Natural Gas

SMUD®
Energy Education & Technology Center

What Is Natural Gas?

Natural gas is a **fossil fuel** like petroleum and coal. Natural gas is called a fossil fuel because it was formed from the remains of ancient sea plants and animals. When the plants and tiny sea animals died hundreds of millions of years ago, they sank to the bottom of the oceans where they were buried by sediment and sand. This eventually turned into **sedimentary** rock. The layers of plant and animal matter and sedimentary rock continued to build until the pressure and heat from the Earth turned the remains into petroleum and natural gas.

Natural gas is trapped in underground rocks much like a sponge traps water in pockets. Natural gas is really a mixture of gases. The main ingredient is **methane**. Methane has no color, odor, or taste. As a safety measure, natural gas companies add an odorant, **mercaptan**, to the gas so that leaking gas can be detected (it smells like rotten eggs). People use natural gas mostly for heating. Natural gas should not be confused with gasoline, which is made from petroleum.

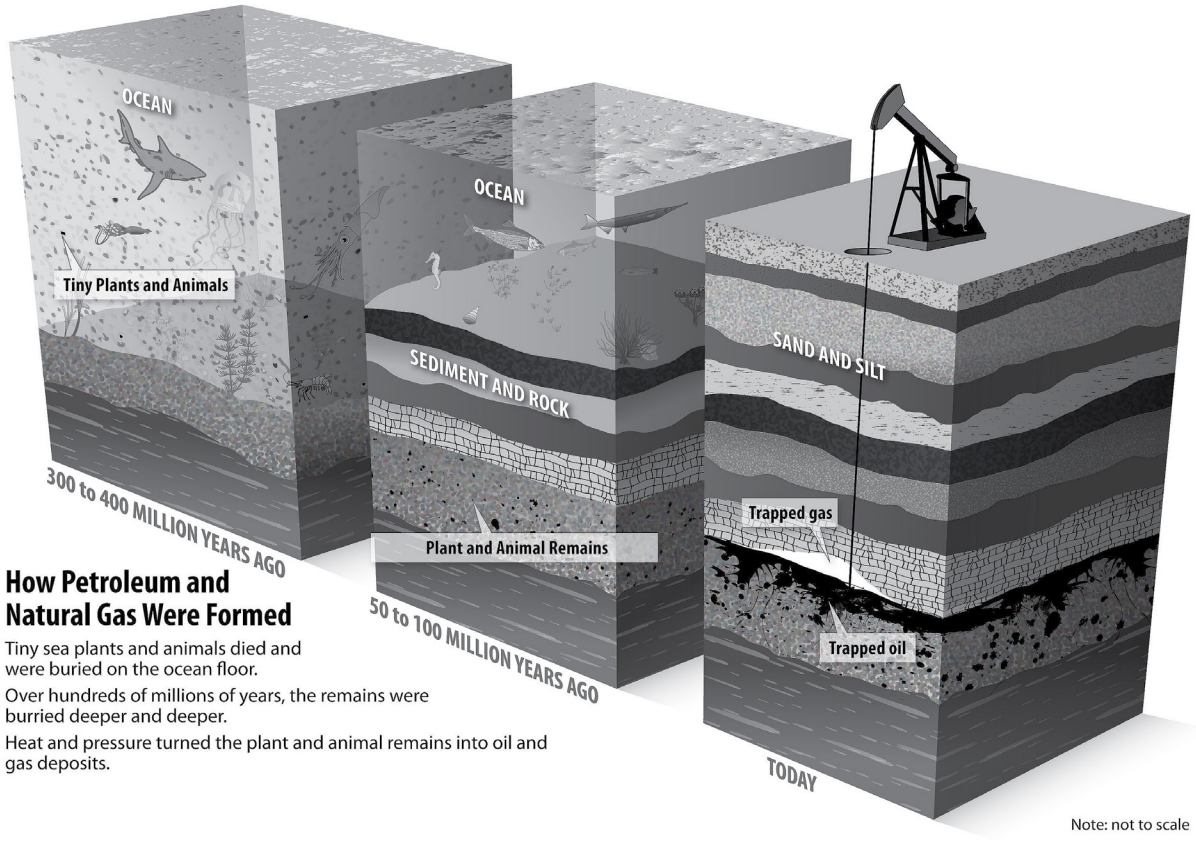
Natural gas is almost always considered **nonrenewable**, which means we cannot make more in a short time. However, there are some renewable sources of methane, such as landfills.

