



Photo from Wikipedia

Geysers Geothermal Power Development



Geysers Geothermal Power Development

lat:38.7906,lon:-122.7558

Sonoma #3

Socrates Mine Rd

Socrates Mine Rd

Socrates Mine Rd

Socrates

Socrates Mine Rd

Socrates Mine Rd

Socrates Mine Rd

Socrates Mine Rd

Socrates Mine Rd

The Geysers

From Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/The_Geysers

Coordinates: 38°47′26″N 122°45′21″W﻿ / ﻿38.79056°N 122.75583°W﻿ / 38.79056; -122.75583

The Geysers is the world's largest geothermal field, containing a complex of 18 [geothermal power](#) plants, drawing steam from more than 350 wells, located in the [Mayacamas Mountains](#) approximately 72 miles (116 km) north of [San Francisco, California](#).

Geysers produced about 20% of California's renewable energy in 2019.^[4]

History [edit]

For about 12,000 years, Native American tribes built steambaths and thermal pools at the Geysers and used the steam and hot water for healing purposes, as well as spiritual and ceremonial practices, and cooking.^[5] The thermal pools were used as a medicinal treatment for rheumatism and arthritis.^[6] The heated muds were used to soothe skin rashes and other aches and pains, using the fumaroles as a natural energy source.^[7] When European Americans first entered the area, six Indian tribes inhabited the area around the Geysers, three bands of [Pomo people](#), two bands of [Wappo people](#), and the Lake [Miwok people](#).^[5] The Wappo also collected [sulfur](#) which they called *te'ke* and a Wappo village, named *tekena'ntsonoma* (*teke* sulphur + *nan* well containing water + *tso* ground + *no'ma* village) was located about 12 miles (19 km) southeast of [Cloverdale](#) and on the present-day Sulphur Creek.^[5] Today, Calpine Corporation, the largest generator of electricity from natural gas and geothermal resources in the US, generates power at the site.

The Geysers were first seen by European Americans and named in 1847 during [John Fremont's](#) survey of the [Sierra Mountains](#) and the [Great Basin](#) by William Bell Elliot who called the area "The Geysers," although the geothermal features he discovered were not technically [geysers](#), but [fumaroles](#).^[8]

Between 1848 and 1854, [Archibald C. Godwin](#) developed The Geysers into a spa named *The Geysers Resort Hotel*, which attracted tourists including [Ulysses S. Grant](#), [Theodore Roosevelt](#) and [Mark Twain](#).^{[5][8][9]} The resort declined in popularity in the mid 1880s, and rebranded itself to appeal to lower-income people.^[5] In 1938, the main building was destroyed in a landslide although the bar/restaurant, small cabins and the swimming pool stayed open, despite another fire in March 1957, until about 1979.^[5] In 1960, [Pacific Gas and Electric](#) began operation of their 11-megawatt geothermal electric plant at the Geysers. [Unocal Corporation](#) dismantled the remains of the resort in 1980.^[5]

The Geysers



The Sonoma Calpine 3 power plant is one of 18 power plants at The Geysers



Official name	The Geysers
Country	 United States
Location	Sonoma and Lake counties California
Coordinates	38°47′26″N 122°45′21″W﻿ / ﻿38.79056°N 122.75583°W﻿ / 38.79056; -122.75583
Status	Operational
Commission date	September 1960 ^[1]
Owner(s)	Calpine Corporation (86.5%) NCPA (4.5%) Silicon Valley Power (4.5%) USRG (4.5%)
Operator(s)	Calpine Corporation
Geothermal power station	
Type	Dry steam
Wells	376 (active) ^[1] 591 (total) ^[1]
Max. well depth	12,900 ft (3,900 m) ^[1]
Site area	29,000 acres (120 km ²) ^[1]
Power generation	
Units operational	22 units (18 power stations)

Five of the Geysers facilities were damaged in the [Valley Fire](#) of September 2015, suffering "severe" damage to their cooling towers. The main power houses were not damaged.^[10] The [Kincade Fire](#) was reported burning at John Kincade Road and Burned Mountain Road in The Geysers, at 9:27 PM on October 23, 2019.^{[11][12]} The fire started at 9:24 PM during an extreme wind event,^[13] and subsequently burned 77,758 acres (31,468 ha) until the fire was fully contained on November 6.

The Geysers Geothermal Power Development project was designated as a California Historic Civil Engineering Landmark by the San Francisco Section of the [American Society of Civil Engineers](#) in 1976.^[14]

Geothermal development [edit]

The Geysers is the world's largest geothermal field^[15] spanning an area of around 30 square miles (78 km²) in [Sonoma](#), [Lake](#) and [Mendocino](#) counties in California, centered in the area of [Geyser Canyon](#) and [Cobb Mountain](#). Power from The Geysers provides electricity to Sonoma, Lake, Mendocino, [Marin](#), and [Napa](#) counties. It is estimated that the development meets 60% of the power demand for the coastal region between the [Golden Gate Bridge](#) and the [Oregon](#) state line.^[16] Unlike most geothermal resources, the Geysers is a dry steam field which mainly produces [superheated](#) steam.^[15]

Units planned	3 units
Units decommissioned	7 units (4 power stations)
Nameplate capacity	1,590 MW ^[2]
Capacity factor	53% ^[2]
Annual net output	6,516 GWh (2018) ^[3]

External links

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The Geysers Resort Hotel,
c. 1880



Steam used at The Geysers is produced from a [greywacke](#) sandstone reservoir, capped by a heterogeneous mix of low permeability rocks and underlain by a [silicic intrusion](#).^{[8][17]} Gravitational and seismic studies suggest that the source of heat for the steam reservoir is a large [magma](#) chamber over 4 miles (6.4 km) beneath the surface, and greater than 8 miles (13 km) in diameter.^[18]

