



## **CNG 101: Basic Questions about Natural Gas as a Transportation Fuel**

### **What is natural gas?**

Natural gas primarily consists of methane (around 90 percent), with small amounts of ethane, propane and other gases. Methane is a simple gas molecule made up of one atom of carbon and four of hydrogen (CH<sub>4</sub>). It is lighter than air and burns almost completely, with by-products of combustion being carbon dioxide and water.

### **Why use natural gas as a fuel?**

- Engine urban and greenhouse gas emissions are inherently lower than from gasoline or diesel engines.
- Natural gas decreases our reliance on foreign fuel sources (more than 98 percent of the natural gas used in the U.S. comes from North America)
- Natural gas costs less per energy unit than gasoline or diesel.

### **How do you use natural gas as a transportation fuel?**

Compressed natural gas or CNG is the most common form of natural gas used in vehicles, but engines for heavy-duty vehicles are designed to use liquefied natural gas or LNG. Natural gas is stored on the vehicles by being compressed to 3,600 psi or liquefied at -260 degrees Fahrenheit.

### **Who provides the natural gas?**

In the case of CNG, the local utility provides the natural gas, which is piped to the location where the gas will be compressed before being dispensed into the vehicles. In the case of LNG, the fuel typically is trucked from the plant that produces LNG and is delivered to the location in a specially designed tank truck and put into cryogenic storage on-site.

### **Do NGVs operate differently than diesel or gasoline?**

NGVs operate on the same basic principles as gasoline-powered vehicles. When the engine in an NGV is started, natural gas flows from the storage cylinders into a fuel line. Near the engine, the natural gas enters a regulator to reduce the pressure. Then the gas feeds through a gaseous fuel-injection system, which introduces the fuel into the cylinders. Sensors and computers adjust the fuel-air mixture so that when a spark plug ignites the gas, it burns efficiently and very cleanly. For LNG, the liquid is heated, converting it back to a gas. From that point on, the process is similar to CNG engines.

Since natural gas is a gas rather than a liquid at standard pressure and temperature, some modifications are required to make an NGV work efficiently. These changes are primarily in the fuel storage tank, fueling receptacle/nozzle and the engine. The specially designed tanks that contain the CNG or LNG onboard the vehicle weigh more and take up more space than gasoline or diesel containers.

### **What kinds of vehicles use natural gas?**

Natural gas vehicles are available in all classes of vehicle. These vehicles are available either from an original equipment manufacturer or from a small volume manufacturer that converts the vehicle to run on natural gas. The vehicles converted by these small volume manufacturers meet all government safety and emissions requirements. The vehicles range from

the light-duty Honda Civic GX to heavy duty buses, refuse trucks and 18-wheelers. More than 50 different light-duty sedans, vans and pick-ups are available.

Factory-built natural gas options are available from all the major refuse truck chassis manufacturers and body-upfitters, most of the transit and shuttle bus builders, two of the top three school bus builders, all major street sweeper manufacturers, and leading truck builders Freightliner, Peterbilt and Kenworth.

### **Are these dedicated or bi-fuel vehicles?**

Both, depending on the specific vehicle. The dedicated vehicles run only on natural gas, but some manufacturers provide vehicles that are bi-fuel, meaning they can run on either gasoline or natural gas. Bi-fuel vehicles require additional storage to accommodate both fuels.

### **How do you fuel a natural gas vehicle?**

It is similar to the way you fuel any car or truck. The dispenser looks about the same, but the nozzle is different. Drivers can be easily educated on how to fill a CNG vehicle. Because natural gas is under pressure, the storage systems must be designed so that no fuel escapes when the vehicle is being fueled. Natural gas nozzles lock onto the receptacles, and form a leak-free seal, similar to the coupling on an air compressor nozzle. The receptacles are designed so that when the nozzle is removed, the gas is prevented from escaping.

### **How is the fuel stored in the vehicle?**

Most NGVs operate on compressed natural gas so the fuel takes up less space. CNG is stored on board vehicles under high-pressure (3,600 pounds per square inch) in tube-shaped cylinders that are attached to the rear, top or undercarriage of the vehicle. The cylinders meet very rigorous safety standards. They are made of high-strength materials designed to withstand impact, puncture and, in the case of fire, their pressure relief devices (PRDs) provide a controlled venting of the gas rather than letting the pressure build up in the tank.

Natural gas may also be stored on-board in the form of liquefied natural gas or LNG. To become LNG, natural gas must be cooled to -260 degrees Fahrenheit. The biggest advantage of LNG over CNG is space requirements. LNG requires only 30 percent of the space of CNG to store the same amount of energy. In order to keep the LNG cold, LNG is stored on-board vehicles in thermal storage tanks.

### **How long does it take to fuel a natural gas vehicle?**

There are basically two types of fueling equipment for CNG vehicles – fast-fill and time-fill. In fast-fill, the combination of a large compressor coupled with a high-pressure storage tank system, called a cascade, fills the tank in about the same amount of time it takes to fuel a comparable petroleum vehicle.

A time-fill system does not have a storage system and has a much smaller – and less expensive – compressor. It typically refuels CNG vehicles overnight at a rate of about one gallon per hour. Time-fill works for vehicles that remain idle overnight, such as refuse trucks and school buses

There are also home refueling options for individuals who own a CNG powered vehicle and are looking for the convenience of being able to fuel at home. The units connect to a residential gas line and are typically hung on a garage wall. They can fuel a single vehicle at the rate of slightly less than a half a gallon per hour.

### **Are natural gas vehicles safe?**

Absolutely. Compressed natural gas is stored on board vehicles in tanks that meet the most stringent safety standards in the world. Some of the tests that these tanks must pass are the drop test, the bonfire test and the gunshot test.

