



In 1999, the U.S. Department of Energy (DOE) conducted a study that provided direct, side-by-side cost and emissions comparisons of CNG and gasoline-fueled taxi-cab operations. The report, *Alternative Fuels Case Study: Barwood Cab Fleet Study Summary*, compared 10 CNG-fueled cars from 1996 with 10 gasoline-fueled cars of the same make and model to determine operating costs.

The study found that the fuel economy of the CNG and gasoline cabs were identical and that operating costs for CNG cabs were 25 percent less than the gasoline-powered cabs. Average fuel costs for the CNG cabs were 32 percent less, and reportedly cost about 15 percent less to maintain than the gasoline vehicles. Tailpipe emissions tests on 14 of the 20 vehicles indicated that CNG exhaust emissions were significantly lower than their gasoline counterparts for non-methane hydrocarbons and carbon monoxide.

A copy of this report is available at www.ott.doe.gov/pdfs/barwood.pdf.

Clean Alternative Fuels: Compressed Natural Gas

One in a series of fact sheets



Natural gas is one of the most widely used forms of energy today. It is commonly used to heat and cool homes and businesses nationwide. In addition, more than 85,000 compressed natural gas (CNG) vehicles, including one out of every five transit buses, are operating successfully today. CNG's popularity stems, in part, from its clean-burning properties. In many cases, CNG vehicles generate fewer exhaust and greenhouse gas emissions than their gasoline- or diesel-powered counterparts.

CNG is odorless, colorless, and tasteless. It consists mostly of methane and is drawn from gas wells or in conjunction with crude oil production. CNG vehicles store natural gas in high-pressure fuel cylinders at 3,000 to 3,600 pounds per square inch. An odorant is normally added to CNG for safety reasons.

AVAILABILITY

Two types of CNG fuel systems are on the market: dedicated vehicles, which operate exclusively on natural gas, and dual-fuel vehicles, which can use both natural gas and gasoline. Auto manufacturers offer a variety of both dedicated and dual-fuel CNG vehicles, including compacts, trucks, vans, and buses.

The United States has vast natural gas reserves distributed across the country through extensive pipeline systems extending from the wellhead to the end-user. As a result, CNG is currently available at approximately 1,300 refueling stations in 46 states, and this number continues to grow. In addition, CNG vehicle owners can refuel their cars at home by installing

small compressors connected directly to the home's natural gas supply.

EMISSIONS CHARACTERISTICS*

Actual emissions will vary with engine design; these numbers reflect the potential reductions offered by compressed natural gas, relative to conventional gasoline.

- Reductions in carbon monoxide emissions of 90 to 97 percent, and reductions in carbon dioxide emissions of 25 percent.
- Reductions in nitrogen oxide emissions of 35 to 60 percent.
- Potential reductions in nonmethane hydrocarbon emissions of 50 to 75 percent.
- Fewer toxic and carcinogenic pollutants, and little to no particulate matter produced.
- No evaporative emissions in dedicated engines (such as those associated with gasoline or diesel).

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

AFFORDABILITY

The CNG market is more stable than the gasoline market. CNG generally costs 15 to 40 percent less than gasoline or diesel. CNG requires more frequent refueling, however, because it contains only about a quarter of the energy by volume of gasoline. In addition, CNG vehicles cost between \$3,500 to \$6,000 more than their gasoline-powered counterparts. This is primarily due to the higher cost of the fuel cylinders. As the popularity and production of CNG vehicles increases, vehicle costs are expected to decrease.

PERFORMANCE

The octane rating for CNG is higher than that for gasoline; in a dedicated engine, a CNG vehicle's power, acceleration, and cruise speed can be greater than that of a gasoline-powered vehicle. In addition, due to the cleaner burning characteristics of natural gas, CNG vehicle engines can run more efficiently than a gasoline-powered vehicle, thereby extending the life of the vehicle. In heavy-duty vehicles, CNG engines are also generally less noisy than diesel engines.

SAFETY

Although CNG is a flammable gas, it has a narrow flammability range, making it an inherently safe fuel. Strict safety standards make CNG vehicles as safe as gasoline-powered vehicles. In the event of a spill or accidental release, CNG poses no threat to land or water; it is non-toxic. CNG also disperses rapidly, minimizing ignition risk relative to

gasoline. Natural gas is lighter than air and will not pool as a liquid or vapor on the ground. Nevertheless, leaks indoors may form a flammable mixture in the vicinity of an ignition source. CNG is primarily methane, however, which is a greenhouse gas that could contribute to global climate change if leaked. Methane is slightly soluble in water and under certain environmental conditions (anaerobic) does not biodegrade; if excess amounts accumulate, the gas can bubble from the water, possibly creating a risk of fire or explosion.

Reported incidences of bus fires are related to engine failures, not the use of natural gas. Natural gas buses have onboard gas detectors and other safety devices, such as tank safety valves that allow fuel flow only when the engine is keyed on. Also, the tanks must be inspected and approved by the U.S. Department of Transportation after certain periods of use.

There are some different safety concerns with CNG buses than diesel fuel buses, such as greater breaking distance due to increased fuel storage system weight. This is a relatively small concern, however, because the fuel system is a small fraction of a bus' total weight. CNG buses also might accelerate slower than their diesel counterparts.

MAINTENANCE

Proper training is required for all maintenance personnel working on CNG vehicles. The oil in a CNG vehicle does not need to be changed as frequently because CNG burns more cleanly than gasoline, producing less deposits in the oil.

For More Information

EPA Alternative Fuels Web Site
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

Alternative Fuel Refueling Station Locator
Web site: afdcmap.nrel.gov/nrel

Alternative Fuels Data Center
Web site: www.afdc.nrel.gov

National Alternative Fuels Hotline
Phone: 800 423-1DOE