Propane

What Is Propane?

Propane is a gas found mixed in natural gas and petroleum deposits. To obtain propane, it must be separated from natural gas and crude oil when they are processed for their final uses. 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 and were buried by layers of sediment and sand that turned into rock. Over time, the layers became thousands of feet thick.

The layers were subjected to enormous heat and pressure, changing the energy-rich remains into petroleum and natural gas deposits. Eventually, pockets of these fossil fuels became trapped in rocks, similar to the way a wet sponge holds water.

Propane is one member of the family of **hydrocarbon gas liquids** (HGL). These **hydrocarbons** are mixtures of molecules of hydrogen and carbon that can occur as gases, or can be easily pressurized to become liquids. HGLs are found in both natural gas and crude oil because both are mixtures of hydrogen and carbon. Once natural gas and petroleum are

Propane at a Glance, 2016

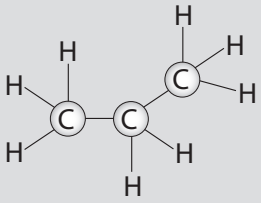
Classification:
- nonrenewable

Major Uses:
- industry, heating, transportation

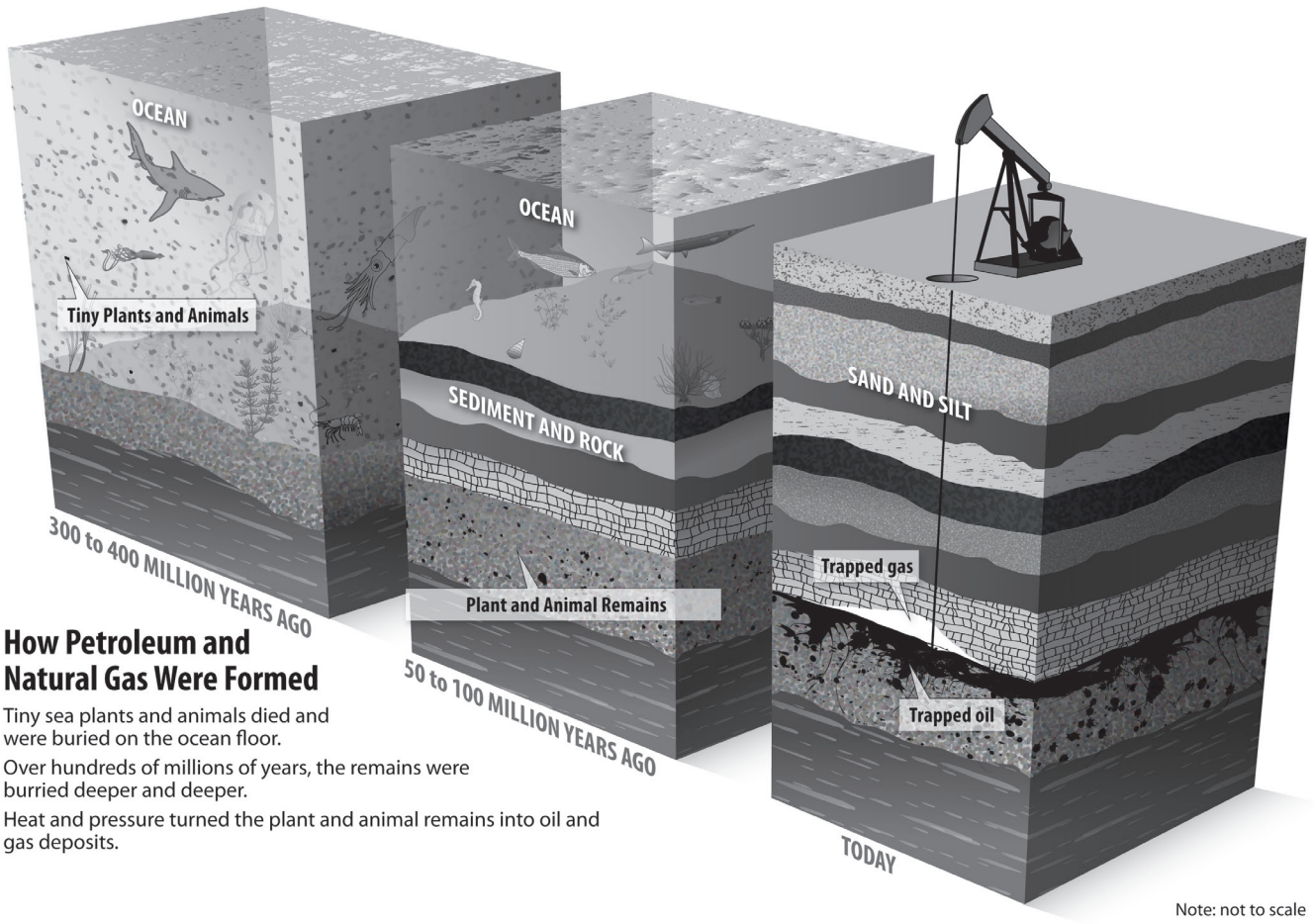
Alternative Names:
- Hydrocarbon Gas Liquid (HGL)
- Liquefied Petroleum Gas (LPG)