History of Natural Gas

The ancient people of Greece, Persia, and India discovered natural gas many centuries ago. The people were mystified by the burning springs created when natural gas seeped from cracks in the ground and was ignited by lightning. They sometimes built temples around these eternal flames and worshipped the fire.

About 2,500 years ago, the Chinese recognized that natural gas could be put to work. The Chinese piped the gas from shallow wells and burned it under large pans to evaporate sea water to make salt.

In 1816, natural gas was first used in America to fuel street lamps in Baltimore, Maryland. Soon after, in 1821, William Hart dug the United States' first successful natural gas well in Fredonia, New York. It was just 27 feet deep, quite shallow compared to today's wells. Today, natural gas is the country's second largest supplier of energy, after petroleum.



Producing Natural Gas

Natural gas can be hard to find since it is often trapped in **porous** rocks deep underground. Scientists use many methods to find natural gas deposits. They may look at surface rocks to find clues about underground formations. They may set off small explosions or drop heavy weights on the surface to record the sound waves as they bounce back from the rock layers underground.

Natural gas can be found in pockets by itself or in petroleum deposits. Natural gas wells average more than 8,600 feet (2.5 km) deep!

After natural gas comes out of the ground, it is sent to a plant where it is cleaned of impurities and separated into its various parts. Natural gas is mostly methane, but it also contains small amounts of other gases such as propane and butane.

Today natural gas is produced in 35 states, though just five states produce nearly 60 percent of our supply. Natural gas is also produced **offshore**. A little less than 5 percent of natural gas production came from offshore wells in 2017. Scientists estimate that we have enough natural gas to last 80 years at current prices and rate of consumption.

Natural gas can also come from other sources, such as the methane gas found in coal. **Coal bed methane** was once considered just a safety hazard to miners, but now it is a valuable source of energy. Another source of natural gas is the gas produced in landfills. Landfill gas, a **biogas**, is considered a renewable source of natural gas since it comes from something continually produced—trash.

Shipping Natural Gas

Natural gas is usually shipped by **pipeline**. Over 2.4 million miles of pipelines connect gas fields to cities, to homes, and to businesses. Natural gas is sometimes transported thousands of miles in these pipelines to its final destination. It can take up to a week to move natural gas from Texas to New York.

Eventually, the gas reaches the city gate of a local gas utility. Smaller pipes carry the gas the last few miles to homes and businesses. A gas meter measures the volume of gas a consumer uses.

Who Uses Natural Gas?

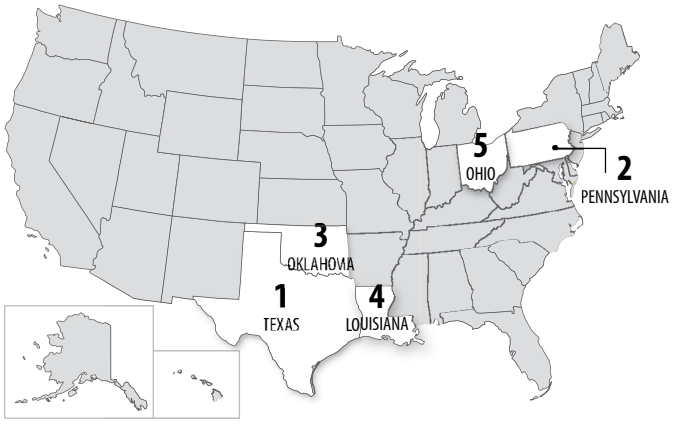
Just about everyone in the United States uses natural gas. Natural gas is used for 28.7 percent of U.S. energy. Industry burns natural gas for heat to manufacture goods. Natural gas is also used as an ingredient in fertilizer, glue, paint, laundry detergent, and many other items.

Residences, or homes, use natural gas for heating. Like residences, commercial buildings use natural gas mostly for heating. Commercial users include stores, offices, schools, churches, and hospitals.

Natural gas is also be used to generate electricity. It accounts for 32.2 percent of U.S. electricity generated. Many new power plants are using natural gas as fuel because it is cleaner burning and can produce electricity quickly when it is needed for periods of high demand.

