



A Guide to CNG Technology

2019 Emerging Leaders Academy Project

Table of Contents

What is CNG?	2
Why CNG?	3
How to begin using CNG?	5
Additional Considerations.....	7
Bibliography	8

What is CNG?

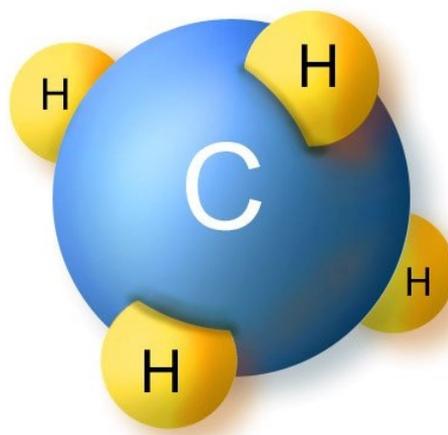
“Compressed Natural Gas” is a type of alternative fuel system that consists of storing natural gas in high-pressure tanks, usually around 3000 to 3600 psi.

Natural gas is a naturally occurring type of fuel source, consisting primarily of methane. It is often found near other fossil fuels such as coal beds and oil deposits. The process called “methanogenic organisms” is also responsible for the creating of natural gas in environments such as bogs, land-fills and marshes.

Natural gas in its purest form is often call a “First Gas”. It is completely colorless, shapeless, and odorless.

Unlike many other fossil fuels, natural gas burns extremely clean and emits very low levels of harmful waste and byproducts into the environment.

Methane, or CH_4 , only has one carbon atom with four hydrogen atoms. Gasoline ($\text{C}_8\text{H}_{18} + 28 \text{O}_2$) has 8 carbon atoms and diesel ($\text{C}_{12}\text{H}_{23}$) has 12.



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)

This means, by nature, CNG has less carbon and thus a lower “carbon footprint.”

The process of refining natural gas creates some very valuable byproducts such as butane, ethane, pentane, propane, and some of the higher molecular weight hydrocarbons, elemental sulfur, along with helium and nitrogen (Dept).

Why CNG?

The popularity of CNG is not without reason.

Environmentally friendly “Compressed Natural Gas” is the cleanest burning fuel used for transportation today. Engines powered by CNG produce only 10 % of the carbon monoxide and particle discharge of engines powered by gasoline. Carbon dioxide discharge is cut by 20%. And nitrogen oxides are cut by half (AVSG). As where gasoline and diesel combustion produce high quantities of carbon and nitrogen oxides, and sulfur. The combustion of natural gas produces mainly carbon dioxide and water vapor, these are the same components the human body produces when we exhale. While these factors are great for the environment, but they are also good for your engine. Combusting natural gas leaves little or no residue and produces less particulate matter as compared to gasoline or diesel. This means a CNG engine does not contaminate engine oil as fast as gasoline or diesel thus resulting in greater time between maintenance. Because of the cleaner burning fuel components such as plugs, and exhaust systems also last longer.

The environment is not the only benefactor in CNG technology, noise pollution is also lessened. An average CNG engine can operate at 10 decibels less than their diesel counterpart.

The price of CNG is also more stable than petroleum-based fuels. This is mainly because natural gas has a different pricing structure than gasoline and diesel. As much as 70% of the cost of gasoline and 60% if diesel is dependent on the cost of oil. As with natural gas only 20% is of the cost is directly dependent on the cost of oil. This means if there is price volatility in OPEC nations, the most natural gas will fluctuate is 20%, where gasoline could increase up to 70% by the time it gets to you at the pump.

One common misconception about CNG technology is its more dangerous or not as safe as gasoline or diesel. This couldn't be further from the truth. When gasoline is leaked or spilled it creates a pool on the floor. Natural gas is lighter than air and disperses quickly. Also, natural gas will only burn if the fuel air mixture is correct. That mixture must be 5% to 15% natural gas. Any thing less than 5% and it's too

thin to burn, anything over 15% and there is not enough oxygen to burn. The ignition temperature is also much higher. Natural gas has an ignition temperature of about 1,200 degrees F, where gasoline's ignition temperature is around 600 F. The high ignition temperature combined with the limited flammability range makes natural gas a much safer option than gasoline or diesel (ANG). The storage tanks for the natural gas are also much safer than other fuel tanks. They are usually aluminum with glass/epoxy or carbon fiber reinforcement. In the case of an accident the CNG system is designed to dissipate the gas into the air, making the fuel system safe for all in the area.

