

## Natural Gas Basics

Natural gas powers more than 100,000 vehicles in the United States and roughly 11.2 million vehicles worldwide.<sup>1</sup> Natural gas vehicles (NGVs) are a good choice for high-mileage fleets—such as buses and taxis—that are centrally fueled or operate within a limited area. The advantages of natural gas as an alternative fuel include its domestic availability, widespread distribution infrastructure, low cost compared with gasoline and diesel, and clean-burning qualities.

### What is natural gas?

Natural gas is an odorless, nontoxic, gaseous mixture of hydrocarbons—predominantly methane (CH<sub>4</sub>). Because it is a gas, it must be stored onboard a vehicle in either a compressed gaseous or liquefied state. Compressed natural gas (CNG) is typically stored in a tank at a pressure of 3,000 to 3,600 pounds per square inch. Liquefied natural gas (LNG) is super-cooled and stored in its liquid phase at -260°F in special insulated tanks. Natural gas is sold in units of gasoline or diesel gallon equivalents based on the energy content of a gallon of gasoline or diesel fuel.

### How and where is natural gas produced and distributed?

Natural gas is drawn from wells or extracted in conjunction with crude oil production. Biomethane, a renewable form of natural gas, is produced from decaying organic materials, such as waste from landfills, wastewater, and livestock. In recent years, 80% to 90% of the natural gas used in the United States was produced domestically. The United States has a vast natural gas distribution system, which can quickly and economically distribute natural gas to and from almost any location in the lower 48 states.

### How is natural gas used?

Natural gas accounts for about a quarter of the energy used in the United States. About one-third goes to residential and commercial uses, such as heating and

cooking; one-third to industrial uses; and one-third to electric power production. Only about one-tenth of 1% is used for transportation fuel.

### Is natural gas safe for use in vehicles?

Yes. NGVs meet the same safety standards as gasoline and diesel vehicles and also meet the National Fire Protection Association's (NFPA) NFPA 52 Vehicular Fuel System Code. Natural gas has a narrow flammability range and, because it is lighter than air, dissipates quickly if released. NGV fuel tanks are strong and extremely puncture resistant.

### What NGVs are available?

A wide variety of new, heavy-duty NGVs are available. The Honda Civic GX is the only light-duty NGV available from a U.S. original equipment manufacturer (OEM). Consumers and fleets also have the option of economically and reliably converting existing light- or heavy-duty gasoline or diesel vehicles for natural gas operation using certified installers. See the Conversions page in the Vehicles section of the Alternative Fuels and Advanced Vehicles Data Center (AFDC) Web site at [www.afdc.energy.gov](http://www.afdc.energy.gov). For



Compressed natural gas is stored onboard a vehicle in safe, puncture-resistant tanks. Photo from Clean Energy, NREL/PIX 16724

the latest new vehicle offerings, also see the AFDC's light-duty and heavy-duty vehicle searches.

### How do NGVs work?

NGVs operate in one of three modes: dedicated, bifuel, or dual-fuel. Dedicated NGVs run on only natural gas. Bifuel NGVs can run on either natural gas or gasoline. Dual-fuel vehicles run on natural gas and use diesel for ignition assist. Light-duty vehicles typically operate in dedicated or bifuel modes, and heavy-duty vehicles operate in dedicated or dual-fuel modes.

A CNG fuel system transfers high-pressure natural gas from the storage tank to the engine while reducing the pressure of the gas to the operating pressure of the engine's fuel-management system. The natural gas is injected into the engine intake air the same way gasoline is injected into a gasoline-fueled engine. The engine functions the same way as a gasoline engine: The fuel-air mixture is compressed and ignited by a spark plug and the expanding gases produce rotational forces that propel the vehicle.

On the vehicle, natural gas is stored in tanks as CNG, or in some heavy-duty

<sup>1</sup> NGV Communications Group ([www.ngvgroup.com](http://www.ngvgroup.com))

vehicles, as LNG, a more expensive option. The form chosen is often dependent on the range a driver needs. More natural gas can be stored in the tanks as LNG than as CNG.

### How do NGVs perform?

Natural gas vehicles are similar to gasoline or diesel vehicles with regard to power, acceleration, and cruising speed. The driving range of NGVs is generally less than that of comparable gasoline and diesel vehicles because, with natural gas, less overall energy content can be stored in the same size tank as the more energy-dense gasoline or diesel fuels. Extra natural gas storage tanks or the use of LNG can help increase range for larger vehicles.

In heavy-duty vehicles, dual-fuel, compression-ignited engines are slightly more fuel-efficient than spark-ignited dedicated natural gas engines. However, a dual-fuel engine increases the complexity of the fuel-storage system by requiring storage of both types of fuel.

