Briefing Paper

Natural Gas Vehicles: What State Public Utility Commissions Should Know and Ask

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Online Access

The reader can find this paper on the Web at:
http://www.nrri.org/pubs/gas/NRRI_natural_gas_vehicles_dec10-16.pdf.

Executive Summary

New technologies for drilling shale gas, heightened recognition of natural gas's smaller carbon footprint compared to gasoline and diesel oil, the motivation of gas utilities to increase profits through demand growth, and advances in transportation-oriented gas technology have all produced a renewed interest in natural gas vehicles (NGVs). This interest leads to the inevitable question of what role state public utility commissions and utilities should play, if any, in growing or reacting to the NGV market.

The premise of this paper is that state commissions should foster the NGV market—meaning, allow natural gas utilities or their affiliates to charge ratepayers for investing in and operating infrastructure necessary for NGVs—if and when they determine that this action would coincide with the public interest. This determination might require state commissions to examine whether such an action advances important regulatory objectives while not impeding others. These objectives can include environmental and other positive social gains that do not directly benefit NGV users.

If state commissions deem NGVs to be in the public interest, they should then determine: (a) whether existing rules and regulations hinder the development of NGVs; (b) the most effective actions to take in removing uneconomical barriers; (c) whether, to what extent, and how utilities should pursue the development of NGVs; (d) whether gas utilities should provide NGV-related services as a core function or through an unregulated affiliate—or not at all, leaving these activities to non-utility players; and (e) the effect of utilities' NGV activities on customers and other regulatory objectives (e.g., cost-of-service rates, fair competition).

This paper has two major purposes. The first is to educate commissions on the status of, and prospects for, NGVs. Compared to vehicles using other forms of energy, NGVs have both favorable and unfavorable features. The appendix highlights the assessments of outside experts on the outlook for NGVs. The consensus is that NGVs and electric vehicles can coexist to displace a portion of the market for conventional vehicles in urban fleets. The most promising markets for NGVs, based on the latest evidence, are commercial and government fleets. Specifically, NGVs' best bet is high-mileage urban (light and heavy) fleets with central refueling.

The second purpose of this paper is to (a) describe the possible roles that state commissions and local gas utilities might play in NGV development, and (b) identify issues that state commissions should address and questions they should ask.

Gas utilities can assume different roles in the NGV market. At one pole they can confine their activities to the provision, under existing regulatory rules, of local gas transportation service: (1) public and private refueling stations and (2) homes with a refueling appliance. In this minimalist role, utilities provide no marketing or promotion of NGVs. They merely provide a natural-monopoly service (e.g., local transportation) at a regulated price. They might also provide city-gate service—for example, the interstate delivery of natural gas to the utility's distribution system. Overall, gas utilities would simply react to the demand for NGVs and not try to affect the NGV market itself.

In a more active role, gas utilities would engage in marketing and promoting NGVs. They might attempt to educate customers on the benefits of NGVs and purchase NGVs for their own fleets. Education and outreach are particularly critical for technologies like NGVs that are largely unknown to the general public. This role might also include advocating for governmental financial incentives at the federal, state, and local levels.

Gas utilities might also provide ratepayer-funded financial incentives for the purchase of home fueling appliances, offer price discounts to customers who have NGVs, and provide financial support for the development of central refueling stations. All of these activities attempt to bolster or "jump-start" the market for NGVs. This paper discusses the fundamental question of whether, and under what conditions, the utility should "charge" all customers for a service that would directly benefit only a distinct minority. One essential condition for such a role is that the gap between the social benefits of NGVs and the private benefits to vehicle owners be large enough to justify a general ratepayer-funded subsidy.

State commissions can influence the development of NGVs. Through their policies, commissions can affect the scope of a utility's NGV-related services, in addition to the utility's incentive to provide those services. In determining cost recovery and the speed of optimal market penetration, commissions should evaluate the merits of new and underdeveloped technologies like NGVs on the basis of their effects on consumers. They will need to:

1. Measure the risks to consumers and utility shareholders,

2. Determine how different cost-recovery mechanisms would affect the utility's financial condition and the risks to consumers,

3. Identify and measure the benefits and costs of new and underdeveloped technologies,

4. Determine the proper market structure for deploying the technology, and

5. Determine the effects of consumer education on the market penetration of new demand-side technologies, such as NGVs.

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Natural Gas Vehicles: What State Public Utility Commissions Should Know and Ask