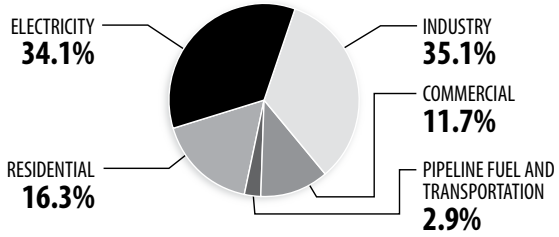
A small amount of natural gas is also used as fuel for automobiles. Natural gas is cleaner burning than gasoline, but to use it, vehicles must have special equipment.

Top Natural Gas Producing States, 2017



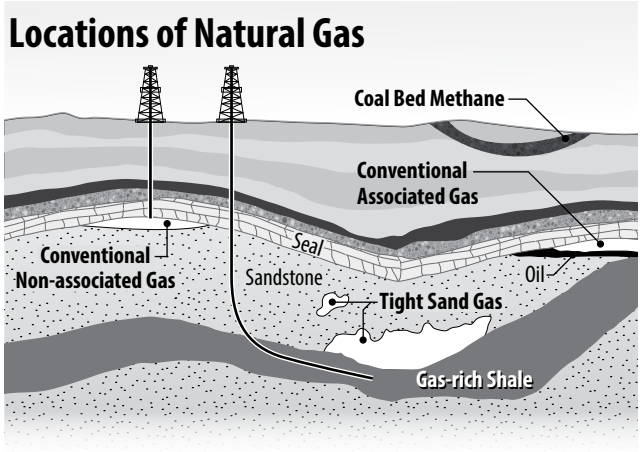
Data: Energy Information Administration

U.S. Natural Gas Consumption by Sector, 2017



Data: Energy Information Administration

Locations of Natural Gas



Natural Gas and the Environment

Burning biomass or any fossil fuel, including natural gas, releases emissions into the air, including **carbon dioxide**, a **greenhouse gas**.

Natural gas and propane are the cleanest burning fossil fuels. Compared to coal and petroleum, natural gas releases much less sulfur, carbon dioxide, and ash when it is burned. Scientists are looking for new sources of natural gas and new ways to use it.

Petroleum

What Is Petroleum?

Petroleum is a **fossil fuel**. Petroleum is often called **crude oil**, or **oil**. It is called a fossil fuel because it was formed from the remains of tiny sea plants and animals that died hundreds of millions of years ago. When the plants and animals died, they sank to the bottom of the oceans.

Here, they were buried by thousands of feet of sand and sediment, which turned into **sedimentary** rock. As the layers increased, they pressed harder and harder on the decayed remains at the bottom. The pressure and some heat changed the remains and, eventually, petroleum was formed.

Petroleum deposits are locked in **porous** rocks almost like water is trapped in a wet sponge. When crude oil comes out of the ground, it can be as thin as water or as thick as tar. Petroleum is called a **nonrenewable** energy source because it takes hundreds of millions of years to form. We cannot make new petroleum reserves.

