Coal

Coal at a Glance, 2025

Classification:
- nonrenewable

Major Uses:
- electricity, industry

U.S. Energy Consumption:
- 8.710 Q
- 9.05%

U.S. Energy Production:
- 10.876 Q
- 10.17%

Data: Energy Information Administration

What Is Coal?

Coal is a **fossil fuel** created from the remains of plants that lived and died about 100 to 400 million years ago when parts of the Earth were covered with huge swampy forests. Coal is classified as a **nonrenewable** energy source because it takes millions of years or more to form.

The energy we get from coal today comes from the energy that plants absorbed from the sun millions of years ago. All living plants store solar energy through a process known as **photosynthesis**. When plants die, this energy is usually released as the plants decay. Under conditions favorable to coal formation, however, the decay process is interrupted, preventing the release of the stored solar energy. The energy is locked into the coal.

Millions to hundreds of millions of years ago, plants that fell to the bottom of swampy land began to decay as layers of dirt and water were piled on top. Heat and pressure from these layers caused a chemical change to occur, eventually creating coal over time.

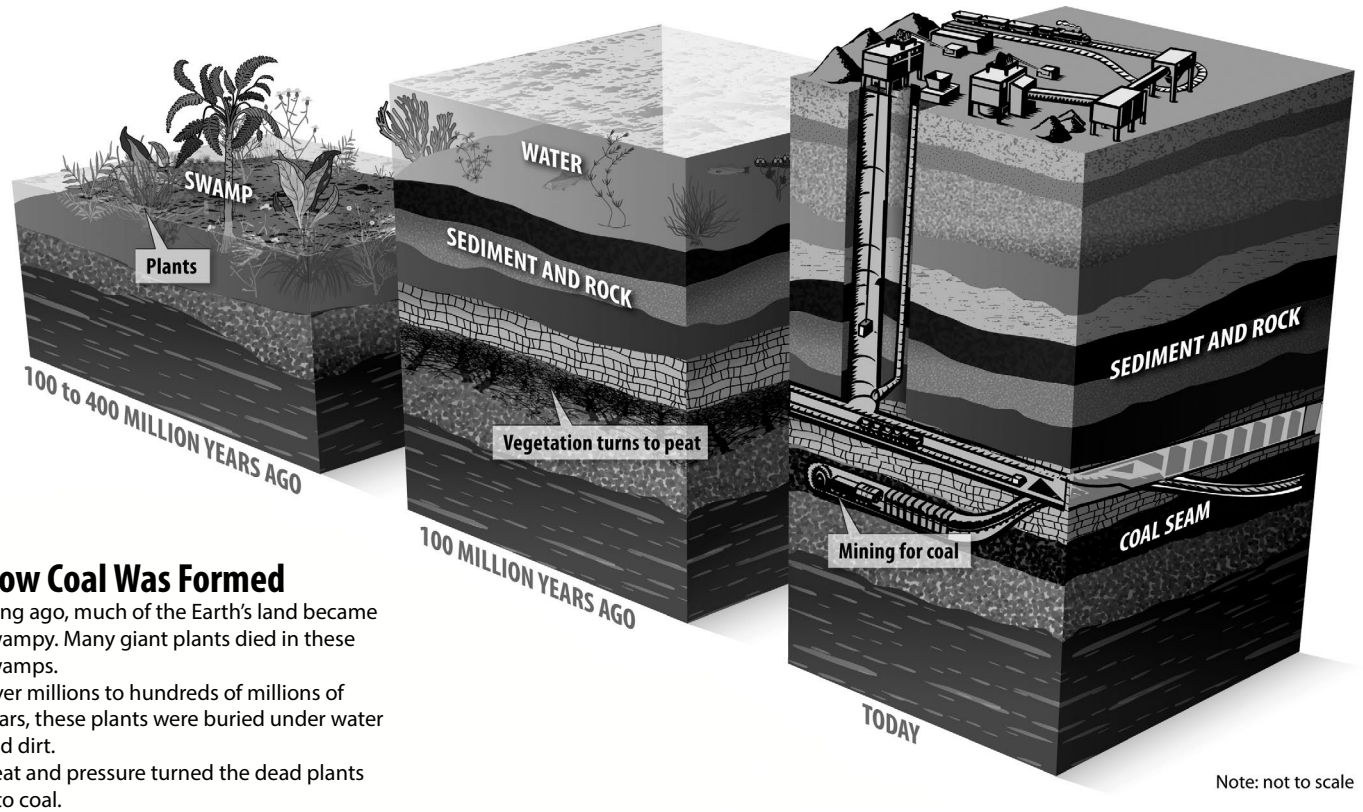
Seams of coal—ranging in thickness from a fraction of an inch to hundreds of feet—may represent hundreds or thousands of years of plant growth. One seam, the seven-foot thick Pittsburgh seam, may represent 2,000 years of rapid plant growth. One acre of this seam contains about 14,000 tons of coal.