The optimistic outlook for natural gas in the United States has heightened interest in growing the use of this source of energy in various sectors including transportation.[1] Concerns over our dependency on oil imports and greenhouse gas have elevated the urgency of finding alternatives to petroleum-based vehicles. These alternatives, referred to as alternate fuel vehicles (AFVs), include natural gas vehicles (NGVs), biodiesel vehicles, and electric vehicles.[2] They offer our country hope for increased energy independence and a cleaner environment.[3]

The extent to which AFVs will penetrate the transportation market and the contributions of each type hinge on economic, technical, environmental, political, and regulatory factors. A major factor is consumer acceptance of non-petroleum vehicles over petroleum vehicles, which have long dominated the U.S. transportation market.

This paper focuses on NGVs.[4] Fueling sources for NGVs can include compressed natural gas (CNG), liquid natural gas (LNG), or biomethane. CNG allows gas to be stored in a safe and secure cylinder within the vehicle. LNG has the advantage of requiring only 30 percent of the space that CNG needs to store the same amount of energy. The lower space requirement is especially beneficial for heavy-duty trucks traveling long distances. Recoverable from landfills, wastewater, and dairy farms, biomethane emits less pollution than other sources of gas.

This paper has two major purposes. The first is to educate state public utility commissions ("state commissions" or "PUCs") on the status of, and prospects for, NGVs. Compared to vehicles using other forms of energy, NGVs have both favorable and unfavorable features. The appendix highlights the assessments of outside experts on the outlook for NGVs.

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[1] *See*, for example, U.S. Department of Energy and National Energy Technology Laboratory, *Modern Gas Shale Development in the United States: A Primer*, April 2009; and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, May 2010.

[2] For comprehensive information on AFVs, including state/federal financial incentives and detailed information on each type of AFV, *see* DOE AFV Data.

[3] Natural gas is the cleanest of the fossil fuels and a source of energy that is about 98 percent produced domestically (excluding Canadian imports). NGVs emit about 25 percent less carbon dioxide than comparable gasoline- or diesel-fuel vehicles and produce about 80 percent fewer ozone-forming emissions.

[4] NRRI conducted a comprehensive study on NGVs back in 1992. *See* Daniel J. Duann and Youssef Hegazy, *Natural Gas Vehicles and the Role of State Public Service Commissions*, NRRI 92-8 (Columbus, OH: National Regulatory Research Institute, 1992).

The second purpose of this paper is to (1) describe the possible roles that state commissions and local gas utilities might play in NGV development; and (2) identify issues commissions should address and questions they should ask.

I. Utility Involvement in the NGV Market

A. Utilities can assume a wide range of roles

The development of NGVs offers gas utilities an opportunity to increase their profits. At the least, NGVs would increase throughput on the distribution system, which is the major source of profits for gas utilities.[5] In contrast, increases in natural gas demands by the electric power producers would benefit gas utilities less because many, if not most, gas-fired generating facilities bypass the local gas utility system.[6]

Gas utilities can assume different roles in the NGV market. At one pole they can confine their activities to the provision of distribution service under existing regulatory rules to (1) public and private refueling stations and (2) homes with a refueling appliance.[7] In this minimalist role, utilities provide no marketing or promotion of NGVs. They merely provide a natural-monopoly service (e.g., local transportation) at a regulated price.[8] They might also provide city-gate service—for example, the interstate delivery of natural gas to the utility's distribution system.[9] Overall, gas utilities would simply react to the demand for NGVs and not try to affect the NGV market itself.

In a more active role, gas utilities would engage in marketing and promoting NGVs. They might attempt to educate customers on the benefits of NGVs and purchase NGVs for their own fleets. Education and outreach are particularly critical for technologies that, like NGVs, are largely unknown to the general public.[10] This role might also include advocating for governmental financial incentives at the federal, state, and local levels.

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[5] This new throughput might require new investments that utilities can include in rate base and make a return. In a revenue-decoupling world, utilities' profits could increase less or not at all in the short term.

[6] Bypass occurs when a new or existing consumer takes natural gas off the interstate or intrastate pipeline system. These consumers, therefore, require no or minimal services from the local utility.

[7] Distribution service includes transportation from the city gate to the customer's premises as well as backup, storage, and load balancing provided to transportation customers.

