification tools available to the petroleum industry are more effective than those available to the geothermal industry and geothermal systems are more complex. Therefore, overall fossil fuels have a higher success rate for drilling discovery wells.

The process of obtaining permits to lease land and build geothermal power plants can be lengthy and cumbersome and may increase the costs of developing geothermal resources. (For more information see "Jurisdiction Over Geothermal Energy" at www.geocollaborative.org/publications.)

9. What state and federal incentives exist for geothermal energy?

A few financial and regulatory incentives promote the development of geothermal resources for power generation and direct use. The Database of State Incentives for Renewable Energy (www.dsireusa.org) describes many of them. The major federal incentive is an investment tax credit of 10 percent that is available to commercial businesses that invest in equipment used to produce, distribute or use geothermal energy. The federal production tax credit of $0.018 per kilowatt-hour (adjusted for inflation) applies to geothermal energy for each of the first five years of service. This production tax credit has been a major factor in the growth of the domestic wind industry in recent years. Geothermal facilities may qualify for both the production tax credit and the investment tax credit, but they cannot receive both. If applied to geothermal energy, this incentive would decrease the price of electricity generated at geothermal power plants and provide a significant incentive to the geothermal industry. States offer a variety of incentives, including investment tax credits, sales and property tax exemptions, and grant and loan programs. States also can use geothermal energy to meet renewable energy portfolio standards (RPS). Currently, 15 states have an RPS that requires power retailers to sell a specific amount of power from renewable resources, and more states are considering implementing such a standard.