History of Oil

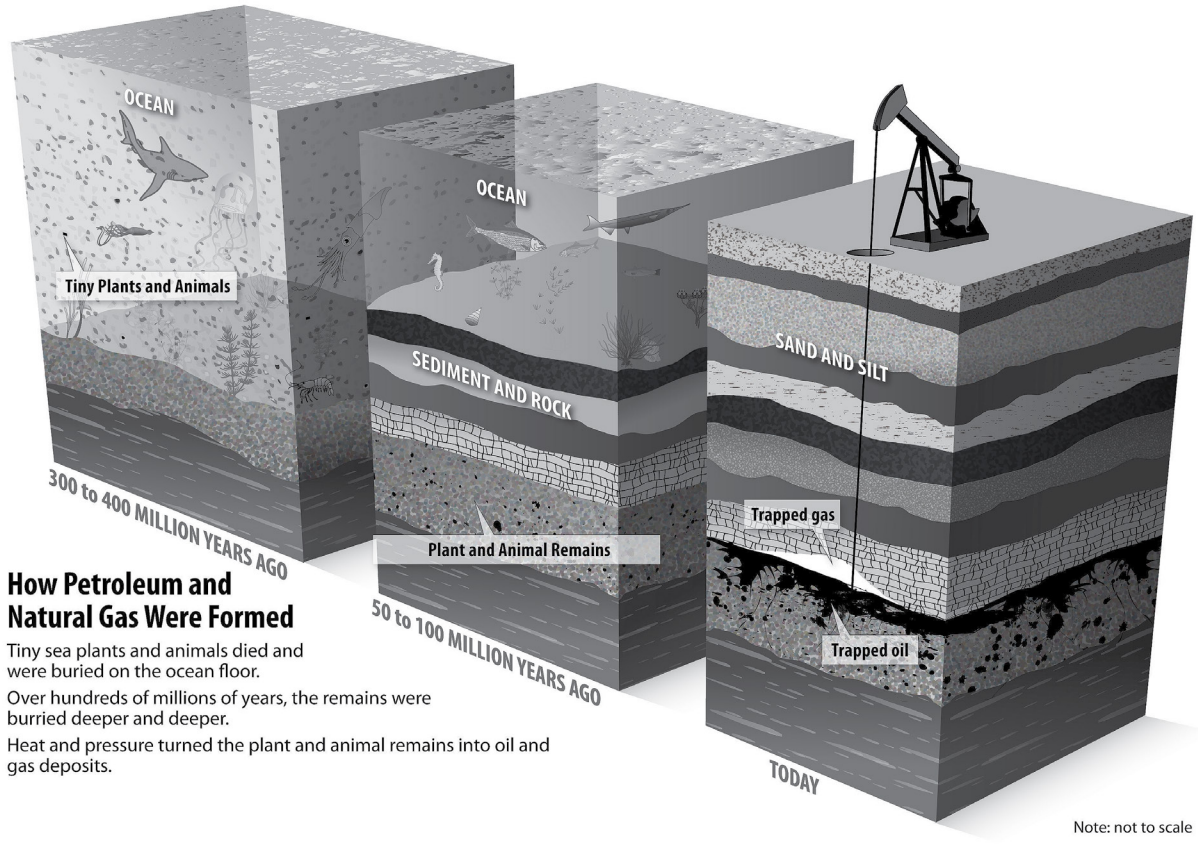
People have used petroleum since ancient times. The ancient Chinese and Egyptians burned oil to light their homes. Before the 1850s, Americans used whale oil to light their homes. When whale oil became scarce due to overfishing, people skimmed the oil that seeped to the surface of ponds and streams. The demand for oil grew and, in 1859, Edwin Drake drilled the first oil well near Titusville, Pennsylvania.

At first, the crude oil was refined or made into kerosene for lighting. Gasoline and other products made during refining were thrown away because people had no use for them. This all changed when Henry Ford began mass producing automobiles in 1913. Everyone wanted an automobile and they all ran on gasoline. Gasoline was the fuel of choice because it provided the greatest amount of energy in relation to cost and ease of use.

Today, Americans use more petroleum than any other energy source, mostly for transportation. Petroleum provides 37.0 percent of the energy we use.

Producing Oil

Geologists look at the types of rocks and the way they are arranged deep within the Earth to determine whether oil is likely to be found at a specific location. Even with new technology, oil exploration is expensive and often unsuccessful. Only about 60 percent of **exploratory wells** produce oil. When scientists think there may be oil in a certain place, a petroleum company brings in a **drilling rig** and raises an oil **derrick** that houses the tools and pipes they need to drill a well. The typical oil well is over one mile deep. If oil is found, a pump moves the oil through a pipe to the surface.



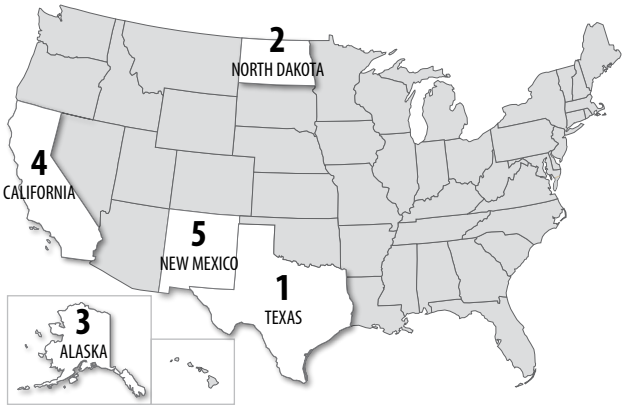
How Petroleum and Natural Gas Were Formed

Tiny sea plants and animals died and were buried on the ocean floor.