[8] One issue is the price they should charge. The utility might justify lower rates to homes with a refueling appliance on the basis that these customers would have a higher load factor than other residential customers.

[9] This situation would occur when the customer has to buy the natural gas itself from the local gas utility. As an example, a residential customer who refuels her NGV at home might not have the right to purchase natural gas from sellers other than the local utility.

[10] Evidence has shown that consumers tend to be myopic in not accounting for the life-cycle benefits of durable goods like motor vehicles. Such shortsightedness, caused by such

Gas utilities might also provide ratepayer-funded financial incentives for the purchase of home fueling appliances, offer price discounts to customers who have NGVs, and provide financial support for the development of central refueling stations. All of these activities attempt to bolster or "jump-start" the market for NGVs. Part III.A of this paper discusses the fundamental question of whether, and under what conditions, a utility should "charge" all customers for a service that would directly benefit only a distinct minority. One essential condition is that the gap between the social benefits and the private benefits of NGVs is large enough to justify a subsidy.

In sum, gas utilities can assume different roles. They range from a minimalist role to a more active role in which utilities attempt to act as a catalyst for market activities. The latter function might include managing and funding an upgraded infrastructure (e.g., refueling stations) that would simulate the market for NGVs. It might also involve promotional activities that subsidize consumers for NGV-related services that utilities provide.[11] An important question is: If utilities, with approval from their commission, engage in active promotion of NGVs with financial assistance from ratepayers, how long should they be able to carry out this activity? If "jump-starting" the NGV market is the rationale for promotion (e.g., giving financial assistance to NGV owners), good commission policy would limit both the money spent and the duration of such activities.

B. Specific utility functions

Possible utility functions are as follows:

1. *Selling of distribution service:* The utility would deliver natural gas owned by a third party from the city gate to the party's refueling station at low pressure; the station would then compress the gas and dispense it at high pressure into NGVs.

2. *Selling of bundled sales service:* The utility would sell the commodity natural gas, and interstate and local transportation to third-party refueling stations.

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factors as uncertainty about the future and imperfect information, might warrant government or utility intervention. It might include better consumer education and financial incentives. Incidentally, benefits-myopic consumers are a major rationale for utility activities promoting energy efficiency.

[11] Questar in Utah has taken a more active role than other gas distributors in the development of NGVs. It has, among other things, (1) assisted fleet operators and others in the building and operation of refueling stations, (2) worked with state and local governments to promote NGVs, and (3) helped to assure adequate utility system requirements to accommodate growing demand for NGVs. Questar's service territory has more than one hundred refueling stations, some of them owned and operated by the utility. Utah has seen a large number of used NGVs imported from other areas of the country. See *American Gas*, "Full Speed Ahead," April 2010: 22-26, at Full Speed Ahead.

3. *Selling of bundled sales service plus "fueling" service:*[12] Besides providing delivery and commodity gas, the utility would own refueling stations in which it would compress the gas and dispense it for vehicle use.

4. *Selling or leasing of home refueling appliances:* The utility would own these appliances and rate base them or lease them to customers who own NGVs.[13]

5. *Dissemination of information on NGVs:* The utility would educate customers on the benefits of NGVs and the availability of government financial incentives.

6. *Marketing of NGVs through promotional and other practices:* The utility would offer discounted rates for NGV-related services and provide financial and other assistance to refueling stations or other entities involved with NGVs.[14]

7. *Research and development (R&D) activities and funding:* The utility would perform the R&D itself or, more likely, contribute funds to other organizations for R&D activities that, among other things, would improve the economics and consumer acceptability of NGVs.[15]

8. *Expansion of infrastructure to accommodate NGVs:* The utility might have to expand its facilities to accommodate NGVs.[16] One possible expansion would be an increase in the number of distribution lines to refueling stations. A utility might also partner with other entities to develop the necessary infrastructure.[17]

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[12] Although gas utilities might have the capability to provide services, such as vehicle repair and maintenance, conversion of vehicles to NGVs, and equipment sales, the author assumes that they are unlikely to do so.

[13] By leasing home refueling appliances, the household would not have to make substantial investments in purchasing, installing, and maintaining the appliances. Third-party financing might help to alleviate this problem.

