

THE GEYSERS: NORTH AMERICA'S LARGEST GEOTHERMAL OPERATION INSIDE A GEOTHERMAL POWER PLANT

Located north of San Francisco in the Mayacamas Mountains, The Geysers is the single-largest geothermal electrical operation in the world. Because geothermal power plants do not burn fossil fuel, they have an inherent environmental advantage.

Geothermal energy is a source of renewable energy in California. A geothermal resource occurs when water deep below the earth's surface is heated by exposure to hot, permeable rock. At The Geysers, dry superheated steam is piped directly to steam turbines to produce electricity.

Steam production wells, some deeper than two miles, are drilled to tap this naturally occurring steam. Once the steam reaches the surface, it is piped overland to a network of interconnected power plants, where it spins conventional steam turbines that drive generators to produce clean, reliable electricity.

By contrast, different types of geothermal energy is produced by pumping superhot water to the surface, where it is flashed into steam to turn turbines. This is done in other areas of California such as Coso, Imperial Valley and in Nevada, Idaho and other western states.

How Do Power Plants at The Geysers Work?

The major components in a geothermal power plant at The Geysers are the steam turbine, generator, condenser, cooling tower, vacuum system and hydrogen sulfide (H₂S) abatement system.

Thermal energy in the form of pressurized steam flows to the power plant from steam wells through insulated steel pipelines. The steam enters the turbine at 40-100 psig. As the steam expands through the turbine, its thermal energy is converted into mechanical shaft energy. The steam turbine is directly coupled to the generator, which converts that mechanical energy into electrical energy.

Spent steam exhausts from the turbine into the condenser and is condensed into steam condensate (liquid water). The condenser is operated under vacuum to allow the turbine to extract the maximum amount of energy from each pound of steam. The steam condensate goes to the cooling tower, where a portion is evaporated to create cool water that is pumped back to the condenser to condense the steam exiting the turbine, completing the cycle. Any residual condensate from the cooling tower is injected back into the steam reservoir to make additional steam.

The steam turbine and generator both spin at 3,600 revolutions per minute, the speed needed to produce three-phase, 60-cycle power, which is standard throughout the United States. The generators at The Geysers produce electrical power at 13,800 volts. This is stepped up to either 115,000 volts or 230,000 volts in the station's main transformer to send the power over the transmission lines connected to the California power grid.



Calpine LLC is America's largest generator of electricity from natural gas and geothermal resources, operating 80 facilities with more than 27,000 megawatts of generation capacity. Through wholesale power operations and our retail businesses, we serve customers in 22 states and Canada. The Geysers, a wholly owned indirect subsidiary of Calpine, is the world's largest geothermal electrical operation, supplying renewable baseload energy to California every hour of every day. Calpine is a business unit of Constellation (Nasdaq: CEG). If you would like to learn more about Calpine, follow us: [Linkedin.com/company/Calpine](https://www.linkedin.com/company/Calpine).



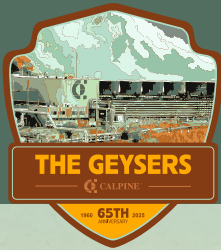
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Have a question?

