

NGV Overview – Trends and Implications

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Current State of the Natural Gas Vehicle (NGV) Market

Several issues have increased interest in developing alternate fuel vehicles (AFVs), including NGVs

- ◆ Increased level of domestic gas reserves due to shale reserves
- ◆ Concerns over dependency of oil imports, exacerbated by projected increases in oil prices
- ◆ Initiatives and policies designed to decrease greenhouse gas emissions
- ◆ Expanding trucking corridors and urban fleets

Natural gas as a transportation fuel is not a new technology, but its use has been limited historically

- ◆ Out of 250 million vehicles in the United States, only about 110,000 are NGVs. Natural gas accounts for less than 0.2% of the fuel used by all highway vehicles
 - There has been very little development of natural gas fueling infrastructure. The low number of NGVs in operation has provided little incentive to build more infrastructure
 - Similarly, a lack of infrastructure has limited interest in NGV development
- ◆ Relative to petroleum-fueled vehicles, NGVs have key disadvantages which have prevented their wide acceptance
 - In addition to limited refueling availability, these include higher costs, shorter driving ranges, and heavier fuel tanks
- ◆ In the United States, NGV penetration has been limited primarily to “return-to-base” fleets, such as buses, sanitation trucks, and delivery vehicles

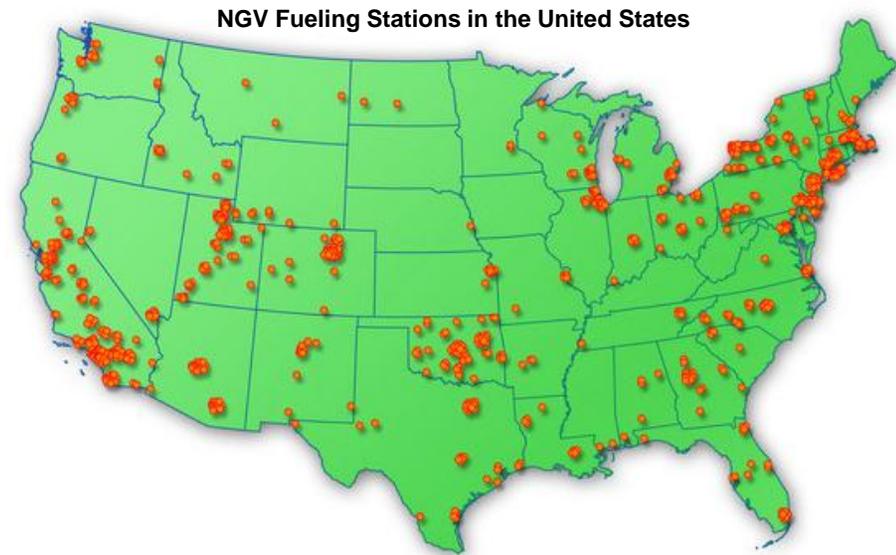
However, some transportation sectors have been a good fit for NGVs and provide potential for growth

- ◆ Fleet operations (e.g., transit, local trucking, municipal, utility) are considered good opportunities to expand NGV deployments
 - Heavy-duty, diesel-powered trucks represent only about 4% of all registered on-road vehicles but comprise 25% of fuel consumption
 - Centralized and fixed routes allow for more predictable refueling requirements
- ◆ Other applications include transit, port drayage, and airport operations

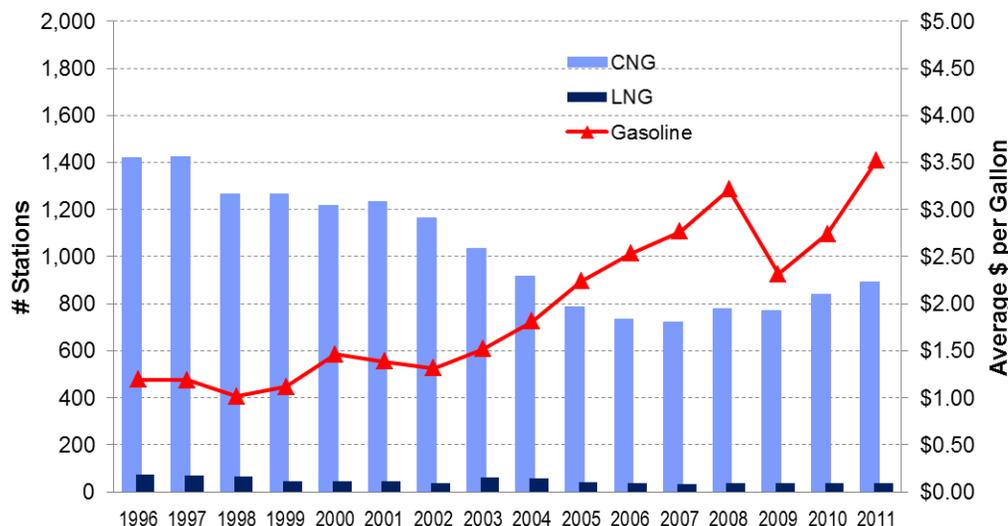
Current State of the Natural Gas Vehicle (NGV) Market (Cont'd)