[14] Discounted rates reflect value-of-service rates that account for the demand characteristics of customers. These rates are discriminatory in that the utility charges different rates to customers in the same class (as long as they fall within the zone of allowable rates). Discounted rates raise the issue of who should bear the cost of discounts (i.e., revenue shortfalls from fully allocated cost revenues)—utility customers, utility shareholders, or both groups sharing the costs.

[15] A major issue revolves around who should fund R&D activities—utility customers, utility shareholders, or both groups sharing the costs.

[16] As with the previous two roles, a major policy issue is who should bear the costs—utility customers, utility shareholders, or both groups.

[17] On September 7, 2010 Atlanta Gas Light (AGL) filed a proposal with the Georgia Public Service Commission to build refueling stations for the purpose of encouraging public and

C. Market structures for different NGV-related functions

"Market structure" refers to the number and concentration of sellers and buyers that consummate trades for specific goods or services and entry conditions affecting those sellers and buyers. The three broad descriptions of market structure are competitive, oligopolistic, and monopolistic. When a market has several actual or potential buyers and sellers, with minimal entry and exit barriers, analysts consider it competitive. In competitive markets, individual firms have no effect on market prices. Oligopolistic markets have few sellers, with each firm having some influence over price. Monopolistic markets have one seller and severe entry barriers. As a rule, if a market is effectively competitive[18] or even oligopolistic,[19] the best results happen with no price regulation. Some markets in their nascent stage lack competitive features, but at a later time acquire them through technological changes, fewer entry barriers, and better-informed consumers.

The previous discussion on possible functions that utilities can perform in the NGV market leads to the policy question of whether non-utility entities can perform them feasibly and economically. If transactions for a specific service, for example, can consummate in a competitive market, the commission should then eliminate any entry barriers that might stifle competition. In this instance, the utility should not have a monopoly in that market and participate as a regulated entity; the commission might also decide not to allow the utility's unregulated affiliate to participate in that market as well.[20] At the other end of the spectrum, if

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private fleets to purchase NGVs. As expressed in its filing, AGL hopes to "seed the market." The utility sees the lack of refueling stations as the primary barrier to the development of NGVs. The utility proposes to work with fleet operators and local governments to construct central refueling stations. It also proposes to work with fleet operators and CNG retailers to encourage market participation. (*See* Docket 32499.)

[18] An effectively competitive market would have a number of features, including (a) consumers have real choices for goods and services, (b) consumers receive proper price signals, (c) individual suppliers are unable to control prices, and (d) no individual firm has an unfair advantage over other firms.

[19] Analysis of oligopoly markets lacks a unifying theory in producing precise, useful results relating market structure to conduct and performance. Oligopoly theory, for example, does not offer any definite price predictions analogous to the predictions of perfectly competitive and monopoly markets. Most theories that are applied predict that prices in oligopoly markets are greater than marginal cost but less than the price of a pure monopolist. Various oligopoly models predict different outcomes because of their varying assumptions about how firms behave, the number of firms in a relevant market, the characteristics of a market and the products sold, and the degree of interaction between firms. *See*, for example, Luis M.B. Cabral, *Introduction to Industrial Organization* (Cambridge, MA: The MIT Press, 2000), 99-126.

[20] Several sources can account for problems arising from a utility-affiliate relationship: the pricing of utility-affiliate transactions, cost shifting, cross-subsidization, discriminatory regulated service from "essential facilities," mandatory tying of "essential facilities" service and

the most efficient market structure for a service (e.g., gas distribution) is a natural monopoly, then having the local gas utility as the sole provider makes economic sense. [21]

Table 1 on page 11 lists the different NGV-market functions and the possible entities that can perform those functions. Although the local gas utility can perform all of the functions listed, other parties can perform most of them as well. The table suggests that third parties can assume several functions in the NGV market, with the utility role limited to providing only the natural-monopoly service, local distribution. The burden, therefore, lies with the utility to show that it should perform a number of functions that other entities presumably can perform. Whether third parties would perform these functions in a competitive environment is a legitimate question that commissions would need to ask. Especially in an underdeveloped market such as that for NGVs, competition might be difficult to achieve initially.

