Inside the Power Plant

Calpine’s commitment to environmental excellence in power generation is fundamental to our corporate philosophy and culture. It defines who we are as a company and how we serve our customers. Today, Calpine is America’s largest generator of electricity from natural gas and geothermal resources, and our power plant fleet is among the cleanest in the nation.

A power plant is like a factory. It takes a raw material and turns it into a product that is valuable to the economy. And like any other manufacturer that sells its product into a competitive market, a power plant has to operate as efficiently as possible.

Most of Calpine’s power plants use clean-burning natural gas as the primary raw material to produce electricity. But we are also the nation’s largest producer of geothermal power. Our plants in The Geysers region of northern California use heat from the earth’s interior to generate electricity.

In addition to being efficient, a power plant must be highly reliable and operate within strict environmental standards. Reliability is important because electricity is a vital part of our modern economy. The power grid cannot store electricity and relies on power plants to generate electricity as it is needed. At the same time, the electric power industry must reduce carbon dioxide emissions in light of increasing concerns about global climate change. As a leader in balancing reliability with sustainability, Calpine operates a low-carbon fleet of power plants that will help the United States meet its energy needs – in an environmentally responsible manner – for many years to come.

How Do Calpine’s Plants Work?

Calpine operates a variety of power plants that fall into four main types: simple cycle, combined cycle, cogeneration and geothermal.

**Simple Cycle**

This process uses clean-burning natural gas to power a combustion turbine, which is connected directly to a generator that produces electricity. Calpine operates a number of small, simple-cycle plants as quick-responding “peaker” facilities to generate power when demand is highest.

A combustion turbine in a power plant is similar to a jet engine on an airplane. The process starts as air flows through intake structures, where it is filtered before entering the combustion turbine. The air then enters the gas turbine where it is compressed and mixed with natural gas and ignited, which causes it to expand. The pressure created from this expansion spins the turbine blades, which are attached to a drive shaft and generator, creating electricity.
**Combined Cycle**

Highly efficient combined-cycle plants generate the most megawatts produced by Calpine’s fleet. They capture even more of the energy contained in the fuel by using the extremely hot exhaust from natural-gas combustion turbines to generate additional electricity. Using that energy, which otherwise would be wasted, is a major benefit of the combined-cycle design.

Energy from the exhaust of each combustion turbine is captured by a heat recovery steam generator (HRSG). The HRSGs at modern combined-cycle plants are so efficient that exhaust leaving turbines at more than 1,000 degrees Fahrenheit is reduced in temperature to about 200 degrees by the time the heat recovery process is completed. HRSGs are also often equipped with sophisticated emissions control technology that reduces potentially harmful air emissions.

HRSGs contain boiler tubes filled with ultrapure water. Hot exhaust flows past these tubes, turning the water into steam. The steam is routed to a steam turbine, which is connected to its own generator. Steam enters the turbine at more than 1,000 degrees and at a pressure of more than 1,000 psi.

The spent steam then flows into a condenser. The condenser converts the steam back into water, which is returned to the HRSG in a closed-loop cycle to be reused. A cooling tower adjacent to the plant provides a constant flow of cool water to the condenser.

**Cogeneration**

Calpine also operates the nation’s largest portfolio of cogeneration plants, also called combined heat and power facilities. A simple-cycle or combined-cycle plant may incorporate cogeneration capabilities. In this process, steam from the HRSG or steam turbine is piped to a customer who uses it in an industrial process. This is a cost-effective way to support the energy needs of local industry and one of the most efficient ways to generate electric power.

**Geothermal**

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.

A geothermal resource occurs when water deep below the earth’s surface is heated by exposure to hot, permeable rock resulting in dry steam or hot water. At The Geysers, dry or superheated steam is produced.

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. The spent steam leaving the turbines is condensed and cycled through the cooling towers. Also, treated wastewater from local municipalities is injected underground to help replenish the geothermal reservoir.
Plant Operations

Operating a power plant is a complicated, highly automated process. A plant’s control room is filled with computer screens that allow operators to monitor and control every valve, pump and sensor in the plant. The operators are skilled professionals who have a very detailed understanding of the facility and its many systems. Plants are monitored 24 hours a day, seven days a week, and they are run in accordance with numerous regulatory, safety and commercial requirements.

Calpine’s power plants deliver electricity either directly to wholesale customers or to regional power grids, whose operators constantly manage generation and transmission resources to minimize costs and maintain system reliability. This is a highly dynamic process because consumer demand varies based on factors such as time of day, weather conditions and season.

During periods of peak demand, a plant may run at full capacity around the clock. At other times, it may ramp up and down during the day – often making adjustments in five-minute increments. Operators at Calpine’s natural gas-fired plants can run combustion turbines at varying load levels to adjust the output. Sometimes a plant will completely shut down at night or over the weekend and then resume operations when called upon.

This level of flexibility is very valuable to the power grid and makes Calpine’s fleet a perfect complement to wind and solar generation. Unlike most large hydroelectric, nuclear and coal stations, natural gas-fired plants can quickly adjust their output to compensate for the inherent weather variability that affects intermittent renewable resources.

Environmental Performance

Calpine is among the cleanest power generating companies in North America. In addition to its geothermal resources, Calpine focuses on combined-cycle generation, combined heat and power partnerships, the use of clean-burning natural gas, highly efficient plant design and sophisticated emissions reduction technology to achieve industry-leading environmental performance while producing the maximum amount of electricity from each unit of fuel.

With its 21st century design and technology, Calpine’s modern fleet of power plants is making an important contribution to an environmentally responsible energy future.