

# The long road for natural gas vehicles

Natural gas has made only small inroads in the world's transportation market, where the fuels of choice remain those refined from crude oil. The global market for cars and trucks powered by natural gas has been growing, however, and the technology improving, spurred by tax incentives, high gasoline and diesel prices, and a blossoming green movement.

But compressed natural gas, or CNG, vehicles are largely a niche market for fleet vehicles in the United States. Growth in their use by the general public or as a fleet fuel could accelerate Lower 48 natural gas demand in coming years — anything that builds demand could help the multibillion-dollar Alaska natural gas pipeline project. However, CNG vehicles are unlikely to rival electrical generation as the major driver of higher gas demand in the next decade.

Even with interest sparked by today's high gasoline prices, four key roadblocks stand in the way of a widespread deployment of natural gas vehicles in the United States:

The vehicles cost more than gasoline-powered cars and

trucks, a handicap partly offset by less expensive fuel.

The compressed natural gas tanks on converted vehicles take up a lot of room, typically absorbing much of the trunk space in cars.

Drivers must refuel the vehicles more frequently.

Refueling stations are sparse, so refueling the vehicles is far less convenient than pulling into the corner gas station to top off the tank.

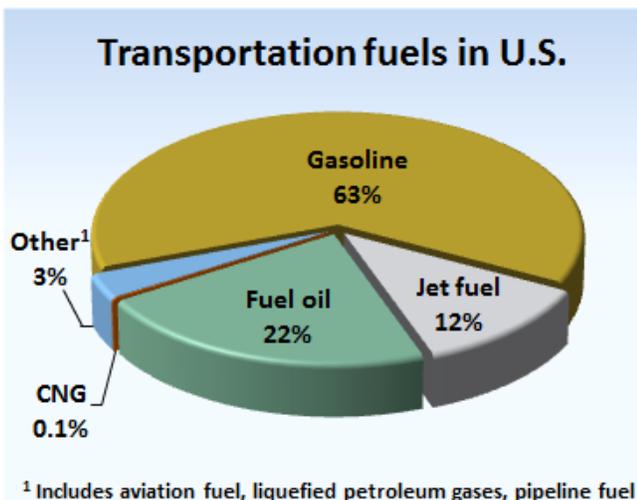
These barriers mean that converts to compressed natural gas vehicles for now likely will remain operators of diesel or gas-guzzling heavy-duty fleets — such as city or school buses, delivery or garbage trucks — whose vehicles can return to a central yard for refueling each day, or individuals with such deep commitment to curbing greenhouse gas emissions that they will spend the extra money required.

## More common outside U.S.

The United States has an estimated 117,000 vehicles fueled by compressed natural gas or liquefied natural gas, with CNG accounting for 114,000 of them. That's up from fewer than 30,000 in the early 1990s, but it compares to about 240 million cars and light-duty trucks using gasoline.

The United States lags many other countries in number of natural gas-powered vehicles. An estimated 12 million such vehicles are on the road worldwide.

Pakistan, Argentina, Iran, Brazil and India lead the way. Pakistan with 2.3 million gas-powered cars and trucks has the most, thanks in part of a program to build CNG fueling stations around the country. Europe has about 1 million CNG vehicles, most of which also can run on gasoline, making them easier to refuel. Multi-fuel vehicles are the norm outside the United States.



Source: U.S. Energy Information Administration



Photo by Bill White, Office of the Federal Coordinator

**Forklift powered by CNG refuels at Ditch Witch of Alaska.**

An estimated 95 percent of the natural gas vehicles worldwide are cars or pickup trucks, with another 3 percent buses and 2 percent trucks.

The scarcity of U.S. CNG fueling sites has helped constrain growth of natural gas vehicle sales. The United States has about 900 CNG fueling sites, with less than half open to the public. Only 19 states have more than 10 sites, and five have none. Alaska has three, a private site on Anchorage's joint military base, a public station at Ditch Witch of Alaska, also in Anchorage, and a public station run by Ukpeagvik Inupiat Corp. in Barrow.

### Fueling fleets

The most recent U.S. numbers for natural gas vehicles are as of 2008. At that time, oil prices had spiked to record highs, sparking interest in alternatives to oil-based fuels.

CNG vehicles have their biggest presence in California, Oklahoma, Utah and New York, thanks in part to local

programs in those states to promote their use.

In all, compressed natural gas accounts for just 0.1 percent of the energy consumed by the nation's transportation sector. The nation's cars, trucks and buses burned just 100 million cubic feet of gas a day last year, about as much as is used to heat homes and buildings in Southcentral Alaska.