As one illustration, refueling stations do not have the characteristics of a natural monopoly. A market should be able economically to sustain several refueling stations; but this premise assumes a developed market with a large number of NGVs. At the initial stages, however, the number of NGVs might be too small to sustain more than a few refueling stations. Without a regulated utility-owned refueling station, these few stations can exercise market price by charging excessive prices (assuming that they are not subject to price regulation). Thus, a regulated utility-owned refueling station can constrain the price charged by other stations. On the other hand, utility presence in the refueling station can discourage the entry of third-party stations. The utility might have cost advantages because of economies of scale or scope or other advantages that could act as a barrier to the entry of third-party entities. A policy question then becomes: How can a state commission create a "level playing field" between utility-owned and third-party refueling stations?

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unregulated service, and discriminatory release of information from a utility to unregulated entities.

[21] According to one definition of a natural monopoly, if total production costs rise when two or more firms produce instead of one, the single firm in a market is called a "natural monopoly."

II. Essential Information for Commissions

In making good decisions about the utility's proper role in the NGV market, commissions should have certain information, which includes:

Barriers to NGV development

1. Regulatory barriers to the development of NGVs

2. Market barriers to the development of NGVs

3. Market barriers that represent market failures or distortions that might justify government or utility intervention (e.g., financial incentives)[22]

4. Different regulatory, utility, and other actions that address individual regulatory and market barriers and their associated costs

Economics of NGVs

1. The conditions (e.g., technological advancements, low natural gas prices) required for the economic attractiveness of NGVs compared to other AFVs and petroleum vehicles[23]

2. Reasons for the current low penetration rate of NGVs in the U.S.[24]

3. The effect of government financial incentives to "jump-start" the NGV market

4. The proper market structure for refueling and other NGV-related services,[25] with the follow-up question of what role utilities can play in providing those services

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[22] Market failures are those barriers to NGV development that prevent vehicle consumers from making rational and socially desirable decisions. They might stem from third-party environmental and national security benefits, as well as the lack of unbiased information on the economics of NGVs compared to other kinds of vehicles.

[23] What, for example, would trigger the public to purchase NGVs over petroleum vehicles and other AFVs?

[24] The low penetration of NGVs might be a rational response of the market to the unattractive economics and other negative features of NGVs compared to other kinds of vehicles. It might reflect, however, a serious market problem in which vehicles drivers are underestimating the private benefits of NGVs or overestimating the costs.

[25] Are refueling stations, for example, natural monopolies or can they operate in a competitive environment? It is reasonable to conclude that refueling stations could operate in a competitive environment assuming a developed NGV market, similarly to retail gasoline

Social benefits of NGVs

1. The environmental and other social benefits of NGVs[26]

2. The social desirability and competitiveness of NGVs compared to electric vehicles

3. The social desirability of a higher penetration of NGVs, along with the most efficient and effective ways to achieve a higher level if found justified

State experiences with NGVs

1. Examples of successes in states that have promoted NGVs

2. Examples of failures in states that have promoted NGVs

Utility role in providing NGV-related services

1. Possible utility roles and the rationale underlying each one

2. Requisite conditions for utility provision of NGV-related services

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stations, in the absence of evidence showing significant economies of scale or scope to justify a regulated monopoly. Refueling stations can be either limited-access or public. Limited-access stations would offer service only to specific fleets (e.g., city buses, an airport shuttle company). Fleet owners would build and operate their own refueling stations to ensure that their vehicles receive fuel when needed. The utility or a third party alone can own and operate them, or they can form a partnership, say, with an oil company.

[26] If these social benefits are substantial, as a policy matter NGV development then should become the purview of the government's energy and environment policies, rather than just a gas utility and commission matter.

III. Using the Information to Reach Commission Decisions

A. Four questions for commissions to ask

State commissions can influence the development of NGVs. Through their policies, commissions can affect the scope of a utility's NGV-related services, in addition to the utility's incentive to provide those services.

In determining cost recovery and the scope of utility involvement, commissions should evaluate the merits of new and underdeveloped technologies like NGVs on the basis of their effects on consumers.[27] They will need to: (a) measure the risks to consumers and utility shareholders, (b) determine how different cost-recovery mechanisms would affect the utility's financial condition and the risks to consumers, (c) conceptualize and measure the benefits and costs of new and underdeveloped technologies, (d) determine the proper market structure for deploying the technology,[28] and (e) determine the effects of consumer education on the market penetration of new demand-side technologies, such as NGVs.

