Compressed Natural Gas (CNG) as an Automotive Fuel
CNG 101

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What is natural gas?

Natural gas is a hydrocarbon-based fuel. It’s a chemical compound and is 85% methane (CH4) with one carbon atom and four hydrogen atoms. Methane is 80% hydrogen. Compared to other fuels transportation fuels, natural gas is very clean:

- Propane (LPG) – C3H8
- Gasoline – C8H18
- Diesel – C14H30
What is natural gas? (cont):

- Natural gas is primarily a domestic product. Over 98% of the natural gas supplies originate in North America. Natural gas is transported via the underground pipe infrastructure from the wells to the markets.

- The remaining 2% is imported as liquefied natural gas (LNG).

- Natural gas is lighter-than-air, non-toxic to breathe or touch, and cannot contaminate soil or groundwater.

- Natural gas is odorless and colorless. The interstate pipelines companies add an odorant. Many states require additional odorant.

- The historic uses of natural gas: street lamp lighting, space heating, water heating, cooking, drying, manufacturing, and electric power generation.
So what is CNG?

- Compressed natural gas or CNG is the compressed form of natural gas. So in reality - it is the same fuel consumers and businesses use for heating, hot water, drying, and cooking.

- CNG is compressed so a large volume may be stored in a relatively compact space, such as on-board a vehicle.

- CNG is stored on-board a vehicle at 3,600 psi. CNG does not change state – it remains a lighter-than-air gas.

- CNG fuel storage systems (i.e. cylinders) pass US DOT tests that no gasoline or diesel fuel tanks could ever survive. These tests include dynamite, bonfire, gunfire, drop, and crash tests.

- CNG cylinders can be Type 1 (all metal – typically steel or aluminum), Type 2 (metal liner with fiberglass – hoop wrapped), Type 3 (metal liner with fiberglass – full wrap), and Type 4 (plastic liner with full composite wrap).
So what is CNG? (cont)

- CNG is measured in gasoline gallon equivalents (GGEs) and diesel gallon equivalents (DGEs).
- CNG has an octane rating of 130 versus an octane rating between 87-94 for gasoline.
- All CNG engines, regardless of the size of the vehicle, are gasoline-type spark ignited engines.
Compressed Natural Gas (CNG) Vehicle Facts:

- On average, CNG vehicles emit (regulated emissions): 95% percent less particulate matter (PM), also known as soot, 90% percent less carbon monoxide (CO), and 75% less nitrogen oxide (NOx).

- On average, CNG vehicles emit (non-regulated emissions): 20-25% less carbon dioxide (CO2) compared to diesel vehicles and 30-35% less CO2 compared to gasoline vehicles.

- CNG vehicles (medium- and heavy-duty) are extremely quiet compared to their diesel counterparts.

- According to Cummins-Westport, one (1) diesel engine idling alone is louder than ten (10) CNG engines idling together.

- CNG is the most prevalent alternative fuel in use today in New England.
Natural gas is one of the six (6) federally-recognized alternative fuels:

- Bio-diesel (B-20)
- Electricity (EVs)
- Ethanol (E-85)
- Hydrogen (compressed - CHG and liquefied - LHG)
- Liquefied petroleum gas (LPG) - commonly known as propane
- Natural gas (compressed - CNG and liquefied - LNG)
GX Fuel System Components
On-road applications for CNG (in order of economic feasibility):

- Refuse/recycling - trash removal and recycling collection
- Transportation - transit buses (RTAs), airport / hotel shuttles / transportation companies
- Delivery - beverage, linen, dry goods, and package
- Freight - intrastate and interstate
- Utilities - customer service vans, distribution trucks, pool sedans, line trucks
- Municipalities - DPWs, schools, senior transportation
- Consumers and first adopters
On-road vehicle offerings:

- Dedicated CNG: CNG is the only fuel on-board the vehicle.

- Bi-fuel: CNG and gasoline. Two (2) independent fuel systems on-board. The vehicle typically operates on CNG. As the CNG supply is depleted (according to pressure), the vehicle automatically changes over to gasoline. Only one fuel is consumed at a time.

- Dual-fuel: CNG and diesel. CNG and diesel are burned simultaneously in the engine (in varying percentages). CNG displaces approximately 70% to 80% of the diesel normally consumed.

- At this point in the industry’s history, nearly every major automobile, bus, and truck manufacturer offers some type of CNG option.

- The best resource is: www.ngvamerica.org
  Go to “Technology”
  Then to: “Available Vehicles and Engines”
CNG Station Facts:

- CNG stations require no fuel deliveries. Natural gas is delivered to the station directly from the existing underground natural gas infrastructure.

- CNG storage is above ground (at 4,500 psi). A typical fast-fill station stores an amount of fuel approximately equal to 300 gallons of diesel fuel.

- If there were to be a leak (which is very unusual), the CNG would readily dissipate into the atmosphere.

- CNG station site selection includes: finding highest natural gas pressure as possible, 460 VAC - 3 phase electric power supply, and for public-access station - proximity to fleet customers.

- Space requirements: Approximately 15,000 to 20,000 square feet for a full public-access CNG station.
Compressed Natural Gas (CNG) Station Facts (cont.):

- CNG stations can be time-fill, fast-fill, or combination time- and fast-fill.
- Each station design has its positives and negatives.
Time-fill Fueling Station

Natural gas utility service

Gas dryer

Compressor

Temperature compensation

Fueling Station

1. 25% Full
2. 50% Full
3. 75% Full
Cascade Fast-Fill Fueling Station

Natural gas utility service

Gas dryer

Compressor

Priority-fill system

Storage bypass

Temperature compensation

Fast-fill dispenser
CNG Station Facts (cont.):

• CNG stations can be public-access or private-access

• Public-access CNG stations are typically open 24/7/365

• Public-access CNG stations typically accept Wright Express (WEX), PHH, MasterCard, VISA, and proprietary fuel cards.

• Public-access (retail) CNG stations dispense fuel at:

  - Gasoline gallon equivalent (GGE) = $2.599
  - Diesel gallon equivalent (DGE) = $2.849

• Private-access (not open for retail) CNG stations dispense fuel at:

  - Gasoline gallon equivalent (GGE) = $2.20
  - Diesel gallon equivalent (DGE) = $2.50
CNG / GH$_2$ Repair Garages – NFPA 30A

- **Lighting Fixture**
  - Class 1, Division 2 or sealed.

- **Open flame heaters or heating equipment with surfaces > 750 °F not permitted. Non-complying equipment may be turned off.**

- **General purpose equipment is normally used in the area between 18” above the floor and the vehicle roof line.**

- **Class 1, Division 2 – to 18” below ceiling except where 4 ACH ventilation is provided.**

- **Electric Reel Class 1, Division 2 or non sparking.**

- **Flammable gas detection system required.**

- **Class 1, Division 2 area – to 18” above floor.**

- **Defueling system is recommended.**

*Image Credit: U.S. DOE, Alternative Fuels & Advanced Vehicles Data Center, CNG 201*
If you have any questions, please feel free to contact me at:

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