History of Coal in America

Indigenous Americans used coal long before the first settlers arrived in the New World. The Hopi Tribe, who lived in what is now Arizona, used coal to bake the pottery they made from clay. European settlers discovered coal in North America during the first half of the 1600s. They used very little at first. Instead, they relied on water wheels and wood to power colonial industries.

Coal became a powerhouse by the 1800s. People used coal to manufacture goods and to power steamships and railroad engines. By the American Civil War, people also used coal to make iron and steel. And by the end of the 1800s, people even used coal to make electricity.

When America entered the 1900s, coal was the energy mainstay for the nation's businesses and industries. Coal stayed America's number-one energy source until the demand for petroleum products pushed petroleum to the front. Automobiles needed gasoline. Trains switched from coal power to diesel fuel. Even homes that used to be heated by coal turned to oil or natural gas furnaces instead.



How Coal Was Formed

Long ago, much of the Earth's land became swampy. Many giant plants died in these swamps.

Over millions to hundreds of millions of years, these plants were buried under water and dirt.

Heat and pressure turned the dead plants into coal.

Note: not to scale

Coal

Coal production reached its low point in 1961. Since 1970, coal production reached high points during which coal production was up by as much as 48 percent. Today, coal supplies only about nine percent of the nation's total energy needs, mostly for electricity production. The increased use of natural gas and renewable energy sources for electricity has led to a sharp decline in the amount of coal consumed for electricity generation.

Coal Mining

There are two ways to remove coal from the ground, surface and underground mining. **Surface mining** is used when a coal seam is relatively close to the surface, usually within 200 feet. The first step in surface mining is to remove and store the soil and rock covering the coal, called the **overburden**. Workers use a variety of equipment—draglines, power shovels, bulldozers, and front-end loaders—to expose the coal seam for mining.

After surface mining, workers replace the overburden, grade it, cover it with topsoil, and fertilize and seed the area. This land reclamation is required by law and helps restore the biological balance of the area and prevent erosion. The land can then be used for croplands, wildlife habitats, recreation, or sites for commercial development.

About 60 percent of the nation's coal is obtained through surface mining. Surface mining is typically much less expensive than underground mining. New technologies increased surface mining productivity as much as 100 percent after 1970. Today, however, new technology gains are attributable to a 12 percent increase in productivity, because productivity overall, has decreased.

Underground (or deep) mining is used when the coal seam is buried several hundred feet below the surface. In underground mining, workers and machinery go down a vertical shaft or a slanted tunnel called a slope to remove the coal. Mine shafts may be as deep as 1,000 feet.

One method of underground mining is called **room-and-pillar mining**. With this method, much of the coal must be left behind to support the mine's roofs and walls. Sometimes as much as half the coal is left behind in large column formations to keep the mine from collapsing.

A more efficient and safer underground mining method, called **longwall mining**, uses a specially shielded machine that allows a mined-out area to collapse in a controlled manner. This method is called longwall mining because huge blocks of coal up to several hundred feet wide can be removed.