Consumption and Production
- produced from refined petroleum and natural gas
- more than 1 million barrels produced per day
- 39% of the gas liquids consumed

PROPANE = C_3H_8



Data: Energy Information Administration



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.

Note: not to scale

Propane

processed, the HGLs can be extracted. These materials straddle the line between gas and liquids, and this makes them very versatile for making products and use for energy consumption. Propane is a special type of HGL called **liquefied petroleum gas** (LPG), that is extracted from refining crude oil and natural gas. Propane (C_3H_8) is the most common LPG, but the fuels isobutane and butane are also classified as LPGs. Butane is often used in lighters, while isobutane is used as a fuel and as a propellant for aerosols. HGLs account for more than twelve percent of U.S. petroleum consumption because of their many uses in creating products, and as fuels for transportation, heating, cooking, and drying. Propane, or LPG, is the most used gas liquid in the U.S., making up 39 percent of our HGL consumption annually.

Just as water can change its physical state and become a liquid or a gas (steam vapor), so can propane. Under normal atmospheric pressure and temperature, propane is a gas. Under moderate pressure and/or lower temperatures, however, propane changes into a liquid. Propane is easily stored as a liquid in pressurized tanks. Think of the small tank you see attached to a gas barbecue grill, for example.

Propane takes up much less space in its liquid form. It is 270 times more compact in its liquid state than it is as a gas. A thousand gallon tank holding gaseous propane would provide a family enough cooking fuel for one week. A thousand gallon tank holding liquid propane would provide enough cooking fuel for more than five years!

When propane vapor (gas) is drawn from a tank, some of the liquid in the tank instantly vaporizes to replace the vapor that was removed. Propane is nicknamed the portable gas because it is easier to store and transport than natural gas, which requires pipelines.

Like natural gas, propane is colorless and odorless. An odorant called **mercaptan** is added to propane (as it is to natural gas) to serve as a warning agent for escaping gas. And, like all fossil fuels, propane is a **nonrenewable** energy source. We can't make more propane in a short period of time.

History of Propane

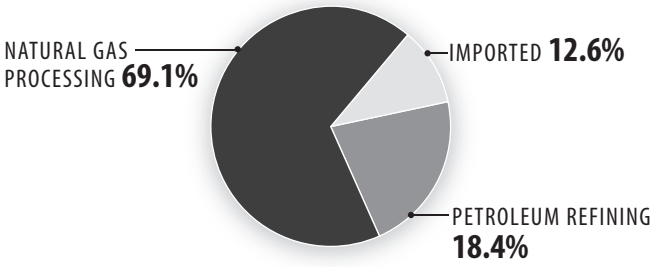
Propane does not have a long history. It wasn't discovered until 1912 when people were trying to find a way to store gasoline. The problem with gasoline was that it evaporated when stored under normal conditions.

Dr. Walter Snelling, directing a series of experiments for the U.S. Bureau of Mines, discovered that several evaporating gases could be changed into liquids and stored at moderate pressure. The most plentiful of those gases was propane. Dr. Snelling developed a way to bottle the liquid gas. One year later, the propane industry began heating American homes. By 1915, propane was being used in torches to cut through metal.

