

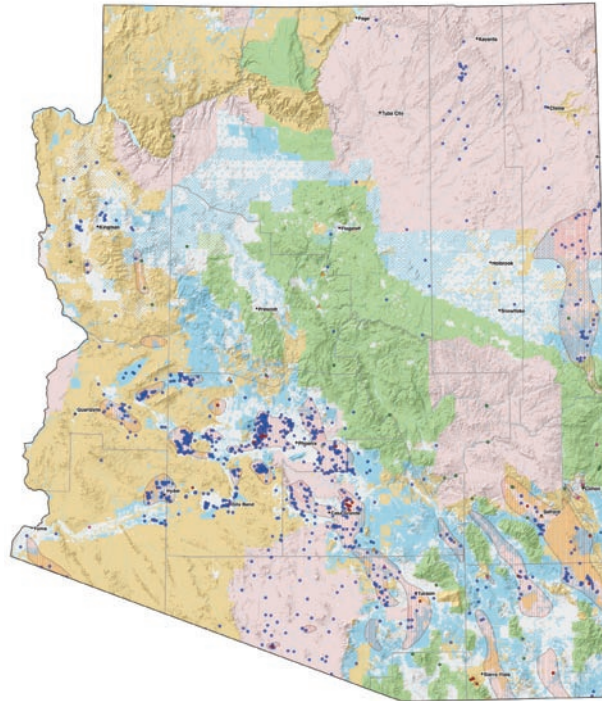


# Geothermal Technologies Program Arizona



Credit: Carol Shipman, courtesy of Arizona Public Service Company PIX 14634

**M**any of the basins of southern and western Arizona have large-volume low-temperature (less than 100°C, or 212°F) near-surface geothermal resources. Arizona low-temperature geothermal resources have the potential for direct-use applications such as heating buildings or greenhouses and providing warm water for aquaculture. Arizona already has a significant geothermal aquaculture industry and some small hot spring resorts, but little major geothermal development so far.



Idaho National Laboratory <http://geothermal.id.doe.gov/maps-software.shtml>

Higher-temperature or deeper resources with potential for power generation in Arizona include the eastern San Francisco Volcanic Field near Flagstaff and several areas in southeastern Arizona. One of these is the Clifton area near the New Mexico border. Arizona Public Service Company is actively investigating a potential project in the Clifton area with support from a U.S. Department of Energy Geothermal Technologies Program grant. This effort has been encouraged in part by the recently revised state environmental portfolio standard toward which any geothermal power development would apply.

## Current Development

Arizona has no major active developed hot springs resorts, but it does have several small spas, a few historic resorts, and numerous undeveloped hot springs. The small spas include Essence of Tranquility and Kachina Mineral Springs near Safford and El Dorado near Tonopah. Also, Muleshoe Ranch, northwest of Wilcox, includes hot springs now operated for tourism by The Nature Conservancy. Privately owned and not open to the public, the most famous geothermal site in Arizona was Castle Hot Springs, 50 miles northwest of Phoenix. For several decades, many famous people visited there to play golf and soak in the hot waters. Other historic resorts included Buckhorn Mineral Wells in Mesa and Agua Caliente near Sentinel.

Arizona's geothermal aquaculture industry includes tilapia and shrimp production in the Hyder Valley/Gila Bend area, tilapia and catfish production in the Safford area, and tilapia production near Marana. All Arizona aquaculture operations except for a couple small shrimp farms use geothermal water and it makes a big difference in their profitability. Fish and shrimp farms use the geothermal water to grow brood stock over the winter and to extend the growing season in the spring and the fall. Arizona aquaculture often also makes double use of the water, applying it to irrigation after fish farming, sometimes even raising the fish in irrigation canals or using them to control weeds in canals or golf course ponds.

**Arizona Public Service Company geothermal test drilling project near Clifton, Arizona. One well found temperatures steadily increasing to 55°C (131°F) at 300 meters (1,000 feet), suggesting a gradient of 100°C per kilometer (5.5°F/ft).**

## A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



Robb Williamson, NREL, PX13008

A binary power plant at a geothermal greenhouse in New Mexico. In a binary power plant, hot—but not boiling—water is used to heat a lower-boiling-point liquid to drive the turbine. In this case, the still-warm geothermal water heats the greenhouse after it passes through the heat exchangers of the turbines. Geothermal power development near Clifton or elsewhere in Arizona would likely use binary technology.

## Potential Development

Hot springs in the Clifton area of southeastern Arizona include some of the state's hottest water and offer potential for power generation. With funding assistance from the Geothermal Technologies Program of the U.S. Department of Energy, Arizona Public Service Company recently drilled two test wells near Clifton and found encouraging evidence that there is sufficient geothermal energy at reasonable depth to sustain an electrical generating station. Another Arizona site identified as having potential for power generation is the eastern San Francisco Volcanic Field near Flagstaff. This area has no surface manifestations, but has similar geology to developed high-temperature geothermal resources in other states.

Low-temperature geothermal resources also offer potential for development. Because many Arizona agriculture areas are in basins underlain by voluminous low-temperature resources, potential exists for direct-use geothermal agricultural from additional fish farming to biofuels production. For example, an estimated 15,000 to 20,000 acres in the Gila Bend area alone would be suitable for aquaculture and a farmer near Casa Grande is investigating a geothermal greenhouse.

More developed areas could also benefit from geothermal energy. According to a "Collocated Resources Study," conducted by the Geo-Heat Center at the Oregon Institute of Technology, fourteen communities in Arizona are within 8 km (5 miles) of a geothermal resource with a temperature of

50°C (122°F) or greater, making them candidates for district heating or other geothermal use. Geothermal heat pumps have been considered for a new building at the Tucson Zoo. Other possibilities, such as a destination spa, have also raised local geothermal interest.

## Policy

The Arizona Corporate Commission is in the process of increasing the state's environmental portfolio standard—which requires regulated utilities in the state to generate power from renewable energy—from 1.1% to 15%. The rule did not originally include geothermal energy, but was amended specifically to do so.

## Technical Capabilities

The Sustainable Energy Solutions (SES) Program at Northern Arizona University (NAU) includes a substantial geothermal component. NAU faculty have excellent expertise on exploration and assessment of geothermal energy. With U.S. Department of Energy funding, the SES program has developed and posted an informational Web site on development of geothermal energy resources <http://geothermal.nau.edu/>. Arizona State University (ASU) also has faculty with expertise in geothermal energy. Past work at ASU has included resource assessment, geothermal planning, and environmental impact evaluation. The University of Arizona is recognized for its expertise in aquaculture.



## GEOPOWERING THE WEST

GeoPowering the West is a cooperative federal, state, and local effort to promote awareness of the vast geothermal energy resources in the western United States, including Alaska and Hawaii. GeoPowering the West partners with businesses, government officials, Native American groups, utilities, and energy consumers to expand the use of geothermal energy.

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