



WILL NATURAL GAS VEHICLES BE IN OUR FUTURE?

Alan J. Krupnick examines the bid for natural gas to become a fuel of choice for America's vehicle fleet.

Natural gas holds the promise of reducing carbon emissions and dependence on oil. But until recently, it was an also-ran in the sweepstakes for transforming fuel costs and transportation in the United States. The new abundance of domestically available shale gas and continually high gasoline and diesel prices could change that. Will these developments be enough to extend the reach of natural gas vehicles beyond buses, garbage trucks, and delivery trucks?

To answer this question, I compared passenger vehicles running on compressed

natural gas (CNG) with gasoline and hybrid electric models, and heavy-duty trucks running on liquefied natural gas (LNG) with their diesel counterparts. High costs, reduced cargo space, and range issues—along with stiff competition from other alternative fuels—are likely to make switching to natural gas a tough sell for passenger vehicles. Tractor trailer semi-trucks running on LNG can be a good deal for reducing oil use, conventional pollutant emissions, and costs, but significant uncertainty surrounds the size of their carbon footprints.

Natural Gas Vehicles at a Glance

Natural gas vehicles have been a part of global vehicle fleets for decades, with an estimated 11 million on the road worldwide. With just 110,000 of these, the United States ranks 12th globally in number of gas-fueled vehicles—considerably behind Argentina, Brazil, Italy, India, and others. Between 1999 and 2009, US domestic consumption of natural gas in the transportation sector tripled, but infrastructure is lacking. There are 840 compressed natural gas and 39 liquefied natural gas fueling stations in the United States (compared with 4,000 diesel truck stops).

Sources: Bryce 2011; Natural & Bio Gas Vehicle Association 2011.

Passenger Vehicles: Comparing the Options

The light-duty vehicle market currently has one natural gas entrant: the Civic Natural Gas (formerly the GX) by Honda. Chrysler, Ford, and Hong Kong-based Hybrid Kinetic Motors are also gearing up to produce passenger vehicles that run, at least in part, on natural gas.

Some of the issues hindering penetration of natural gas-fueled passenger vehicles

gasoline alternative. But fuel tanks for compressed natural gas are large and heavy, decreasing cargo space by a dramatic 50 percent compared with the gasoline version. Also, its range is lowered to only 218 miles, compared with 383 miles for the comparable gasoline vehicle and 504 miles for the hybrid.

Assuming a seven-year period of annualization, an interest rate of 6 percent, a gasoline cost of \$4 per gallon, and a natural

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become clear using Honda's website to compare its 2011 Civic GX with comparably equipped conventional and hybrid Civics.

Without a subsidy, the natural gas Civic costs \$26,240—modestly more expensive than the \$24,700 hybrid but substantially more expensive than the \$19,905 gasoline version. Its maintenance and repair costs are also considerably more expensive.

The fuel economy for the natural gas Civic is about the same as that of the

gas price of \$3 per thousand cubic feet, the natural gas Civic is still more expensive. While a hybrid is more expensive than its gasoline-fueled counterpart by almost \$400 per year, the natural gas Civic is \$721 more expensive per year when the annualized cost of a home-fueling unit is included. Things look even worse for the natural gas-fueled car with a higher interest rate and the current gasoline price of around \$3.50 per gallon.

Of course, subsidies lower costs considerably. The Energy Tax Policy of 2005 offered a \$4,000 subsidy for the purchase cost. While it expired in 2010, new bills call for reinstating it, and in April 2011, Congress passed HR 1380, an act that provides a \$2,000 subsidy for home charging stations and the annual cost of the loan. After these adjustments, amortized costs are about \$100 less than a gasoline vehicle. But the key question is whether a subsidy is justified independently of other types of vehicles and, then, in relation to other types of vehicles.

