



In its quest to be an environmental leader, Waste Management, Inc., began using LNG in 1998 to fuel six of its waste haulers in Pittsburgh, Pennsylvania. Since that time, driver response has been very positive, in part because LNG generates less noise than diesel-powered engines.

In California, the company is currently purchasing new vehicles and converting existing vehicle engines to run on LNG. Soon, more than 100 of the company's heavy-duty trucks will use both compressed and liquefied natural gas.

In addition to helping the environment, the company's use of LNG is benefiting its bottom line. By using cleaner fuels such as LNG, the company has a competitive advantage when bidding on waste hauling contracts in cities trying to control air emissions.

For more information on Waste Management's use of LNG, contact Paul Gannon at (813) 909-0163.

# Clean Alternative Fuels: Liquefied Natural Gas

One in a series of fact sheets



For decades, natural gas has provided clean power to thousands of households and businesses nationwide. Today, more than 1,000 vehicles traveling U.S. roads are powered by natural gas that is cooled to a liquid—liquefied natural gas (LNG). LNG results when natural gas is cooled to temperatures of 260 degrees below zero, thus producing a viable vehicle fuel used mainly in heavy-duty trucks and buses.

LNG is odorless, colorless, noncorrosive, and nontoxic. When extracted from underground reserves, natural gas is composed of approximately 90 percent methane. During the liquefaction process, oxygen, carbon dioxide, sulfur compounds, and water are removed, purifying the fuel and increasing its methane content to almost 100 percent. As a result, LNG-fueled vehicles can offer significant emissions benefits compared with older diesel-powered vehicles, and can significantly reduce carbon monoxide and particulate emissions as well as nitrogen oxide emissions.

## AVAILABILITY

To date, LNG vehicles have primarily been used by fleet managers. Therefore, most LNG refueling stations are located at heavy-duty vehicle fleet operations not open to the public. This is due in part to the various safety issues discussed later. In conjunction with plans to expand LNG use in long-haul trucking in the West, efforts are under way to improve access to LNG fueling stations in that region. For example, California expects to fund the

development of public-access facilities. Such a program is aimed at helping heavy-duty trucks switch to natural gas.

LNG's complex onboard storage system does not make it a viable fuel for light-

## EMISSIONS CHARACTERISTICS\*

Actual emissions will vary with engine design; these numbers reflect the potential reductions offered by LNG relative to diesel.

- Production of half particulate matter of average diesel vehicles.
- Can significantly reduce carbon monoxide emissions.
- Reductions of nitrogen oxide and volatile organic hydrocarbon emissions by 50 percent or more.
- Potential reductions in carbon dioxide emissions of 25 percent depending on the source of the natural gas.
- Drastic reductions in toxic and carcinogenic pollutants.
- Increase in methane emissions.

\* Estimates based on LNG's inherently "cleaner" chemical properties with an engine that takes full advantage of these fuel properties.

duty vehicles. It is, however, replacing diesel in many heavy-duty trucks and buses and many new gas-fueled locomotives. For example, some trash trucks in San Diego and some long-haul trucks in Los Angeles and Sacramento use LNG fuel. In addition, the number of LNG-fueled transit buses is expanding rapidly as many cities try to reduce air pollution levels. Bus fleets in Orange County, California, and Phoenix, Arizona, are fueled entirely by LNG.

## AFFORDABILITY

Depending on the quantity of vehicles purchased and the equipment used, LNG heavy-duty trucks or buses can cost an additional \$30,000 to \$50,000. Industry experts expect these costs to drop as market development and vehicle production rises. Fuel dispensing and fuel storage required for LNG typically costs \$15,000 to \$22,000 per vehicle. In addition, LNG's price is highly dependent on geographic location, purity of feedstock, transportation costs, and quantity of fuel purchased, but LNG's cost per mile is generally less than or equal to the price of diesel.

## PERFORMANCE

There are no discernible differences in LNG vehicle performance, operation, and utility when compared with diesel. The high ignition quality of LNG is similar to that of diesel, providing for similar durability and engine life overall.

## SAFETY

A LNG vehicle parked indoors and unmoved for a week or more will vent a flammable gas mixture that could catch fire in the vicinity of an ignition source. To address this safety issue, LNG use should be restricted to frequently driven fleet vehicles or to vehicles stored outdoors. Only trained personnel should service the vehicles.

In addition, refueling vehicles with LNG requires training because of the fuel's ultra low temperature. It can cause frostbite if it contacts skin. Since LNG is almost 100 percent methane—a greenhouse gas—it can also contribute to global climate change if accidentally released into the air. Methane is slightly soluble in water and, under certain environmental conditions (anaerobic), it does not bio-degrade. If excess amounts accumulate, the gas can bubble from the water, possibly creating a risk of fire or explosion.

## MAINTENANCE

LNG's cleaner burning characteristics can result in longer engine life and reduced maintenance costs. Using LNG eliminates the need for periodic tank inspections. In addition, some maintenance savings are anticipated for vehicles using LNG when compared with gasoline-powered vehicles because of the reduced frequency of oil changes. Because of the fuel's below freezing temperatures, only trained personnel should maintain LNG vehicles.

## For More Information

**EPA Alternative Fuels Web Site**  
[www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm](http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm)

**Natural Gas Vehicle Coalition**  
1100 Wilson Boulevard  
Suite 850  
Arlington, VA 22209  
Phone: 703 527-3022  
Fax: 703 527-3025  
Web site: [www.ngvc.org](http://www.ngvc.org)

**Alternative Fuel Refueling Station Locator**  
Web site: [afdcmap.nrel.gov/nrel](http://afdcmap.nrel.gov/nrel)

**Alternative Fuels Data Center**  
Web site: [www.afdc.nrel.gov](http://www.afdc.nrel.gov)

**National Alternative Fuels Hotline**  
Phone: 800 423-1DOE