

BENEFITS OF GEOTHERMAL ENERGY



The heat within the earth is a tremendous, but largely untapped, energy source. Just below the surface the temperature never deviates far from 55°F, but deeper beneath the surface temperatures are hot enough to make hot water or steam. There are two ways to use the earth's heat: for generating electricity and for direct use applications. Only a few states are beginning to tap the true potential of geothermal resources. Geothermal energy has several benefits that state policymakers may wish to consider.

Geothermal energy has the ability to:

- provide reliable electricity at a stable price;
- help states diversify the mix of fuels they use to produce electricity;
- generate electricity in a manner that produces minimal environmental impacts and emissions;
- help states meet renewable portfolio standards;
- generate economic development opportunities, especially in rural areas;
- provide heat for agricultural, industrial and space heating applications.

Geothermal energy can play an important part in a state's energy policy. In addition to identifying the benefits of geothermal energy, this brief also identifies some of the main challenges such as transmission constraints and regulatory barriers.

■ Generating Electricity

Reliable Power

One of the principal benefits of geothermal power plants is that they provide baseload power. Baseload power plants provide power all or most of the time and contrast with “peaker” plants which turn on or off as demand rises, or peaks, throughout the day. Geothermal plants contrast with other renewable energy resources like wind and solar energy that generate power intermittently. Geothermal plants in the United States are available to operate approximately 98 percent of the time. Such high percentages make them compare favorably with fossil fuel and nuclear power plants that operate between 75 and 90 percent of the time depending on the technology and age of the equipment.

Geothermal resources can provide power for many years. The Geysers geothermal field for example, which began commercial production in 1960 in Northern California, had the first

domestic geothermal power plant. Nearly half a century later, the 21 power plants operating there generate power for approximately one million households in California. The key to successful long-term sustainable geothermal production lies in efficiently managing the resource. Technological advances—such as water injection, continue to be developed and allow developers to maximize resources and minimize drilling.

Electricity at Stable Prices

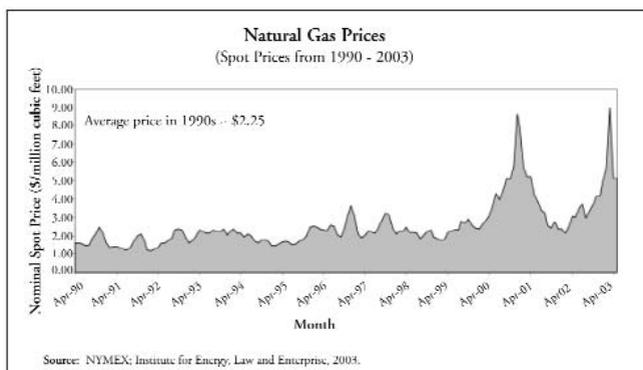
Using geothermal resources for power can help protect against volatile electricity prices. For any power plant, the price of the fuel used to generate power influences the price of the electricity produced; if the price of fuel is unpredictable, the price of electricity is unpredictable. Unlike traditional power plants that require fuel purchases, geothermal power

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Electricity at Stable Prices (Con't.)

plants secure their fuel supply before the plants begin operating. Since the price of geothermal resources will not change, it is possible to know what the price of electricity generated at a geothermal power plant will be over time. The price of electricity from new geothermal power plants ranges from between \$0.05 per kWh and \$0.08 per kWh. Once capital costs for the projects are recovered, the price of power can decrease below \$0.05 per kWh. Fossil fuels have traditionally generated power for less, but the price of these fuels can suddenly increase to a level that is more expensive than geothermal electricity. For example, in early 2004 the price of natural gas was nearly three times what it was throughout the 1990s.

Figure 1. Natural Gas



Note: In contrast to natural gas, the fuel costs for a geothermal power plant are not dependent upon volatile markets. Electricity price from geothermal power plants is predictable and stable over the life of the project.

Diversify Mix of Resources

Renewable energy resources like geothermal can help states diversify the mix of fuels they rely on for power and protect customers from volatile electricity prices. The fuel costs for a geothermal power plant are not dependent upon volatile markets. In contrast, the price of natural gas is volatile and difficult to predict accurately (See figure one). In addition, using domestic renewable resources can help states reduce the amount of fuel they import from nearby states or overseas.