Processing and Transporting Coal

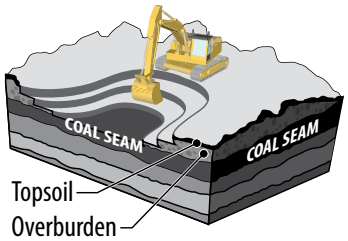
After coal comes out of the ground, it typically goes on a conveyor belt to a preparation plant that is located at the mining site. The plant cleans and processes coal to remove dirt, rock, ash, sulfur, and other impurities, increasing the heating value of the coal.

After the coal is mined and processed, it is ready to go to market. It is very important to consider transportation when comparing coal with other energy sources, because sometimes transporting the coal can cost more than mining it.

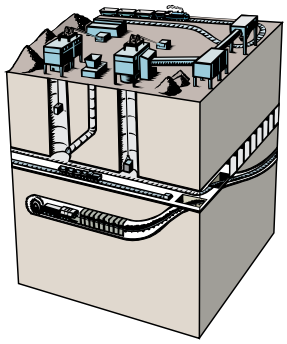
Underground pipelines can easily move petroleum and natural gas to market, but not coal. Huge trains and barges transport most of U.S. coal for some or all of its journey to market.

It is cheaper to transport coal on river barges, but this option is not always available. Coal can also be moved by trucks and conveyors if the coal mine is close by. Ideally, coal-fired **power plants** are built near coal mines to minimize transportation costs.

Surface Mining



Deep Mining



Types of Coal

Coal is classified into four main types, depending on the amount of carbon, oxygen, and hydrogen present. The higher the carbon content, the more energy the coal contains.

Lignite is the lowest rank of coal, with a **heating value** of 4,000 to 8,300 **British thermal units** (Btu) per pound. Lignite is crumbly and has high moisture content. Most lignite mined in the United States comes from Texas. Lignite is mainly used to produce electricity. It contains 25 to 35 percent carbon. About eight percent of the coal mined in 2024 in the U.S. was lignite.

Subbituminous coal typically contains less heating value (8,300 to 13,000 Btu per pound) than bituminous coal and more moisture. It contains 35 to 45 percent carbon. In 2024, 43 percent of the coal mined in the U.S. was subbituminous.

Bituminous coal was formed by added heat and pressure on lignite. Made of many tiny layers, bituminous coal looks smooth and sometimes shiny. It is the most abundant type of coal found in the United States and has two to three times the heating value of lignite. Bituminous coal contains 11,000 to 15,500 Btu per pound. Bituminous coal is used to generate electricity and is an important fuel for the steel and iron industries. It contains 45 to 86 percent carbon. In 2024, 48 percent of the coal mined in the U.S. was bituminous coal.

Anthracite was created where additional pressure combined with very high temperature inside the Earth. It is deep black and looks almost metallic due to its glossy surface. It is found primarily in 11 northeastern counties of Pennsylvania. Like bituminous coal, anthracite coal is a big energy producer, containing nearly 15,000 Btu per pound. It contains 86 to 97 percent carbon. Less than one percent of coal mined in 2024 in the U.S. was anthracite.

©2026 The NEED Project Secondary Energy Infobook www.NEED.org

Coal Reserves

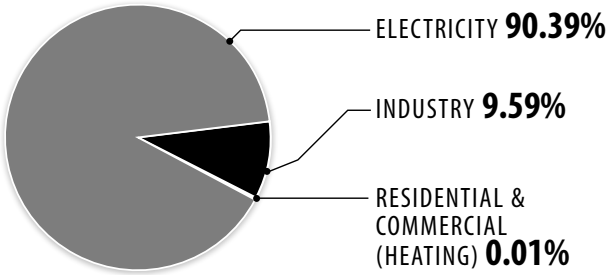
When scientists estimate how much coal, petroleum, natural gas, or other energy sources there are in the United States, they use the term **reserves**. Reserves are deposits that can be harvested using today's methods and technology.

Experts estimate that the United States has over ten million short tons (1 short ton = 2,000 lbs.) of recoverable coal reserves. If we continue to use coal at the same rate as we do today, we will have enough coal to last over 400 years. This vast amount of coal makes the United States the world leader in known coal reserves.