But CNG use in vehicles is up almost 50 percent from five years ago and almost triple the demand in 1999, according to Department of Energy statistics. Industry advocates say a 10-fold increase in CNG-powered vehicles is achievable, especially with gasoline and diesel priced at around \$4 a gallon nationwide.

Much of the U.S. growth is expected to come from public transit and delivery truck fleets that operate out of central garages and fueling stations.

Taxis and long-haul trucks are joining the parade, too, and more converts are possible as Congress considers tax incentives for CNG vehicles.

The Los Angeles County Metropolitan Transportation Authority in January became the first major public transit agency in the world to run entirely on alternative fuels, retiring the last diesel bus in its 2,200-vehicle fleet. The agency even held a retirement ceremony for the bus.

Though the transit authority's CNG buses have higher maintenance costs, the agency says lower fuel prices more than make up for it.

Between 1996 and 2009, the use of natural gas in public transit buses grew from 3 percent to 18 percent, according to the American Public Transportation Association. More than 50 transit agencies across the United States are running CNG buses, with more on their way.

And the switch is not limited to just big-city buses. Shuttle buses that carry travelers to Houston's George Bush Intercontinental Airport's remote lots started running on CNG this year. The operator expects to save \$200,000 a year on fuel.

Houston-based Apache Corp. will supply the gas for the airport shuttles. Apache also is paying to construct a CNG fueling station for the airport; it will donate the station to the city of Houston. And practicing what it produces, the natural gas exploration and production company expects to convert one-quarter of its own

vehicle fleet to CNG by the end of this year.

Apache has joined with fellow producer Anadarko and others to form the Greater Houston Natural Gas Vehicle Alliance, a nonprofit organization to promote CNG vehicles — especially for fleet owners. Apache, Chesapeake Energy and other natural gas producers have started seeding the market by helping underwrite some refueling stations.

A new Massachusetts Institute of Technology study on natural gas estimates that if all U.S. buses, urban delivery trucks, taxis, government and business fleets switched to CNG, they would consume nearly 7 billion cubic feet a day of natural gas, one-and-a-half times as much as an Alaska pipeline would supply to the Lower 48.

### How CNG works

Natural gas as a vehicle fuel has two key attractions. The fuel itself is cheaper. And it's much less polluting than gasoline or diesel.

The price of CNG was \$2.06 per gallon equivalent in April, compared with \$3.69 for gasoline, according to the latest comparison numbers from the U.S. Energy Department. The estimated annual fuel costs for the CNG version of the popular Honda Civic driven 15,000 miles is \$1,034, compared with \$1,992 for the gasoline-fueled Civic and \$1,409 for the hybrid Civic.

CNG also is a greener fuel than gasoline or diesel.

Natural gas vehicles emit 90 to 97 percent less carbon monoxide, 25 percent less carbon dioxide and 35 to 60 percent less nitrogen oxide than gasoline or diesel vehicles, according to the U.S. Environmental Protection Agency. Additionally, CNG engines produce little to no particulate matter.

Natural gas has an important drawback compared with liquid fuels: Its low energy density.

That means machines are needed to compress the gas to 2,400 to 3,600 pounds per square inch to fit enough gas into a storage tank that isn't ridiculously large. Buses and trucks can work especially well as CNG vehicles because the pressurized gas can be stored in large tanks on the roof of buses or along the undercarriage or behind the cab of trucks.

### Honda's CNG car

The Honda Civic GX is the only factory-built CNG sedan available in the United States. It's sold in a few states, and is primarily aimed at businesses as a fleet vehicle. Unlike many natural gas-fueled vehicles, the Civic GX runs only on CNG.

Honda intends to rebrand the car as the Civic Natural Gas for 2012 and start selling it more broadly, focusing initially on states with more public refueling sites. Chrysler says it hopes to introduce a CNG pickup truck in 2017.

In the Civic GX, the compressed gas cylinders take away about two-thirds of the trunk space available in a gasoline-powered Civic. The Civic GX carries a suggested starting price of \$25,490, compared with \$18,655 for a gasoline-powered Civic LX with five-speed automatic transmission.

Besides cost and trunk space, another disadvantage the Civic GX bears is the distance it can be driven on a full tank before its fuel is gone: 170 miles. That compares with an estimated 345 miles for the Civic LX and 454 miles for the hybrid Civic.

Gasoline-powered cars can be converted to run on CNG as well, but at a cost - generally \$8,000 to \$22,000 for most passenger vehicles, depending on the age, make, model and who is installing the kit.