Clean Electricity

Geothermal power plants produce only a small amount of air emissions. Compared to conventional fossil fuel plants, they emit very small amounts of carbon monoxide, particulate matter, sulfur dioxide, carbon dioxide, and typically no nitrogen oxides.

Figure 2. Carbon Dioxide Emissions

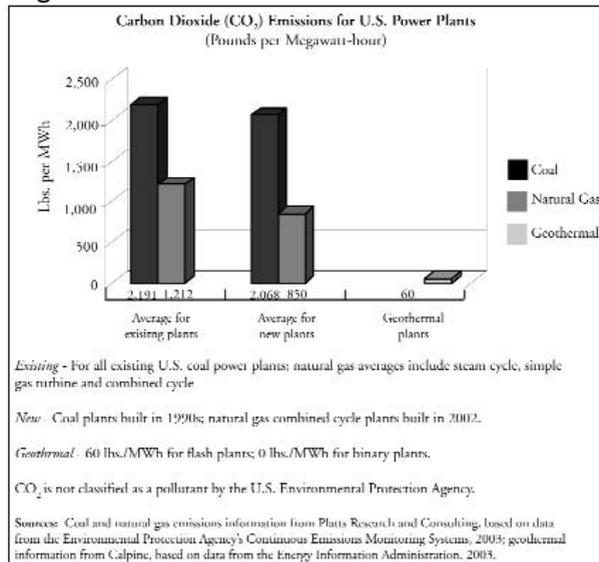


Figure 3. Sulphur Dioxide Emissions

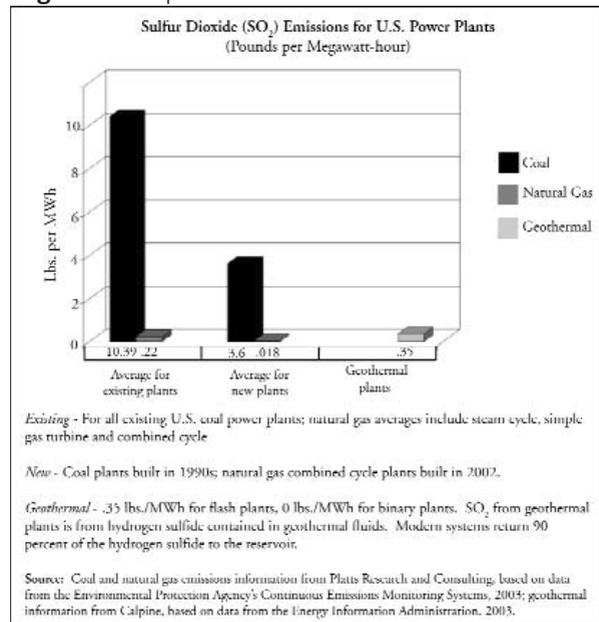
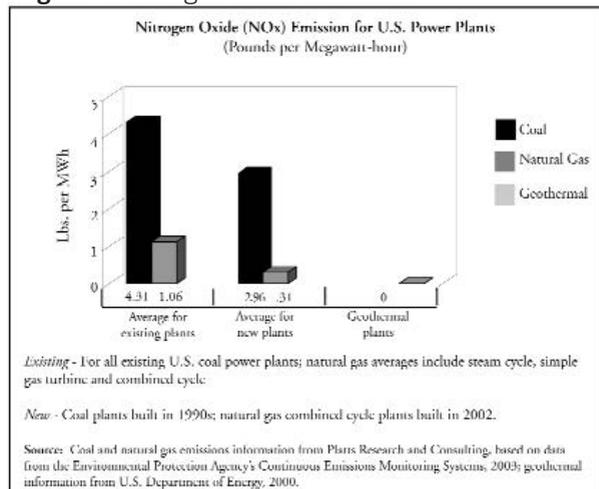


Figure 4. Nitrogen Oxide Emissions



Meet Renewable Energy Standards

Fifteen states now have some sort of renewable portfolio standard (RPS) that requires power providers to supply a certain amount of their power from renewable resources by a specific year. In many of these states, electricity generated from geothermal resources can count toward meeting the standard.

Economic Development Potential

Using geothermal resources can provide economic development opportunities for states in the form of property taxes, royalty payments and jobs. Geothermal power plants are the largest taxpayer in nearly every county where they exist. The 21 geothermal power plants at the Geysers Geothermal Field in California can generate almost 1,000 MW of electricity and have been an important source of revenue and jobs for Lake and Sonoma counties for many years. These power plants employ approximately 425 people full-time plus an additional full-time equivalent contract work force of 225. In 2003, property tax payments to the two counties totaled more than \$11 million.

