

INTERMEDIATE ARTICLE: LNG—Liquefied Natural Gas

Liquefied natural gas (LNG) is the liquid form of the natural gas people use in their homes for heating and cooking. LNG is natural gas cooled and condensed into a liquid. LNG is mostly methane with small amounts of ethane, propane and other gases. A large refrigeration system is used to liquefy natural gas by cooling it to minus 260 degrees Fahrenheit (-260°F). Converting natural gas to a liquid reduces its volume by a factor of 600 to one. Liquefying natural gas makes it economical to transport natural gas by tanker and easier to store it.

LNG is transported in large, specially designed ships. These ships are double-hulled and are fitted with a special system inside the inner hull to maintain the LNG at atmospheric pressure and minus 260 degrees Fahrenheit. There are about 150 ships currently in the LNG fleet and more than 55 additional ones are being built.



LNG Storage Tank at Cove Point, MD

At LNG storage and distribution facilities, LNG is stored in insulated tanks, where it can be turned back into a gas and sent to customers by pipeline. The tanks consist of a stainless steel inner tank surrounded by about four feet of insulation, which is contained by an outer steel tank.

LNG is non-toxic, odorless, non-explosive, non-cancer causing and, in liquid form, non-flammable. LNG only burns when gasified and mixed with air at a rate of five to 15 percent gas to air. Since LNG as a liquid contains no oxygen, it cannot burn and, if it does catch fire, there is no chance of explosion. LNG, if spilled, vaporizes and dissipates. If spilled on water, LNG stays on top where it vaporizes, because its density is only 45 percent that of water.

Safety is a high priority with companies that move and distribute LNG. Ship safety features include radar, positioning systems, automatic distress systems, automatic shut down systems and gas and fire detection equipment. On-shore, facilities such as docks, storage tanks, vaporizers, and other equipment to turn LNG from a liquid to a gas have their own safety features. Closed circuit television, methane detectors, and fire detectors are used along with preventative measures such as restricted access, personnel training, offsite monitoring and emergency procedures to ensure safety.

In the event of a leak or spill, gas, flame, smoke, and high or low temperatures are all monitored. While LNG vapors have no odor or color, if an LNG release occurs, LNG's low temperature would cause water vapor to condense in the air and form a visible white cloud that would be readily apparent.

In the 19th century, British chemist and physicist Michael Faraday was the first to liquefy natural gas. The first liquefied natural gas plant was built in West Virginia in 1912. Today there are about 115 LNG facilities in the United States. In January 1959, the world's first LNG tanker, the *Methane Pioneer*, carried LNG from Lake Charles, Louisiana to Canvey Island, United Kingdom. This voyage demonstrated that large quantities of LNG could be transported safely across the ocean.

LNG supplies come primarily from locations where large gas discoveries have been made, such as Algeria, Trinidad, Venezuela, Nigeria, Norway, Qatar, Oman and Australia. Some LNG is produced in Alaska, as well. Many of these locations are in remote areas that do not have high demand for natural gas, so transporting it to other markets as LNG makes good sense economically.

One special use of LNG is as fuel for vehicles. Currently, there are about 2,000 vehicles in the U.S. that run on LNG and are mostly owned by the government. There are just 44 LNG-fueling stations at this time. The advantage of using LNG in vehicles is a smaller fuel tank than is needed for the more common compressed natural gas (CNG) vehicles, because natural gas takes up less space as a liquid than a gas. Because LNG must be stored at very low temperatures, these vehicles must use fuel to keep the tank cold and specially trained persons must refuel the vehicle, since skin contact with LNG can cause frostbite.

For more information on LNG, see www.eia.doe.gov, www.afdc.doe.gov, www.netl.doe.gov and www.dom.com.