Also, many states offer Grants and or Tax incentives programs. While these can change from state to state many of them offer incentives for building infrastructure, CNG vehicle purchase or conversions, and natural gas motor fuel taxation (cngnow).

“America has an abundant domestic supply (90 + years) of conventional Natural Gas. In fact, the U.S. is the No. 1 producer of Natural Gas in the world (ngvamerica).”

Since most of the worlds natural gas comes from the U.S., we will no longer be dependent of foreign countries for our fuel.

How to begin using CNG?

Once the decision has been made to utilize CNG technology the question arises - purchase a CNG vehicle or convert your existing vehicles? While purchasing a new CNG vehicle is the easiest and quickest route, it may not be the cheapest.

The cost will vary based on the type of engine. Specifying a CNG system for a new vehicle at build time will increase the total cost of the vehicle, when compared to leaving the factory engine in the vehicle.

Many engines can accept a CNG conversion kit. While there are many pre-fab kits on the market, one should take the time and talk to the manufacturer to establish a strategy, not only for choosing the correct kit but also the install and training your mechanic for the kit's maintenance.

Another choice that must be made is what type of system will serve you best. Depending on what your final goal is, there are several different types of CNG systems available, each with their own price structures:

- The “dedicated” vehicle is only able to use only natural gas.
- The “Bi-Fuel” vehicle has two complete fuel systems, natural gas and gasoline or diesel. This allows the driver to choose which fuel type to use.
- The “Dual-Fuel” vehicle have systems that run on natural gas but use diesel fuel for ignition assistance.
- Light-duty vehicles are typically equipped with dedicated or bi-fuel systems, while heavy-duty vehicles use dedicated or dual-fuel system (afdc).

While each of these have their advantages and disadvantages, your kit's manufacturer should help you pick the correct kit for your application. Every fleet is different and assistance from a professional may save you from wasting time and money.

Like any vehicle, a preventative maintenance schedule must be created and implemented. This is where you may first see some of the cost savings with CNG technology. CNG burns cleaner as the oil does not contain as many contaminants therefore the oil life is extended allowing greater times between oil changes. CNG also creates less carbon buildup on the engine heads and pistons, extending the life of the engine. Since each kit is different, refer to the kit's builder for this information. The preventive maintenance schedule should also include tank and

system inspections and certifications. Typically, legal requirements indicate tank and system inspections must be done 36 months or 36,000 miles.

Additional Considerations

While CNG vehicles have many benefits, there are also many elements that unexperienced CNG owners may find difficult. Most of the concerns stems from safety. A new CNG owner will find that the regulations and restrictions are much more stringent than vehicles with other types of fuels. Tanks for example have a manufacture determined life span. Also, tanks must be inspected after an accident.

Storage of a CNG vehicle also imposes its own challenges. Overhead heaters must be of a certain type. Gas detectors must be installed and connected to automatic door openers. Even electrical system be needing to be changed.

Rural areas may have difficulty in finding mechanics with CNG experience. While a CNG engine is almost identical to a traditional engine, the fuel delivery section is not. Mechanics not trained in CNG technology may find it difficult to fully understand and troubleshoot.

While more fueling stations are becoming available every year, they are very limited in rural areas. One solution to this problem is for the fleet owner to install their own filling station, either with an external tank and compressor or tapping into a natural gas supply line.

One last consideration is the end of life sales price for CNG vehicles. Though the average life is longer for CNG powered vehicles, the average resale value could be up to 40% lower than comparable traditionally fueled vehicles.

Bibliography

afdc. https://afdc.energy.gov/vehicles/natural_gas.html. n.d.

ANG. <http://americannaturalgas.com/why-choose-cng/>. n.d.

AVSG. <http://cngnewengland.com/cng/why-cng>. n.d.

cngnow. <http://www.cngnow.com/state/Pages/information.aspx>. n.d.

Dept, Editorial. <https://oilprice.com/Energy/Natural-Gas/What-Exactly-IS-Natural-Gas.html>. 28 Sept 2009. 19 April 2019.

ngvamerica. <https://www.ngvamerica.org/fuel/>. n.d.