In the United States, interest in natural gas fueling stations is increasing

- ◆ Currently, there are approximately 900 fueling stations for compressed natural gas (CNG), the most common natural gas fueling technology in the United States
 - Most are privately owned and used for refueling fleet vehicles
 - Stations are concentrated in a few states, with 50% located in California, Utah, Oklahoma, and New York
- ◆ Liquefied natural gas (LNG) is also used for fueling, but not as commonly as CNG
 - There are now 18 LNG stations open to the public, 14 of which are in California
 - Large carriers, such as UPS and Ryder, have placed orders for LNG trucks; this should promote development of stations outside California



Total U.S. NGV Fueling Stations vs. Retail Gasoline Price



- ◆ The federal government has renewed its focus on natural gas-fueled transportation with:
 - Incentives for fleet conversions and NGV purchases
 - Funding for research toward new NGV technologies
- ◆ If the price differential between natural gas and gasoline is sustained, the number of NGV fueling stations is likely to continue to increase
 - Use of natural gas as a transportation fuel has been growing at a rate of 10%–12% since 2006 and is expected to grow 25% by 2016

Sources: EIA; NRRRI; Resources for the Future; SNL; DOE – AFDC; Bloomberg

NGV Technologies

Detail on the primary NGV technologies, CNG and LNG, follows

Technology	Description
CNG	<ul style="list-style-type: none"> ◆ Stored in high pressure tanks (typically 3,000–3,600 psi) within or on the vehicle ◆ Approximately the same fuel economy as a conventional gasoline vehicle, based on gasoline gallon equivalent (GGE). 1 GGE = ~ 5.7 lbs of CNG* ◆ Vehicle options: production (e.g., Honda Civic GX), upfit – conversion of gasoline engine <p>Refueling Options</p> <ul style="list-style-type: none"> ◆ Time fill – designed for home and commercial refueling <ul style="list-style-type: none"> – Common application – vehicle sits unused for an extended period (i.e., overnight) – Refueling takes from four to eight hours (up to one gallon per hour) – Estimated costs: single-vehicle units – \$4,500, multi-vehicle units – \$10,000+ ◆ Fast fill – typically installed at commercial refueling stations (sometimes with time fill equipment) <ul style="list-style-type: none"> – Approximately five to seven minutes required to refuel a typical light-duty vehicle – Potential cost range of \$20,000 to \$1 million+, driven by fleet size ◆ Example time fill device: Phill <ul style="list-style-type: none"> – Small, free-standing compressor that connects to existing home gas line – Estimated cost: \$4,500 plus installation – Fill times between four and eight hours at a rate of 0.3–0.4 gallons per hour
LNG	<ul style="list-style-type: none"> ◆ Stored as condensed liquid at -260°F in double-wall tanks on the vehicle ◆ For the same amount of energy, requires only 30% of the space needed for CNG <ul style="list-style-type: none"> – Beneficial for longer-range heavy-duty trucks, as more fuel can be carried on the vehicle – 1 GGE = ~ 1.5 gallons of LNG ◆ Less common than CNG due to higher equipment costs <ul style="list-style-type: none"> – Expensive storage and handling – cryogenic storage and pumping equipment required – Fuel typically trucked to station

* Amount of alternative fuel with the same amount of energy as a gallon of gasoline

Promotion of NGVs – Business Models

Business models that promote the expansion of NGVs are becoming more common. These models are designed to drive demand for NGVs or increase development of fueling infrastructure