Over hundreds of millions of years, the remains were burried deeper and deeper.

Heat and pressure turned the plant and animal remains into oil and gas deposits.

Top Petroleum Producing States, 2017



Data: Energy Information Administration

A little less than one-sixth of the oil the U.S. produces comes from **offshore** wells. Some wells are a mile under the ocean. Some of the rigs used to drill these wells float on top of the water. It takes a lot of money and technology to drill and find oil in the ocean.

Texas produces more oil than any other state, followed by North Dakota, Alaska, California, and New Mexico. Americans use much more oil than we produce. Today, the U.S. imports about 40 percent of the oil it consumes from other countries.

From Well to Market

We can't use crude oil as it comes out of the ground. We must change it into fuels that we can use. The first stop for crude oil is at a petroleum **refinery**. A refinery is a factory that processes oil.

The refinery cleans and separates the crude oil into many fuels and products. The most important one is gasoline. Other petroleum products are diesel fuel, heating oil, and jet fuel. Industry uses petroleum as a **feedstock** to make plastics and many other products.

Shipping Petroleum

After the refinery, most petroleum products are shipped out through **pipelines**. There are about 190,000 miles (305,775 km) of underground pipelines in the United States transporting refined petroleum products. Pipelines are the safest and cheapest way to move big shipments of petroleum. It can take two to three weeks to move a shipment of gasoline from Houston, Texas, to New York City. Petroleum can also be moved over water in a tanker.

Special companies called **jobbers** buy petroleum products from oil companies and sell them to gasoline stations and to other big users such as industries, power companies, and farmers.

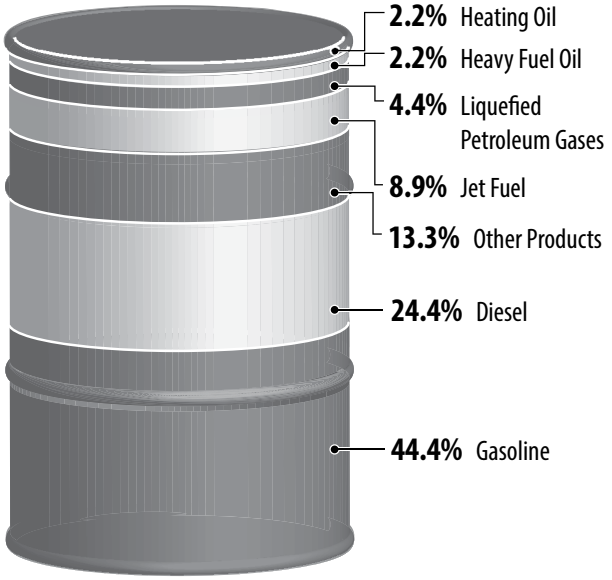
Oil and the Environment

Petroleum products—gasoline, medicines, fertilizers, and others—have helped people all over the world, but there is a trade-off. Petroleum production, exploration, and the use of petroleum products cause air and water pollution.

Drilling for and transporting oil can endanger wildlife and the environment if it spills into rivers or oceans. Leaking underground storage tanks can pollute groundwater and create noxious fumes. Processing oil at the refinery can contribute to air and water pollution. Burning gasoline to fuel our cars contributes to air pollution. Even the careless disposal of waste oil drained from the family car can pollute rivers and lakes.

The petroleum industry works hard to protect the environment. Gasoline and diesel fuel have been changed to burn cleaner. And oil companies work to make sure that they drill and transport oil as safely as possible.

Products Produced From a Barrel of Oil, 2017

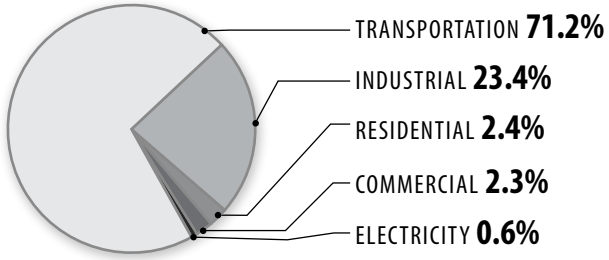


Data: Energy Information Administration

Other Petroleum Products

Ink	Enamel	Pantyhose	Fishing rods
Hand lotion	Movie film	Artificial limbs	Dice
Nail polish	Balloons	Antihistamines	Fertilizers
Heart valves	Antiseptics	Oil filters	Electrical tape
Toothbrushes	Aspirin	Ballpoint pens	Trash bags
Dashboards	Paint brushes	Skis	Insecticides
Crayons	Purses	Pajamas	Floor wax
Toothpaste	Sunglasses	Golf balls	Shampoo
Luggage	Footballs	Perfumes	Cold cream
Parachutes	Deodorant	Cassettes	Tires
Guitar strings	Glue	Contact lenses	Cameras
DVDs	Dyes	Shoe polish	Detergents

