



# Power Station

## Places that produce large amounts of electrical energy

### HIGHLIGHTS

- Electricity is produced by machines called turbines.
- Most power stations in the United States burn fossil fuels.
- Power stations are connected to each other, and to consumers, through a grid.

Industry, commerce, transportation, and people's homes could not operate without electrical power. Factories, computers, shopping malls, domestic appliances, and subways all rely on electricity, which is generated by power stations. The world's first power plant was built in New York City in 1882 to the designs of U.S. inventor Thomas Alva Edison (1847–1931).

## Types of power stations

At the center of any power station are alternators (OL-tuhr-nayt-uhrs), or generators. A shaft inside these devices rotates to create electricity. This rotation is powered by a large fan called a turbine. Turbines can be driven by falling water in a hydroelectric plant, by expanding hot gas in a gas-turbine plant, or by high pressure steam produced in a thermal plant. Thermal power stations use heat to produce steam from water. This heat can be made by a nuclear reaction or by burning fossil fuels such as coal or oil.

The electricity created by power stations is measured in megawatts (MW)—one megawatt is a million watts. A 1,000-MW power station produces enough electricity for one million households. Large coal-fired power stations produce between 800 and 1,200 MW of electricity. Oil- and gas-fired power stations generate between 300 and 600 MW. Smaller gas turbine units generate about 100 MW.

Burning fossil fuels provides 70 to 80 percent of electricity generated in the United States. Most of the remainder comes from hydroelectric or nuclear power stations. France generates 80 percent of its power in nuclear power stations.

## Electricity distribution

Many power stations are far from the places where electricity will be used. Hydroelectric power

stations require reservoirs to provide the water to drive their turbines. Thermal power stations require a large water supply, such as a river, to condense the steam that passes through their turbines. Nuclear power stations are in remote locations to reduce the risk to human health from accidents.

Several power stations are linked to each other and to consumers by a network of high tension cables known as a grid. Electrical energy is lost through heat as the current flows through the grid. To minimize this loss, electricity is transmitted over long distances at the highest possible voltage and transformed to a safer, lower voltage at the destination. Pylons with insulated cables hung from them, or underground cables, carry the power to electricity substations.

The substations reduce the voltage of the electricity supply to the correct level for use. Industry may use electricity at 33,000 volts. However, neighborhood substations reduce power to 11,000 volts, and the supply is reduced again to between only 110 and 240 volts for domestic use.

The amount of electricity required from a grid is called the load. Because peaks happen when people arrive home at the same time and turn on domestic appliances, such as dishwashers and ovens, the load varies throughout 24 hours. The number of generators used varies throughout the day to produce more or less electricity to cope with these peaks in demand.

Large power stations take a long time to start up and close down, but they produce the cheapest electricity. The largest power stations are usually coal-fired or nuclear installations. Medium-sized power stations meet periods of increased average demand, while small gas turbine stations can be put into operation quickly to cope with any sudden short-term peaks in demand.

## Fossil-fueled thermal power stations

Fossil fuels, such as coal, natural gas, and oil, were formed from the remains of plant and animal life that died millions of years ago. The easiest fuel for a fossil fuel power station to handle is natural gas. Natural gas is delivered by pipeline and fed into a furnace, which heats water. No special handling or storage are required. Gas-fired furnaces are the smallest and simplest of the fossil fuel furnaces.

Oil can be delivered by pipeline but usually arrives in tankers by ship, road, or rail. Large storage tanks hold the oil, which is piped into the furnace where it is vaporized and burned.

Coal is stored in large stockpiles, which hold enough coal for the power plant to operate for six months. Coal is taken from the stockpile, crushed to powder in a mill, and put into the furnace. These are the largest fossil fuel furnaces.

Water is pumped at high pressure through the pipes running through the furnace. Burning coal, oil, or natural gas releases heat energy, which turns the water into high pressure steam. Then, this steam is fed to steam turbines and cooled with water at the outlet of the turbine. This condenses the steam and turns it back into hot water.

Condensation creates a vacuum (a space containing no matter) and draws the steam through the turbine. This turns the blades in the turbine to produce electrical power. Heat is removed

from the condensed water in cooling towers (tall structures in which water is circulated). When cooled, the water can be returned to a nearby river or lake.

## LOOK CLOSER

### Controlling emissions

Before they are discharged, gases and liquid waste from fossil-fueled power stations are treated in a process called scrubbing. This reduces any pollution and damage to the environment. During scrubbing, solid particles are removed using devices called electrostatic precipitators (pruh-SIP-uh-tayt-uhrs). Particles are given an electrical charge and are passed over a plate with the opposite charge. The particles become stuck to the plate and are removed.

The main gases produced in fuel-burning power stations are carbon dioxide and nitrogen oxide. These gases add to global warming, which is heating up the Earth. These power stations also emit sulfur dioxide, which produces acid rain. Sulfur dioxide is neutralized using substances such as lime or limestone.

## Improving efficiency

Thermal efficiency is the percentage of the heat generated by a power station that is converted into electricity. By 2000, most power stations in the United States operated at 40 percent efficiency—10 percent more than in the 1940s. Power station turbines operate more efficiently at higher pressures and higher temperatures. New materials improve efficiency.

Modern steam pipes are made from new alloys that can withstand very high pressures and temperatures of up to 1200°F (650°C). These new alloys are made from the metals chromium (KROH-mee-uhm), manganese, nickel, and molybdenum (muh-LIB-duh-nuhm). The pipes made from these new materials can stand steam pressure up to 600,000 pounds per square foot (2.9 million kg/sq m) and temperatures up to 1200°F (650°C).

If the steam is passed through a series of turbines—rather than being passed through just one turbine—more energy can be extracted. Some power units reheat the outgoing steam and then pass it through a set of turbines.

Because all the fossil fuels are a limited resource, any methods that will improve efficiency are important. Reheating steam saves money and reduces the amount of fossil fuel that is used in a power station.

## INTO THE FUTURE

### Fossil fuels and global warming

The amount of carbon dioxide (CO<sub>2</sub>) in the atmosphere has increased from 280 parts per trillion (PPT) parts of air in preindustrial times to 360 PPT in modern times. Much of this increase is due to people burning fossil fuels. CO<sub>2</sub> stays in

Earth's atmosphere for many years. At present levels of production, the concentration of CO<sub>2</sub> in the atmosphere will reach 500 PPT in 200 years.

Experts believe that increased CO<sub>2</sub> in the atmosphere is causing changes in climate. This change is called global warming. The efficient removal of CO<sub>2</sub> is very difficult, and probably the only way to reduce climate change is to rely on renewable energies, such as solar and wind power, rather than to continue using fossil fuels.

**See also:** [ELECTRICITY](#); [ENERGY RESOURCES](#); [NUCLEAR ENERGY](#); [SOLAR POWER](#); [WIND POWER](#).

**Citation:**

"Power Station." *Exploring Technology*. Marshall Cavendish Digital. 2009. 21 July 2009  
<<http://www.marshallcavendishdigital.com/articledisplay/32/6876/70279>>.

Copyright © 2006 Marshall Cavendish Corporation. All rights reserved.