Where is all this coal located? Coal reserves can be found in 20 states. Wyoming has the most coal—about 3.6 billion mineable tons. Coal is also found in large quantities in West Virginia, Illinois, Pennsylvania, Texas, North Dakota, Kentucky, and Montana. Western coal generally contains less sulfur than eastern coal.

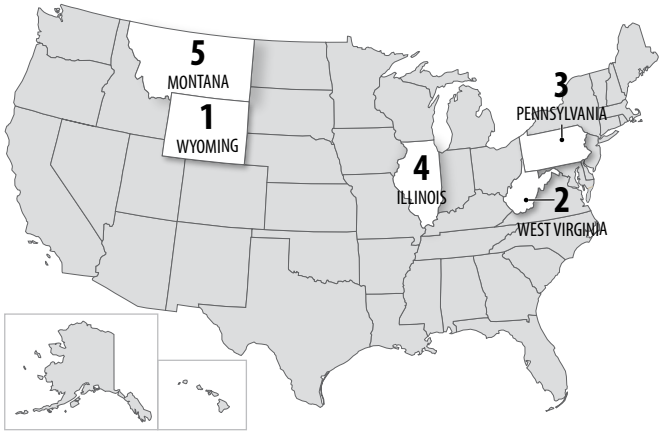
The Federal Government is by far the largest owner of the nation's coalbeds. The Bureau of Land Management leases over 570 million acres of coal bed mineral estates to landowners. Most of these leases are found in Western states.

U.S. Coal Consumption by Sector, 2025



Data: Energy Information Administration
*Total does not equal 100 due to independent rounding.

Top Coal-Producing States, 2024



Data: Energy Information Administration
2024 is the most current reporting available at the time of publication.

Coal Production

Coal production is the amount of coal mined and taken to market. Where does mining take place in the United States? Today, coal is mined in 21 states. More coal is mined in western states than in eastern states, a marked change from the past when most coal came from eastern underground mines.

In the 1950s and 1960s, the East mined approximately 95 percent of the coal produced in the U.S. As of the early 1970s, the amount of coal produced by western mines steadily increased. In 2024, the West provided 55 percent of total production, and states east of the Mississippi River provided 45 percent.

Total U.S. coal production was 513 million tons in 2024. The leading coal states are Wyoming, West Virginia, Pennsylvania, Illinois, and Montana. These five states produce over 72 percent of the coal in the U.S.

Some coal produced in the United States is exported to other countries. In 2024, foreign countries bought 21.14 percent of all the coal produced in the U.S. The biggest foreign markets for U.S. coal are India, the Netherlands, Brazil, Japan, Morocco, Canada, and South Korea.

How Coal Is Used

The main use of coal in the United States is to generate electricity. In 2025, 90 percent of all the coal in the United States was used for electricity production. Coal generates 16.64 percent of the electricity used in the U.S. Other energy sources used to generate electricity include natural gas, uranium (nuclear power), wind, solar, and hydropower.

Another major use of coal is in iron and steelmaking. The iron industry uses coke ovens to melt iron ore. **Coke**, an almost pure carbon residue of coal, is used as a fuel in **smelting** metals. The United States has the finest coking coals in the world. These coals are shipped around the world for use in coke ovens. Coal is also used by other industries. The paper, brick, limestone, and cement industries all use coal to make products.

Coal is no longer a major energy source for heating American homes or other buildings. A very, very small amount of the coal produced in the U.S. today is used for heating. Coal furnaces, which were popular years ago, have largely been replaced by oil or gas furnaces or by electric heat pumps.

COAL MINE



Image courtesy of Wikimedia Commons

Coal and the Environment

As the effects of pollution became more noticeable, Americans decided it was time to balance the needs of industry and the environment.

Over a century ago, concern for the environment was not at the forefront of public attention. For years, smokestacks from electrical and industrial plants emitted pollutants into the air. Coal mining left some land areas barren and destroyed. Automobiles, coming on strong after World War II, contributed noxious gases to the air.

The Clean Air Act and the Clean Water Act require industries to reduce pollutants released into the air and the water. Laws also require companies to reclaim the land damaged by surface mining. Progress has been made toward cleaning and preserving the environment.