Producing Propane

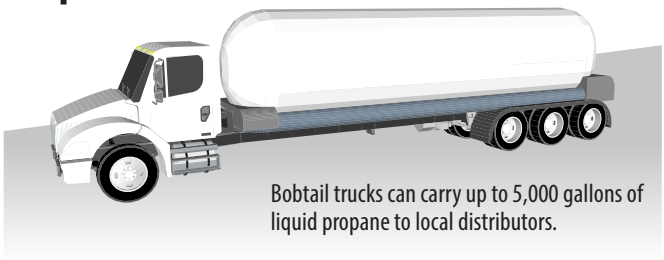
Propane comes from natural gas and petroleum wells. About 69 percent of the propane used in the United States is extracted from raw natural gas. Raw natural gas contains about 90 percent methane, five percent propane, and five percent other gases. The propane is separated from the raw natural gas and the other gases at a natural gas processing facility.

Sources of U.S. Propane, 2016



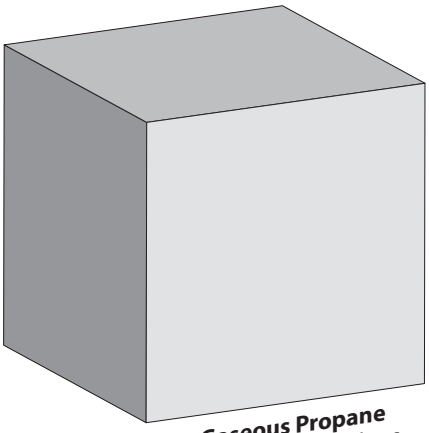
Data: Energy Information Administration

Propane Truck



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

Liquefied Propane



Gaseous Propane
Volume = 270 gallons

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

Liquid Propane
Volume = 1 gallon

About 18 percent of propane is extracted from crude petroleum. Petroleum is separated into its various products at a processing plant called a **refinery**. A little more than 12 percent of the propane we use in the U.S. is imported from other countries, mostly from Canada by rail car.

Transporting Propane

How does propane get from natural gas processing plants and oil refineries to the consumer? Usually, propane first moves through underground pipelines to distribution terminals across the nation. There are about 70,000 miles of pipeline in the United States moving propane to bulk storage and distribution terminals.

Distribution terminals, which are operated by propane companies, function like warehouses that store merchandise before shipping it to stores and shops. Sometimes, especially in the summer when less energy is needed for heating, propane is stored in large underground storage caverns.

After storage at distribution terminals, propane is transported by railroad tank cars, transport trucks, barges, and tanker ships to bulk plants. A **bulk plant** is where local propane dealers fill their small tank trucks, called bobtails.

People who use very little propane—backyard barbecuers, for example—must bring their propane cylinders to a dealer to be filled. There are over 100,000 propane dealers, such as hardware stores and gas stations, in the U.S. today.

How Propane Is Used

Propane is a clean-burning, versatile fuel. It is used by nearly everyone in the United States—in homes, on farms, by business, and in industry—mostly for producing heat and operating equipment.

▪ Homes

Homes and businesses are the second largest consumer of propane in the U.S. Propane is used mostly in homes in rural areas that do not have natural gas service, as well as in manufactured (mobile) homes. Millions of homes use propane to meet some of their energy needs. About five million households use propane as their main heating source. About one fifth of mobile homes use propane for heating.

Propane is also used in homes for air conditioning, heating water, cooking and refrigerating foods, drying clothes, lighting, and fueling fireplaces.

Homes that use propane as a main energy source usually have a large propane tank outside of the house that stores propane under pressure as a liquid. Propane dealers deliver propane to the residences in trucks, filling the tanks several times a year as needed. The average residential propane tank holds between 500 and 1,000 gallons of liquid fuel.

Millions of backyard cooks use propane-powered gas grills for cooking. Recreational vehicles (RVs) usually have propane-fueled appliances, giving them a portable source of energy for cooking, hot water, and refrigeration.

▪ Farms

Many of America's farms use propane to help meet their energy needs. Farmers use propane to dry crops such as corn, soybeans, grains, tobacco, apples, peanuts, and onions. Propane is also used to ripen fruit, heat water, and refrigerate foods.