Cheaper kits can be found on the Internet and through after-market part dealers. These might cost as little as \$1,500 to \$3,500. But many of them are not EPA

## Honda Civic at a glance

2011 gasoline, hybrid, CNG

### Honda Civic, regular gas

LX Model, automatic transmission

**345** miles on a tank  
**\$1,956** annual fuel cost  
**\$3.26** cost to drive 25 miles  
**\$18,655** suggested starting price

### Honda Civic Hybrid

**454** miles on a tank  
**\$1,383** annual fuel cost  
**\$2.30** cost to drive 25 miles  
**\$24,050** suggested starting price

### Honda Civic GX CNG

**170** miles on a tank  
**\$1,103** annual fuel cost  
**\$1.84** cost to drive 25 miles  
**\$25,490** suggested starting price

Assumptions: Cars driven 15,000 miles – 45% highway, 55% city; regular gas costs \$3.78 a gallon; CNG costs \$2.06 per gallon of gasoline equivalent

Sources: [www.fueleconomy.gov](http://www.fueleconomy.gov) and [Honda.com](http://Honda.com)

certified as meeting emissions standards.

## Refueling at home

To get around the scarcity of refueling stations, individuals or businesses can install their own refueling stations. In the case of a homeowner, the refueling machine would tap into the house's natural gas supply.

But the supply of home refueling stations is limited, and owners must pay to modify their gas plumbing and possibly get local building permits.

Consumer Reports magazine estimated in 2008 that the home system costs around \$3,500 plus installation. The Natural Gas Vehicles for America group says these systems involve compressing gas from the home supply line and storing it aboard the vehicle. Some home units are about the size of an outdoor home air-conditioning unit, and some are small enough to fit on a garage wall. While filling up at a commercial CNG station takes a few minutes, home refueling can take hours and typically is done overnight.

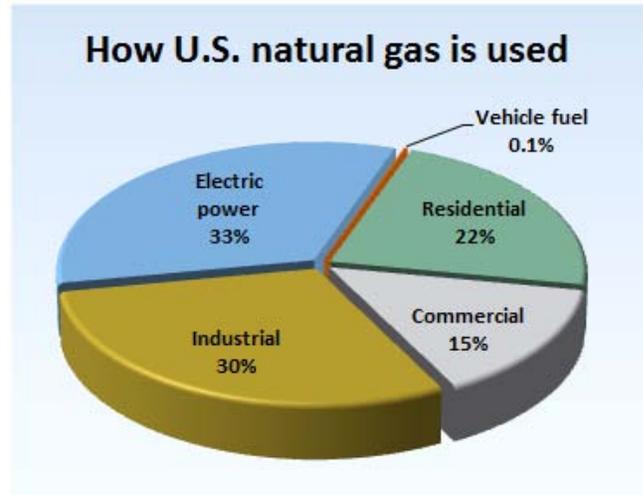
The NGVA says a homeowner can get a \$1,000 federal tax credit for installing new alternative fuel refueling systems.

## Tax breaks to spur switch

The federal government has used tax law to encourage the public to switch to CNG vehicles.

But some of that encouragement has expired and more will expire this year. The \$1,000 credit for residential fueling stations ends at year-end. So does the credit for up to 30 percent of the cost — maximum credit of \$30,000 — for installing a commercial CNG refueling station.

A new bill in Congress, H.R. 1380, introduced in April would revive the already-expired tax credit for purchasing natural gas vehicles and expand the credits for installing refueling equipment.



*Source: U.S. Energy Information Administration*

In April, the EPA issued final regulations that relaxed rules on converting older vehicles to natural gas power. Still in place are stricter rules for certifying the conversion of newer vehicles.

Natural gas vehicle advocates cite the high cost of getting EPA certification as a tall barrier to mass adoption of CNG vehicles by the public. A \$10,000 conversion in the United States would cost only about \$2,500 in Singapore, according to the new MIT report.

That same MIT report said CNG cars and pickups make financial sense only if they're driven a lot. Based on a \$1.50 per gallon of gas equivalent price advantage for CNG, a CNG car that costs \$10,000 more than a gasoline-powered alternative and that is driven 12,000 miles a year takes 17 years before the fuel-cost savings offset the upfront cost.

But if that car is driven 35,000 miles a year - such as a taxi or a car used in long commutes - that break-even time shrinks to 5.9 years.

If the extra up-front cost were \$3,000 instead, the break-even point would be 1.8 years for the 35,000-mile-a-year car and 5 years for the 12,000-mile car.

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