Another revenue stream flows from royalties that developers pay in exchange for the right to tap resources on federal, state or private lands. These are similar to severance taxes that states charge for extracting fuels or minerals. In 2003, operations at The Geysers generated a total of \$6.15 million in federal royalties and \$4.1 million in royalties to the State of California. Local county governments share in both the federal and state royalties.

■ Direct Use

In addition to generating electricity, the heat in geothermal fluids can be used directly for such purposes as growing flowers, raising fish and heating buildings. There are a number of basic types of direct use applications: aquaculture, greenhouses, industrial and agricultural processes, resorts and spas, space and district heating, and cooling. Generally, direct use projects use fluids with temperatures of between 70°F and 300°F. Direct use systems in the United States currently provide approximately 600 thermal megawatts of heat, enough to heat approximately 115,000 average homes. (The power from direct use systems is measured in megawatts of heat as opposed to power plants that measure power

in megawatts of electricity.) Some geothermal projects “cascade” geothermal energy by using the same resource for different purposes simultaneously such as heating and power. Cascading uses the resource more efficiently and may improve the economics of a project.

Four commercial greenhouses in southern New Mexico, which at times have employed up to 400 people, occupy more than 50 acres and use geothermal heat to grow plants. In 2002, these projects generated nearly \$23 million in sales and paid more than \$6 million in payroll. A large greenhouse in rural Utah that grows flowers employs between 80 and 120 people at different times throughout the year.

■ Main Challenges for Geothermal Energy

There are a variety of technical and regulatory challenges preventing the more widespread use of geothermal power. Leasing and siting processes can take long periods and be fraught with uncertainty. Although the cost of generating power from geothermal resources has decreased by 25 percent during the last two decades, exploration and drilling remain expensive and risky. Drilling costs alone can account for as much as one-third to one-half of the total cost of a project and wells typically cost between \$1 and \$5 million each. Detecting potentially productive geothermal reservoirs is difficult, with only about one in every five exploratory wells drilled confirming a valuable resource. The rate of success increases significantly once the resource has been found. Because some of the best geothermal resources are located in remote areas, tapping them may require an expansion of the power transmission system, which can also be expensive. Finally, power plants and direct use systems must be located near geothermal resources because it is not economic to transport hot water or steam over long distances.



Summary of Benefits and Challenges of Geothermal Energy

Benefits	Challenges
<ul style="list-style-type: none"> Geothermal power plants provide steady and predictable baseload power. 	<ul style="list-style-type: none"> Many of the best potential resources are located in remote or rural areas, often on federal or state lands.
<ul style="list-style-type: none"> New geothermal power plants currently generate electricity for between \$0.05 per kWh and \$0.08 per kWh, which can decrease below \$0.05 per kWh after capital investment has been recovered. 	<ul style="list-style-type: none"> Developing projects on federal or state lands can be a challenge. The leasing process can be very cumbersome, especially when a proposed project might conflict with other land uses, ESA, and historical or cultural resources.
<ul style="list-style-type: none"> Direct use applications and power plants can generate tax revenue and royalty payments for federal, tribal, state and local governments and create construction, operation, administrative and maintenance jobs. 	<ul style="list-style-type: none"> Although costs have decreased in recent years, exploration and drilling for power production remain expensive.
<ul style="list-style-type: none"> Responsibly managed geothermal resources can deliver energy and provide power for decades. 	<ul style="list-style-type: none"> Using the best geothermal resources for electricity production may require an expansion or upgrade of the transmission system.
<ul style="list-style-type: none"> Geothermal power plants in the United States are reliable, capable of operating about 98 percent of the time. 	<ul style="list-style-type: none"> The success rate for discovering geothermal resources in new, untapped areas is approximately 20 percent. In areas where wells already are producing, the chance of locating more wells increases to about 80 percent.
<ul style="list-style-type: none"> Power plants are small, require no fuel purchase and are compatible with agricultural land uses. 	<ul style="list-style-type: none"> The productivity of geothermal wells may decline over time. As a result, it is crucial that developers manage the geothermal resource efficiently.
<ul style="list-style-type: none"> Geothermal plants produce a small amount of pollutant emissions compared to traditional fossil fuel power plants. 	