The coal industry's largest environmental challenge today is removing organic sulfur, a substance that is chemically bound to coal. All fossil fuels, such as coal, petroleum, and natural gas, contain sulfur. Low-sulfur coal produces fewer pollutants.

When these fuels are burned, the organic sulfur is released and combines with oxygen to form sulfur dioxide. Sulfur dioxide is an invisible gas that has been shown to have adverse effects on air quality.

The coal industry must continually work to tackle this problem. One method uses devices called **scrubbers** to remove the sulfur in coal smoke. Scrubbers are installed at coal-fired electric and industrial plants where a water and limestone mixture reacts with sulfur dioxide to form sludge. Scrubbers eliminate up to 98 percent of the sulfur dioxide. Utilities that burn coal spend millions of dollars to install these scrubbers.

The coal industry has made significant improvements in reducing sulfur emissions. Since the passing of the Clean Air Act and Clean Water Act, coal-fired plants in the United States have lowered sulfur dioxide emissions per ton by two-thirds and have increased efficiency significantly by modernizing their plants.

Coal plants also recycle millions of tons of fly ash (a coal byproduct) into useful products such as road-building materials, cement additives and, in some cases, pellets to be used in rebuilding oyster beds.

Carbon dioxide (CO_2) is released when coal is burned. CO_2 combines with other gases, such as those emitted from automobiles, to form a shield that allows the sun's light through the atmosphere but doesn't let the heat that is produced out of the atmosphere. This phenomenon is called the **greenhouse effect**. Without this greenhouse effect, the Earth would be too cold to support life. However, the use of combustible fuels like coal plays a major role in the changes in greenhouse gas levels in the Earth's atmosphere that are responsible for a change in the Earth's climate.

The scientific community agrees that the Earth is already experiencing a warming trend due to increased greenhouse gas concentrations. Long-term studies by scientists in many countries are being conducted to determine the effect of increased CO_2 and methane gas levels in the atmosphere and how these atmospheric concentrations affect the oceans, ice sheets, and ecosystems. Scientists are continually researching new technologies to help mitigate changes to the global climate.

Cleaner Coal Technology

Coal is the United States' most plentiful fossil fuel, but traditional methods of burning coal produce emissions that can reduce air and water quality. Using coal can help the United States achieve domestic energy security if we can develop methods to use coal that won't damage the environment.

The Clean Coal Technology Program is a government and industry-funded program that began in 1986 in an effort to resolve U.S. and Canadian concern over **acid rain**. Clean coal technologies remove sulfur and nitrogen oxides before, during, and after coal is burned, or convert coal to a gas or liquid fuel. Clean coal technologies are also more efficient, using less coal to produce the same amount of electricity.

Fluidized Bed Combustion: One technique that cleans coal as it burns is a fluidized bed combustion. In a combustor, crushed coal is mixed with limestone and suspended on jets of air inside a boiler. The coal mixture floats in the boiler much like a boiling liquid. The limestone acts like a sponge by capturing 90 percent of the organic sulfur that is released when the coal is burned. The bubbling motion of the coal also enhances the burning process.

Combustion temperatures can be held to 1,500 degrees Fahrenheit, about half that of a conventional boiler. Since this temperature is below the threshold at which nitrogen pollutants form, a fluidized bed combustor keeps both sulfur and nitrogen oxides in check.

Coal Gasification: Another clean coal technology bypasses the conventional coal-burning process altogether by converting coal into a gas. This method removes sulfur, nitrogen compounds, and particulates before the fuel is burned, making it as clean as natural gas.

Carbon Capture, Utilization, and Storage: Research and demonstration projects are continuing around the U.S. and the world to capture CO_2 from power plants and use it or store it deep underground in geologic formations. Researchers are investigating the best ways to capture CO_2, either before or after coal is combusted. The CO_2 will then be compressed, converting the gas to a liquid. It can then be utilized by industry or transported via pipeline to appropriate storage sites. Three different types of locations have been identified as being able to hold CO_2: 1) deep saline formations, 2) oil and gas reservoirs that are near depletion or have been depleted, and 3) unmineable coal seams. Fifteen carbon capture and storage projects are currently operating in the U.S.