- ◆ Regional corridors – planned networks of refueling stations located along key truck routes (i.e., major highways)
 - Examples include:
 - Pennsylvania Clean Transportation Corridor: network of natural gas refueling stations that would connect large Pennsylvania metropolitan areas along a defined route of interstates and major highways (proposed)
 - Interstate Clean Transportation Corridor: network that connects NGV refueling stations for heavy-duty trucks in Southern California, Northern California, Salt Lake City, and Las Vegas along an 1,800 mile route (underway)
 - Texas Clean Transportation Triangle: network that will link NGV refueling stations for heavy-duty trucks in the metropolitan regions of Dallas/Fort Worth, Houston, and San Antonio (planned)
 - The interstate trucking industry is shifting from a structure of long-haul routes to a hub-and-spoke model, which could facilitate placement of refueling stations
- ◆ Home refueling – devices that allow CNG vehicle owners to refuel from their residential service lines are key to expanding the NGV market, according to many industry proponents
 - Drive Natural Gas Initiative* is working with compressor manufacturers to develop an improved home refueling product
- ◆ Vehicle manufacture and conversion – addressing limited product availability is a key to expanding the passenger vehicle market
 - Stakeholders hope that increased NGV production would lead to lower vehicle costs through economies of scale
 - Chrysler has announced its intention to begin selling CNG vehicles by 2017. By year-end 2012, half of Ford's vehicles, such as vans and pickups, will be capable of operating on alternate fuels, such as CNG
 - Financing and leasing programs, which enable customers to match savings with costs, are increasing in popularity
- ◆ Convenience store chains – partnerships between convenience store chains and transit agencies, municipalities, natural gas producers, and other stakeholders to provide public access to refueling stations at established locations

Promotion of NGVs – Business Models (Cont'd)

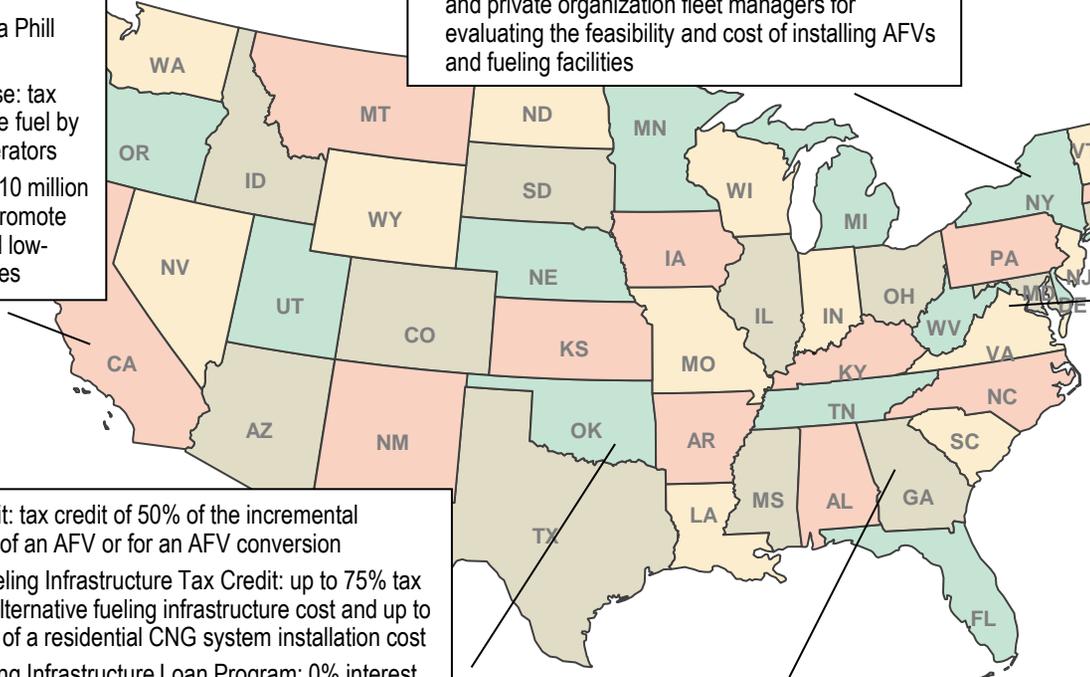
- ◆ Commercial fleet conversion – one of the more attractive models to drive demand for CNG
 - Benefits include:
 - Price competitive – the current price differential between natural gas and gasoline is approximately \$1.50–\$2.00 per equivalent gallon as of June 2012
 - Easier refueling – centralized fleets enable hub refueling stations, and fleets typically remain idle for a significant portion of the day/night, mitigating the impact of lengthy refueling times
 - Fleet refueling stations are typically restricted to company-owned vehicles, but some have been opened to public use in high-traffic areas, such as airports
 - Companies across the country are providing services related to fueling station development, including consulting, construction, and maintenance. These offerings should help support the development of CNG infrastructure

Promotion of NGVs – Example Federal and State Incentives

Below are examples of federal and state incentives designed to further the development and use of NGVs