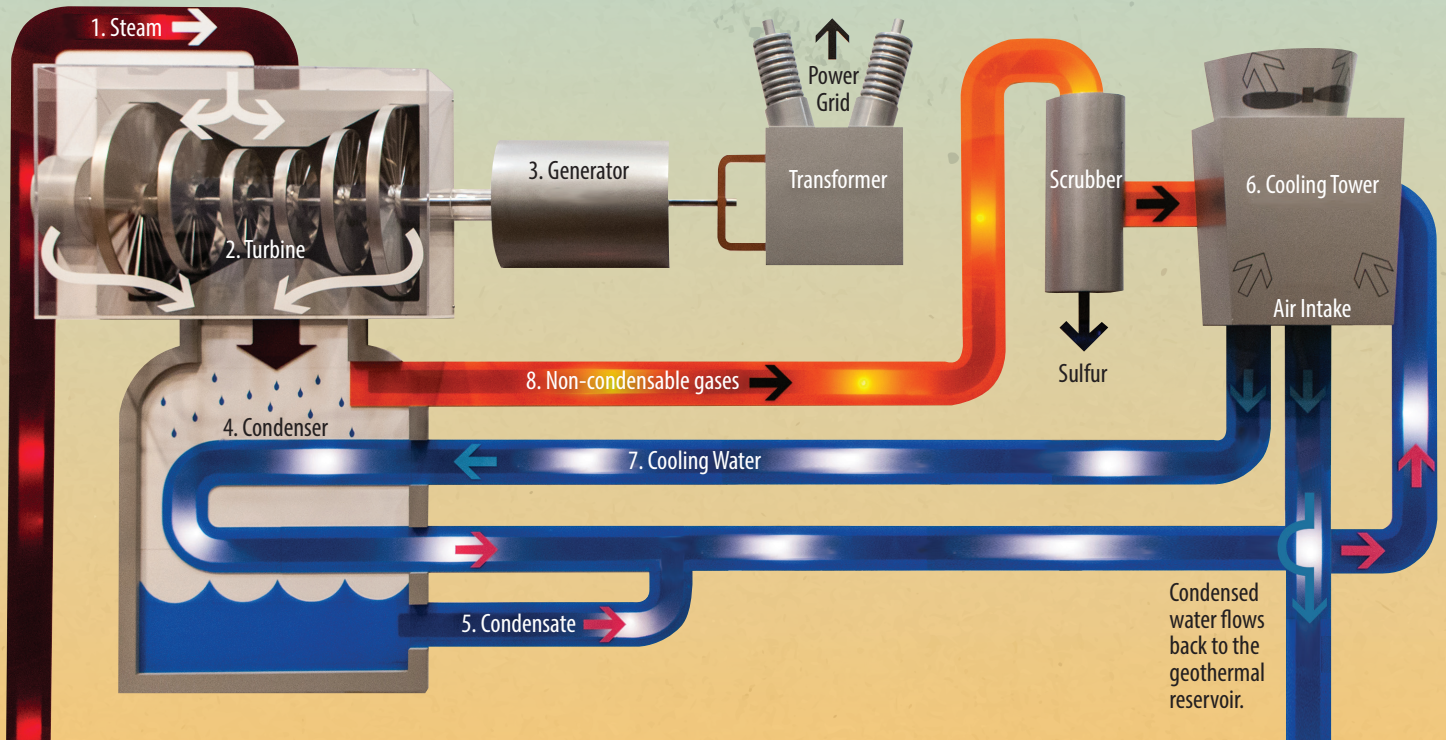
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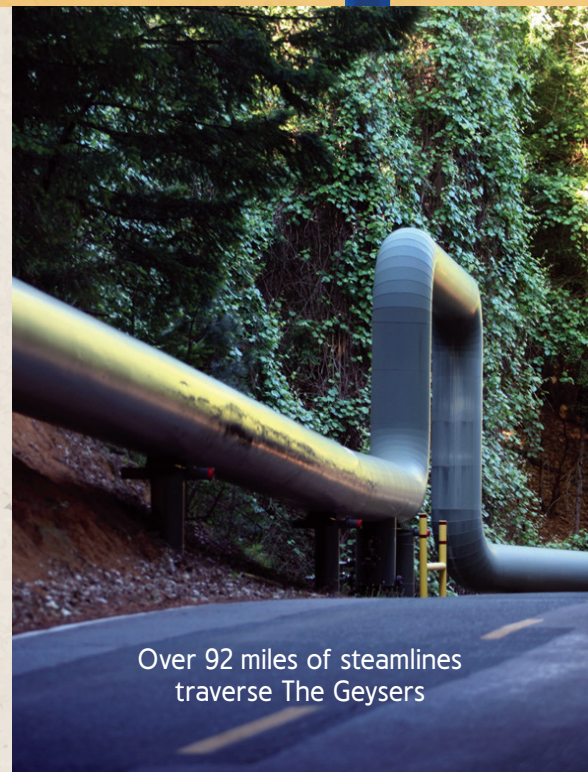
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Geothermal steam has a small amount of non-condensable gases (NCG), gases which do not condense with steam in the condenser. These gases must be continuously removed from the condenser with a gas removal system. In most plants this is done with a multi-stage steam jet ejector system. The NCGs contain small amounts of hydrogen sulfide (H_2S) that must be removed before the NCG can be discharged into the atmosphere to meet environmental regulations. In the lower NCG plants, Stretford H_2S abatement systems scrub out the H_2S from the gases with a vanadium catalyst solution and convert the gaseous H_2S into sulfur cake. This sulfur byproduct is collected in bins and transported offsite for use as an agricultural soil supplement. In higher NCG plants, the H_2S is removed by an incinerator/scrubber system.

The geothermal power plant control room is filled with computer screens that allow operators to monitor and control equipment. Operators are skilled professionals who have a very detailed understanding of the facility and its many systems. Operations are monitored 24 hours a day, seven days a week.

Calpine is committed to powering a lower-carbon and cleaner future. And we back up that commitment not only with our company's renewable and fuel-efficient power plants, but also with our consistent support for efforts to protect the environment.



Over 92 miles of steamlines
traverse The Geysers

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March 2026