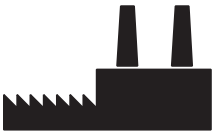
Propane flamethrowers are used to control weeds. Propane is also used to heat barns, chicken houses, stock tanks, nurseries, greenhouses, orchards, and incubators.

Propane is one fuel farmers use to operate a variety of farm equipment, including tractors, weeders, irrigation pumps, stand-by generators, and seedling planters.

RESIDENTIAL TANK

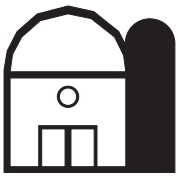
How Propane Is Used

To heat homes



To make products and fuel industry

To fuel backyard grills



To heat barns and operate farm equipment

To fuel fleet vehicles

To fuel machinery that is used indoors

To fuel hot air balloons

To fuel appliances

▪ Business

Some businesses and commercial establishments—such as hotels, schools, hospitals, restaurants, and laundromats—use propane for heating and cooling air, cooking and refrigerating food, heating water, and lighting.

Propane

▪ Industry

Industry uses almost 63 percent of the propane consumed in the U.S. Some industries find propane well suited to their special needs. Metal workers use propane tanks to fuel their cutting torches and other equipment. Industries also use propane for soldering, vulcanizing, and other processes that need a ready heat source.

Portable propane heaters provide a convenient source of heat for construction and road workers in cold weather. Propane also is used to heat asphalt for highway construction and repairs. Propane heaters at construction sites are used to dry concrete, plaster, and fuel pitch. And because propane is a very low-emission fuel, forklift trucks powered by propane can operate safely inside factories and warehouses.

Propane is also a valuable feedstock for the chemical industry. Almost half of the propane used today is as a raw material for making plastic bags, nylon, rubber, pharmaceuticals, and other products.

Propane Today

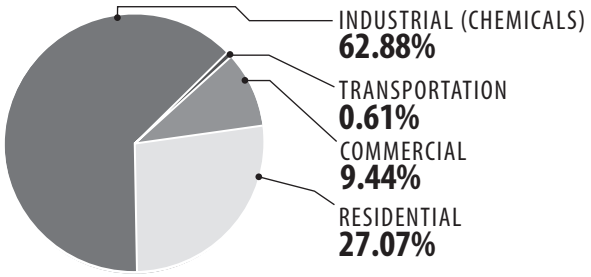
The United States ranks among the world's largest consumers of propane gas. About 90 percent of the propane used in this country is produced in the United States from petroleum and natural gas but, since we import 48 percent of the petroleum we use, about 12.6 percent of the propane we produce here is made from imported fuel.

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.

PROPANE POWERED FORKLIFT

U.S. Propane Consumption by Sector, 2016



Propane is used very little for electricity generation. If used for electric power, often it is in off-grid applications.
Data: Energy Information Administration

Propane as a Transportation Fuel

Did you know that propane has been used as a transportation fuel for more than half a century? Taxicab companies, government agencies, and school districts often use propane, instead of gasoline, to fuel their fleets of vehicles. Today, about one percent of total propane consumption is used for transportation.

There are some interesting characteristics about propane that make it an ideal engine fuel. First, propane is cleaner burning than gasoline. Propane leaves no lead, varnish, or carbon deposits that cause the premature wearing of pistons, rings, valves, and spark plugs. The engine stays clean, free of carbon and sludge. This means less maintenance and an extended engine life.

Also, propane is all fuel. It doesn't require the additives that are usually blended into gasoline. Even without additive boosters, propane's octane rating of 110 is equal to and, in most cases, higher than available gasoline.

A delivery van that runs on propane fuel.

Propane-fueled engines produce less air pollution than gasoline engines. Carbon monoxide emissions from engines using propane are 20 to 90 percent lower than emissions from gasoline-fueled engines. Total hydrocarbon emissions are 40 to 80 percent lower.

So why isn't propane used as a transportation fuel more often? For one reason, propane is not as conveniently available as gasoline. Second, an automobile engine has to be adjusted to use propane fuel, and the cost of converting an engine to use propane is often prohibitive. Third, there is a slight drop in miles traveled per gallon when propane is used to fuel vehicles.