U.S. Petroleum Consumption by Sector, 2017



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

Propane

What Is Propane?

Propane is an energy-rich gas that is included in raw petroleum and natural gas. Propane is found mixed with deposits of natural gas and petroleum underground. Propane is called a **fossil fuel** because it was formed hundreds of millions of years ago from the remains of tiny sea animals and plants.

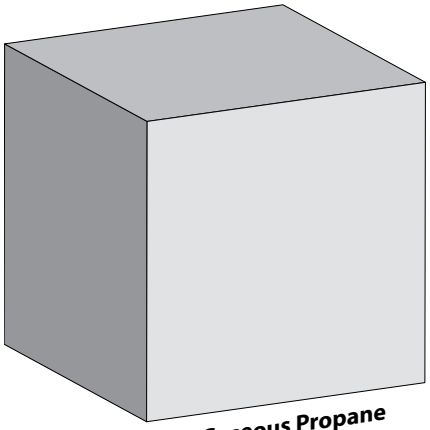
When the plants and animals died, they sank to the bottom of the oceans where they were buried by layers of sediment and sand that turned into **sedimentary** rock. Over time, the layers became thousands of feet thick. The layers were subjected to enormous heat and pressure, changing the remains into petroleum and natural gas deposits. Pockets of these fossil fuels became trapped in rocks like a sponge holds water.

Propane is one of the many fuels that are included in the **liquefied petroleum gas** (or **LPG**) family. In the United States, propane and LPG often mean the same thing, because propane is the most common type of LPG used. Just as water can be a liquid or a gas (steam), so can propane. Under normal conditions, propane is a gas. Under pressure, propane becomes a liquid.

Propane is stored as a liquid fuel in pressurized tanks because it takes up much less space in that form. Gaseous propane takes up 270 times more space than liquid propane. A thousand gallon tank holding gaseous propane would provide a family enough cooking fuel for one week. The same tank holding liquid propane would provide enough cooking fuel for over five years! Propane becomes a gas when it is released to fuel gas appliances.

Propane is very similar to natural gas. Like natural gas, propane is colorless and odorless. An odorant, called **mercaptan**, is added to propane so escaping gas can be detected. And like all fossil fuels—coal, petroleum, natural gas—propane is a **nonrenewable** energy source. That means we cannot renew our propane supplies in a short period of time.

Liquefied Propane



As a gas, propane occupies 270 times more space than when it is pressurized into a liquid.

Gaseous Propane
Volume = 270 gallons

Liquid Propane
Volume = 1 gallon

History of Propane

Propane has been around for millions of years, but it wasn't discovered until 1912. Scientists were trying to find a better way to store gasoline, which had a tendency to evaporate when it was stored.

An American scientist, Dr. Walter Snelling, discovered that propane gas could be changed into a liquid and stored at moderate pressure. Just one year later, the commercial propane industry began heating American homes with propane.

Producing Propane

Propane comes from natural gas and petroleum wells. About 70% of the propane used in the United States comes from raw natural gas. Raw natural gas is about 90 percent **methane**, five percent propane, and five percent other gases. The propane is separated from the other gases at a natural gas processing plant.

The remainder of our propane supply comes from petroleum refineries or is imported. Many gases are separated from petroleum at refineries. Since the U.S. imports 40 percent of the petroleum we use, much of the propane is separated from this imported oil. About 14% of U.S. propane supply is imported.

Transporting Propane

How does propane get to consumers? It is usually moved through **pipelines** to **distribution terminals** across the nation. These distribution terminals are like warehouses that store goods before shipping it to stores. Sometimes in the summer, when people need less propane for heating, it is stored in large underground caverns.