- Alternative Fuel and Vehicle Research and Development Incentives: for projects that expand fleet or fuel infrastructure, improve vehicle technologies, or retrofit medium-/heavy-duty fleets
- NGV Home Fueling Infrastructure Incentive: \$1,000 for installation of a Phill home fueling appliance
- CNG Tax Exemption for Transit Use: tax exemption for CNG used as vehicle fuel by local agencies or public transit operators
- Technology Advancement Fund: \$10 million funding program for projects that promote the commercialization of advanced low-emission transportation technologies

- Clean Fueled Bus Program: funding to transit agencies, municipalities, and schools for up to 100% of the incremental purchase cost of new alternative fuel buses and associated infrastructure
- FlexTech Assistance Program: assistance to public and private organization fleet managers for evaluating the feasibility and cost of installing AFVs and fueling facilities



- AFV Tax Credit: tax credit of 50% of the incremental purchase cost of an AFV or for an AFV conversion
- Alternative Fueling Infrastructure Tax Credit: up to 75% tax credit of new alternative fueling infrastructure cost and up to 50% tax credit of a residential CNG system installation cost
- AFV and Fueling Infrastructure Loan Program: 0% interest loans to government fleets for AFV conversions, incremental purchase cost of AFVs, or construction of AFV fueling infrastructure
- CNG Fueling Infrastructure Development Program: OK legislature's commitment to increase CNG infrastructure by locating a public fueling station every 100 miles along interstate highways by 2015

- AFV Income Tax Credit: available for 10% of the purchase/lease cost of a new dedicated AFV or conversion to an AFV
- AFV High Occupancy Vehicle (HOV) Lane Exemption: gives AFVs with alternative fuel license plates access to HOV lanes, regardless of the number of passengers

Federal Incentives

NAT GAS Act of 2011

- Tax credit of 80% of NGV's incremental purchase cost, and a five-year extension of the \$0.50 per gallon alternative fuel credit
- Infrastructure tax credit of 50% of fueling station construction cost. Existing tax credit of 30% for stations built in 2011
- \$2,000 tax credit extension to home refueling unit purchases

Alternative Fuel Infrastructure Tax Credit

- Tax credit amount up to 30% of the cost, not to exceed \$30,000

Alternative Fuel Excise Tax Credit

- Tax incentive of \$0.50 per gallon for AFVs
- Incentive expired 12/31/11 but will remain until the 4/17/12 federal tax deadline

Alternative Fuel Tax Exemption

- Alternative fuels used in a manner that the IRS deems nontaxable are exempt from federal fuel taxes

Improved Energy Technology Loans

- DOE loan to eligible projects that reduce air pollution and promote early commercial use of advanced technologies

Implications

The outlook for NGVs is promising, with a 25% expected increase in the U.S. market by 2016 supported by incentives on the federal and state level to promote NGV investment and use. Annual sales of NGVs in the United States is expected to increase from 8,400 units in 2012 to nearly 33,000 units in 2016

Potential benefits include:

- ◆ An opportunity for utilities to increase profits due to infrastructure development
 - Inclusion of utility investments in rate base
 - Increase in throughput on distribution system
- ◆ Direct use of natural gas by end-use customers
- ◆ Greater domestic energy independence
- ◆ Lower fuel cost: currently, CNG is less expensive to produce than gasoline (up to 30% on a pre-tax basis)
- ◆ Clean energy standards
- ◆ Safety (i.e., unlike gasoline, CNG dissipates into the atmosphere in the event of an accident)
- ◆ For end-use customers, less engine corrosion than those fueled by gasoline

Implications (Cont'd)

Despite the expected benefits, some hurdles exist:

- ◆ Investments in NGV infrastructure will compete with pipeline safety for funding
- ◆ Significant barriers to widespread adoption remain
 - Limited number and high cost of commercial refueling stations
 - Competition from electric vehicles in the passenger sector
 - Lack of public awareness
 - Negative safety perceptions
 - Use of heavy-duty NGVs limited to LNG technology
 - High initial cost of vehicle conversion; equivalent gasoline or diesel vehicles remain less expensive
 - Large tank size required for light-duty vehicles to have equivalent range of gasoline vehicles (and may involve compromises in cabin size)
- ◆ Potential regulations related to preventing water pollution may impact shale gas production, a primary supply source for NGVs
- ◆ For NGVs to gain a measurable increase in market share, heavy reliance on tax subsidies and incentives will likely be required for a number of years
- ◆ An anticipated “rush-to-gas” in electric generation will put upward pressure on natural gas prices

Contact Us

For more information on NGVs or our thoughts on other aspects of the natural gas industry, please contact us

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