### How much do NGVs cost?

Light-duty NGVs cost \$5,000 to \$7,000 more than comparable gasoline vehicles, and heavy-duty NGVs cost more than their counterparts by \$30,000 or more. The price depends on the fuel-tank capacity and whether the vehicle is produced by an OEM or converted to run on natural gas. However, government incentives are available to offset NGV costs. For more information, visit the AFDC's Incentives and Laws section at [www.afdc.energy.gov](http://www.afdc.energy.gov). Due in part to the high octane rating and clean-burning properties of natural gas, some fleets have reduced maintenance and operating costs for NGVs compared with conventional vehicles.

### How much does natural gas cost?

Historically, the average retail price of natural gas has been lower—and more

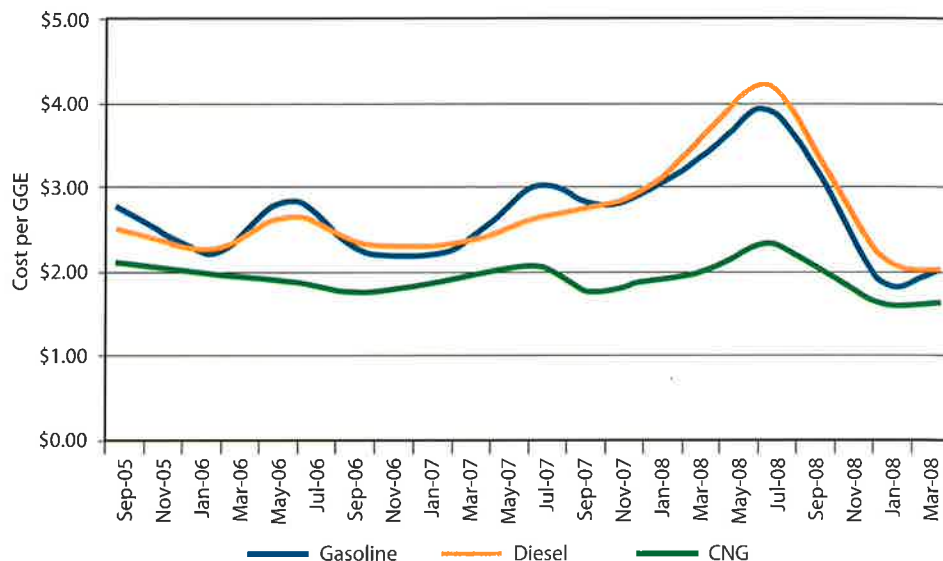


Figure 1. Nationwide Average Retail Gasoline, Diesel, and Natural Gas Prices

stable—than the price of gasoline and diesel (see Figure 1), which makes natural gas a good option for fleets that use a lot of fuel. Incentives are also available to reduce the cost of operating NGVs.

### Where is natural gas available?

According to the AFDC, there were 827 CNG and 38 LNG stations in the United States as of February 2010. To find natural gas station locations, visit the Alternative Fueling Station Locator at [www.afdc.energy.gov/stations](http://www.afdc.energy.gov/stations).

### Is it easy to fuel an NGV?

Yes. CNG vehicles are fueled with easy-to-use, pressure-sealed dispensers. CNG fueling stations can be configured to fuel vehicles at various rates. Time-fill stations fuel parked vehicles overnight, taking advantage of off-peak electricity rates and smaller compression equipment. Fast-fill stations fill vehicles rapidly using larger compression equipment and high-pressure gas-storage systems. Fueling LNG vehicles requires special procedures and training, but the process is not difficult. As with all vehicles,

proper safety precautions must be taken when refueling NGVs.

### How do NGV emissions compare with gasoline and diesel vehicle emissions?

Compared with gasoline and diesel vehicles, NGVs can produce significantly lower carbon monoxide, nitrogen oxide, nonmethane hydrocarbon, particulate matter, and other toxic emissions, as well as greenhouse gas emissions. In addition, because CNG fuel systems are completely sealed, CNG vehicles produce no evaporative emissions. For details, see the Natural Gas Vehicle Emissions page in the Vehicles section of the AFDC at [www.afdc.energy.gov](http://www.afdc.energy.gov).

### Where can I learn more about natural gas?

To learn more about natural gas as a transportation fuel, visit the AFDC's natural gas pages at [www.afdc.energy.gov](http://www.afdc.energy.gov). The NGV America Web site at [www.ngvc.org](http://www.ngvc.org) also features a wealth of information about natural gas and NGVs.