From the distribution terminals, propane goes by railroad, trucks, barges, and supertankers to bulk plants. A **bulk plant** is where local propane dealers come to fill their small tank trucks. People who use very little propane—backyard barbecue cooks, for example—must take their propane tanks to dealers to be filled.

How Propane Is Used

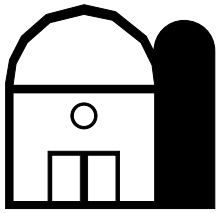
Propane provides the U.S. with a small percentage of its energy. Propane is used by industry, homes, farms, and businesses—mostly for heating. It is also used as a transportation fuel.

- **Industry**

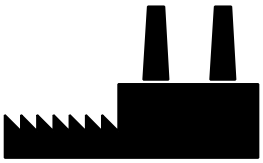
About 61 percent of the propane we use is used by industry. Many industries find propane well-suited for special needs. Metal workers use small propane tanks to fuel cutting torches. Portable propane heaters give construction and road workers warmth in cold weather.

Propane is also used to heat asphalt for highway construction and repairs. And because propane burns so cleanly, forklift trucks powered by propane can operate safely inside factories and warehouses.

How Propane Is Used

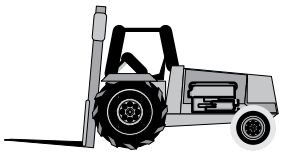


To heat barns and operate farm equipment



To make products and fuel industry

To fuel hot air balloons



To fuel machinery that is used indoors

To fuel backyard grills

To heat homes

To fuel fleet vehicles

To fuel appliances

▪ Homes

Propane is mostly used in rural areas that do not have access to natural gas service. Homes use propane for heating, hot water, cooking, and clothes drying. Many families have barbecue grills fueled by propane gas. Some families have recreational vehicles equipped with propane appliances.

▪ Farms

Many of America's farms rely on propane. Farmers use propane to dry crops, power tractors, and heat greenhouses and chicken coops.

▪ Businesses

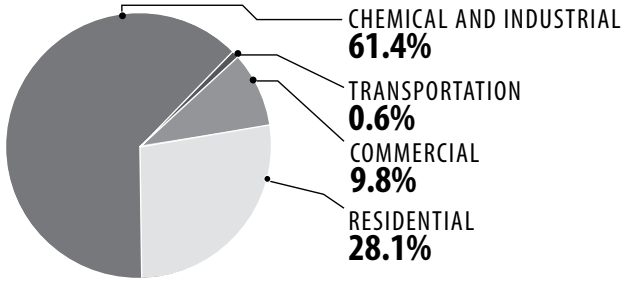
Businesses—office buildings, laundromats, fast-food restaurants, and grocery stores—use propane for heating and cooking.

▪ Transportation Fuel

Propane has been used as a transportation fuel for many years. Today, many taxicab companies, government agencies, and school districts use propane instead of gasoline to fuel their fleets of vehicles. Propane has several advantages over gasoline. First, propane is cleaner-burning and leaves engines free of deposits. Second, engines that use propane emit fewer pollutants into the air than engines that use gasoline.

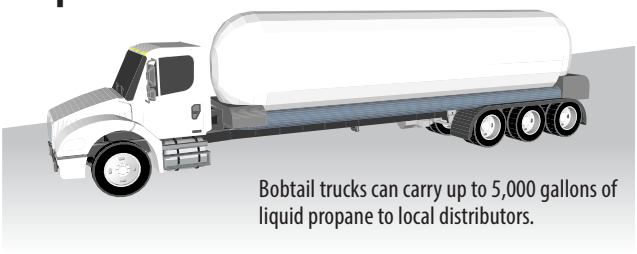
Why isn't propane used as a transportation fuel more often? For one reason, it's not as easy to find as gasoline. Have you ever seen a propane filling station? Second, automobile engines have to be adjusted to use propane fuel, and these adjustments can be costly. Third, there is a slight drop in miles traveled per gallon when propane is used to fuel vehicles.

U.S. Propane Consumption by Sector, 2017



Data: Energy Information Administration

Propane Truck



Bobtail trucks can carry up to 5,000 gallons of liquid propane to local distributors.

Propane and the Environment

Propane is a very clean burning fossil fuel, which explains its use in indoor settings. It was approved as an alternative fuel under the Clean Air Act, as well as the National Energy Policy Act of 1992.