The first geothermal wells drilled in Geysers Canyon were the first in the Western Hemisphere.^[5] The first power plant at the Geysers was privately developed by the owner of The Geysers Resort^[5] and opened in 1921, producing 250 kilowatts of power to light the resort.^[8] In 1960, [Pacific Gas and Electric](#) began operation of their 11-megawatt plant at the Geysers.^[19] The original turbine lasted for more than 30 years and produced 11 [MW](#) net power.^[20]

By 1999 the steam to power extraction had begun to deplete the Geysers steam field and production began to drop.^[8] However, since October 16, 1997, the Geysers steam field has been recharged by injection of treated sewage effluent, producing approximately 77 megawatts of capacity in 2004.^[21] The effluent is piped up to 50 miles (80 km) from its source at the Lake County Sanitation waste water treatment plants and added to the Geysers steam field via geothermal injection.^[21] In 2003, the City of Santa Rosa and Calpine Corporation partnered on constructing a 42-mile pipeline that became known as the Santa Rosa Geysers Recharge Project (SRGRP). Since 2003, SRGRP has delivered approximately 11 million gallons per day of [tertiary treated wastewater](#) to replenish The Geysers' geothermal reservoir. In 2004, 85% of the effluent produced by four waste-water treatment plants serving 10 Lake County communities was diverted to the Geysers steam field.^[21] Injecting treated water into the Geysers field increases the amount of power that can be generated.^[21]

The injection of wastewater to the Geysers protects local waterways and [Clear Lake](#) by diverting effluent which used to be put into surface waters,^[21] and has produced electricity without releasing greenhouse gases into the atmosphere.^[8]



Drilling a geothermal well, 1977 [□]
(USGS)

Geothermal power stations [edit]

This is a table of all constituent geothermal power stations sorted by unit identification.^[2]

[Calpine](#) owns 19 existing units, most of which were acquired from [PG&E](#) and [Unocal Geothermal](#) in 1999. NCPA Units 1-4 are jointly owned by the [Northern California Power Agency](#) (NCPA) and [Silicon Valley Power](#). [Bottle Rock](#) is wholly owned by Bottle Rock Power LLC, a joint-venture between [U.S. Renewables Group](#) and [Riverstone Holdings](#).^[2]

In addition, [Ormat](#) owns the plans for a new 30 MW geothermal power station at the vacant Calpine 15 site that were acquired through a merger with [U.S. Geothermal](#) in 2018. The plans were previously developed by [Ram Power](#) before being sold to U.S. Geothermal in 2014.^{[2][22][23]}

Name	Unit	Type	Status	Capacity (MW _e)	Commissioned	Decommissioned
Bottle Rock	RRP	Dry steam	Operational	55	March 1985 ^[note 1] October 2007	
Aidlin	Calpine 1	Dry steam	Operational	20	May 1989	
Bear Canyon	Calpine 2	Dry steam	Operational	20	September 1988	
Sonoma	Calpine 3	Dry steam	Operational	78	December 1983	
West Ford Flat	Calpine 4	Dry steam	Operational	27	December 1988	
McCabe	Calpine 5	Dry steam	Operational	55	April 1971	
	Calpine 6	Dry steam	Operational	55	April 1971	
Ridge Line	Calpine 7	Dry steam	Operational	55	July 1972	
	Calpine 8	Dry steam	Operational	55	July 1972	
Fumarole	Calpine 9	Dry steam	Offline since 2001	55	November 1973	
	Calpine 10	Dry steam	Offline since 2000	55	November 1973	
Eagle Rock	Calpine 11	Dry steam	Operational	110	December 1975	
Cobb Creek	Calpine 12	Dry steam	Operational	110	August 1979	
Big Geysers	Calpine 13	Dry steam	Operational	60	April 1980	
Sulfur Springs	Calpine 14	Dry steam	Operational	114	February 1980	
PG&E 15 ^[note 2]	Calpine 15	Dry steam	Decommissioned	62	June 1979	1997 (Dismantled)
Quicksilver	Calpine 16	Dry steam	Operational	119	October 1985	
Lake View	Calpine 17	Dry steam	Operational	119	November 1982	
Socrates	Calpine 18	Dry steam	Operational	119	November 1983	
Calistoga	Calpine 19	Dry steam	Operational	80	March 1984	
Grant	Calpine 20	Dry steam	Operational	119	October 1985	
Buckeye	Calpine	Dry steam	Planned	?	TBD	
Wild Horse	Calpine	Dry steam	Planned	?	TBD	
Coldwater Creek	CCPA 1	Dry steam	Decommissioned	65	May 1988	2000 (Dismantled)
	CCPA 2	Dry steam	Decommissioned	65	October 1988	2000 (Dismantled)
NCPA 1 & 2	NCPA 1	Dry steam	Operational	55	February 1983	
	NCPA 2	Dry steam	Operational	55	February 1983	
NCPA 3 & 4	NCPA 3	Dry steam	Operational	55	November 1985	
	NCPA 4	Dry steam	Operational	55	November 1985	
TBD	Ormat	Dry steam	Planned	30	TBD	
PG&E 1 & 2	PG&E 1	Dry steam	Decommissioned	12	September 1960	1993 (Dismantled)
	PG&E 2	Dry steam	Decommissioned	14	September 1960	1993 (Dismantled)
PG&E 3 & 4	PG&E 3	Dry steam	Decommissioned	28	March 1963	1995 (Dismantled)
	PG&E 4	Dry steam	Decommissioned	28	March 1963	1995 (Dismantled)