

Liquefied Natural Gas in Transportation



What is LNG?

Liquefied natural gas, or LNG, is natural gas in a liquid form that is clear, colorless, odorless, non-corrosive, and non-toxic.

LNG is produced when natural gas is cooled to minus 259 degrees Fahrenheit, through a process known as liquefaction. During this process, the natural gas, which is primarily methane, is cooled below its boiling point, whereby certain concentrations of hydrocarbons, water, carbon dioxide, oxygen, and some sulfur compounds are either reduced or removed. LNG is also less than half the weight of water, so it will float if spilled on water.

Where does LNG come from?

A majority of the world's supply comes from countries with the largest natural gas reserves: Algeria, Australia, Brunei, Indonesia, Libya, Malaysia, Nigeria, Oman, Qatar, Trinidad, and Tabago.

How is LNG transported?

LNG is transported in double-hulled ships specifically designed to handle the low temperature of LNG. These carriers are insulated to limit the amount of LNG that evaporates.



LNG Vessel Courtesy of CH-IV International

LNG carriers are up to 1000 feet long, and require a minimum water depth of 40 feet when fully loaded.

Currently there are approximately 140 LNG ships world-wide.

Where are LNG import terminals in the United States?

LNG terminals in the United States are located in Everett, Massachusetts; Cove Point, Maryland;

Elba Island, Georgia; Lake Charles, Louisiana; and Puenelas, Puerto Rico. There are also plans to construct LNG terminals along the west coast of the United States.

How is LNG stored?

When LNG is received at most terminals, it is transferred to insulated storage tanks specifically built to hold LNG. These tanks can be found above or below ground and keep the liquid at low temperature to avoid evaporation.



LNG Vertical Storage Tank

Is it flammable?

When cold LNG comes in contact with warmer air, it creates a visible vapor cloud from condensed moisture in the air. As it continues to get warmer, the vapor cloud becomes lighter than air and rises. When the vapor mixes with air, it is only flammable when the mixture is between 5-15 percent natural gas. When the mixture is less than 5 percent natural gas it doesn't burn. When the mixture is more than 15 percent natural gas in air, there is not enough oxygen for it to burn.

Is it explosive?

As a liquid, LNG is not explosive. LNG vapor will only explode in an enclosed space within the flammable range of 5-15 percent.

Benefits of LNG in transportation applications:

LNG is produced both world-wide and domestically at a relatively low cost, and is cleaner burning than diesel fuel. Since LNG has a higher storage density, it is a more viable alternative to diesel fuel

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than compressed natural gas for heavy-duty vehicle applications.

In addition, LNG in heavy-duty natural gas engines achieves significantly lower NO_x and particulate emission levels than diesel.

Where is LNG fuel available in California?

California's LNG fuel infrastructure is expanding rapidly. By the end of 2005, there will be more than 40 locations strategically located near major highways and thoroughfares throughout the state.



To further enhance the supply and distribution, there are plans to construct one or more fueling terminals in Southern California and/or Mexico.

Fuel station cost:

An average LNG fueling station costs about \$1 million. These locations store and dispense fuel to vehicles.

Energy Commission funded projects:

California Energy Commission programs have

provided more than \$3.5 million in grant cost-share funding for 15 infrastructure projects. The total cost of these projects is more than \$20 million.

What vehicle/niche markets use LNG?

Because of LNG's increased driving range, it is used in heavy-duty vehicles, typically vehicles that are classified as class 8 (33,000 – 80,000 lbs. gross vehicle weight).

Typical transportation applications are refuse haulers, local delivery (grocery trucks), and transit buses.



Courtesy of Sysco Food Services of Los Angeles

For more detailed information regarding LNG, visit the following websites:

www.energy.ca.gov/LNG

www.gladstein.org

www.eere.energy.gov/afdc/altfuel/natural_gas.html



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