The Economics of LNG-Fueled Heavy-Duty Trucks

Natural gas is more likely to fuel large trucks, particularly tractor trailers, and fleet vehicles, including buses. In addition to the cost and range issues, it would be costly to build the infrastructure to service passenger vehicles throughout the nation's extensive road system. But tractor trailers travel mostly by interstate highways, where natural gas refueling stations could be concentrated. Indeed, changes in the way truckers drive—few are willing to routinely travel across the country—are leading to development of an interconnected hub-and-spoke system, where interstate trucking hubs are a one- or even half-day destination for truckers to unload their cargo and then pick up a new load on the way home.

Because manufacturers have had only limited experience with natural gas engines, it is difficult to accurately estimate their future costs. Current estimates suggest natural gas trucks have very high up-front costs—around \$70,000 more than comparable diesel trucks. Maintenance costs for natural gas trucks are also difficult to calculate: they have been found to be as much as 29 percent greater than their diesel



counterparts at one facility, and 6 percent at another, but these estimates are dated.

Yet natural gas historically has cost less than diesel as a fuel, and currently is much cheaper at a gasoline equivalent of \$2.50 per gallon. As a result, natural gas trucks can still make economic sense under plausible, albeit optimistic, scenarios—by providing payback periods that might be acceptable to truck buyers, for example.

Payback refers to the amount of time it takes to repay the up-front investment cost through future energy savings, and it is commonly believed that industry looks for a period of two to three years or even less before it makes investments. To get there for an investment cost difference of \$70,000 and fuel economy of 5.1 miles per gallon



Compared to diesel fuel's lifecycle carbon emissions, those of LNG are smaller. But if the natural gas itself is not burned, it becomes a greenhouse gas 25 times more powerful than carbon dioxide over a 100-year period in the atmosphere.

equivalent, one needs fuel price differentials in the \$1.50-per-gallon equivalent range, rates of interest used to evaluate multi-year fuel savings benefits of 10 percent or less, and vehicle miles traveled around 125,000 per year.

According to the US Department of Transportation, about one-third of the heavy-duty fleet drives this distance. For trucks that travel less than 90,000 miles per year, payback periods increase by about a year. This suggests that the high-mileage part of the trucking fleet is the best target for marketing.

Solving the Chicken-or-Egg Problem

The biggest stumbling block to the introduction of a new fuel is generally the lack

of infrastructure for refueling. Those who would build the infrastructure want to see many vehicles needing the fuel, but those who would buy the vehicles want to see the infrastructure in place first. For natural gas, it has been huge enough to have kept the general public out of the market. Between the compressors for the gas and the cooling units for the LNG, not to mention fuel storage and refueling, only fleet vehicles fueled at centralized facilities could make a go of it.

All this has been changing with the plunging price of natural gas. Companies with large holdings of natural gas wells and high production goals, like Chesapeake Energy, have been looking for outlets for selling their gas, and even to create new



markets, with the increase in demand raising prices and increasing profits. Accordingly, some companies have been making plans to invest in infrastructure. Chesapeake Energy's plans are the most impressive: they are building 150 LNG/CNG stations on interstates across the country, using Pilot J truck filling station land. Other companies are partnering to build and operate LNG "corridors" between some major cities to support heavy-duty truck traffic. Thus, this segment of the market could experience significant growth.

The Last Hurdle: Uncertain Environmental Benefits

With costs and infrastructure in their favor, LNG trucks face one more hurdle—their carbon footprint. Compared to diesel fuel's lifecycle carbon emissions, those of LNG

from conventional gas wells or from shale gas wells are smaller. But if the natural gas itself—methane—is not burned, it becomes a greenhouse gas 25 times more powerful than carbon dioxide over a 100-year period in the atmosphere. Calculating just how methane emissions compare with their carbon dioxide counterparts is tricky, though. Because methane lasts for far less time in the atmosphere, some researchers use a much higher factor in converting methane to its carbon dioxide equivalent. In addition, the amount of methane that escapes—is "fugitive," in industry parlance—from gas wells is uncertain. According to the latest studies, putting together the short lifetime of methane and a high estimate for fugitive methane emissions can result in lifecycle emissions for LNG vehicles exceeding those of diesel. Until this issue is settled, the environmental benefits of natural gas vehicles are uncertain. ●

FURTHER READING

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