When social benefits from a technology extend beyond those received directly by direct beneficiaries (i.e., social benefits exceed private benefits), commissions might find it appropriate to spread the costs to all customers. Assume that the benefits from NGVs include a cleaner environment for everyone and less dependency on foreign oil. Commissions might approve the recovery from all utility customers of costs associated with promoting NGVs and investing in additional infrastructure. On the other hand, if the utility and NGV customers alone stand to benefit from NGVs, the risks of utility actions should not fall on the general ratepayer.[29] In this instance, a policy of balancing the risks and benefits would require the shareholders and NGV customers to shoulder the entirety of the risks.[30]

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[27] New technologies or underdeveloped technologies like NGVs frequently have potentially high but uncertain benefits to consumers and society.

[28] Would, for example, some NGV-related services be more efficiently provided in an unregulated market or in regulated markets with natural-monopoly features?

[29] Sometimes, in other contexts, analysts refer to this outcome as "socializing the risks, but privatizing the benefits."

[30] A utility, for example, might invest in new distribution mains in anticipation of demand growth in NGVs. Compared to other situations, this expectation involves a demand-side technology with a high degree of uncertainty as to its market penetration. Funding this investment from all ratepayers would, therefore, impose an excessive risk upon them.

Table 1: Possible Entities Performing NGV-Market Functions

NGV-Market Function	Possible Providers
Selling of distribution service	▪ **Local gas utility**
Selling of bundled sales service	▪ **Local gas utility** ▪ **Third-party marketers (interstate transportation and commodity natural gas)**
Selling of bundled sales service plus "fueling" service	▪ **Local gas utility** ▪ **Third-party marketers (interstate transportation and commodity natural gas)** ▪ **Third parties (refueling stations)**
Selling or leasing of home refueling appliances	▪ **Local gas utility** ▪ **Third parties (manufacturers, wholesale and retail outlets)**
Dissemination of information on NGVs	▪ **Local gas utility** ▪ **Third parties (auto manufacturers, state or federal agencies, natural gas organizations)**
Marketing of NGVs through promotional and other practices	▪ **Local gas utility** ▪ **Third parties (auto manufacturers, refueling stations, gas marketers)**
R&D activities and funding	▪ **Local gas utility** ▪ **Third parties (auto manufacturers, natural gas organizations)**
Expansion of infrastructure to accommodate NGVs	▪ **Local gas utility (distribution, storage, refueling stations)** ▪ **Third parties (refueling stations)**

The public interest might coincide with a commission policy of encouraging those AFVs that are most economical and socially beneficial, which might not include NGVs. The commission's goal should be to approve those AFV-related expenses and investments that maximize net social benefits, encompassing both fewer air pollutants and improved national security. Greater interest so far lies with electric vehicles than with NGVs. It is unclear at this time whether electric vehicles will turn out to be more economical and socially beneficial than NGVs.[31] Both of these vehicles have promise, but each must overcome major barriers to

[31] One study has shown that the life-cycle cost (i.e., the sum of ownership and operating costs) of a Chevy Volt, which is an electric plug-in vehicle introduced to the U.S. market in late

succeed. Electric vehicles, for example, are expensive relative to petroleum vehicles and NGVs, all-electric cars have less range than other vehicles, customer acceptance is uncertain, and home-based charging stations are costly.

Second, commissions need to ask themselves what is the most appropriate role for utilities in the development of NGVs. Part I.B discusses several roles that utilities can play. Commissions might find preferable utilities' acting only as distributors of natural gas to refueling stations. They might conclude that gas utilities' core function is distribution and that they lack any special business acumen in other functions of the NGV market. In other words, the commission, in addition to determining that distribution has the features of a natural monopoly, might view other NGV-related services as competitive in nature.

Third, commissions should comprehend consumer behavior when it comes to selecting vehicles that have different energy sources. They should, for example, understand the major factors (e.g., utility promotion, government financial incentives, life-cycle costs, initial vehicle cost) and their relative importance in increasing the penetration of NGVs. With access to this information, commissions can better evaluate the efficacy of a utility's proposal to promote NGVs. As an illustration, if a utility wants ratepayers to fund additional refueling stations and new distribution lines, the commission should know the extent to which these investments will actually increase the number of NGVs. Investments might add little to develop the NGV market if other factors, like the high initial cost of an NGV or the cost of conversions, substantially explain the low use of NGVs.[32] The reader should know that the optimistic outlook for NGVs expressed in the 1990s never transpired. The Energy Policy Act of 1992 (EPAct of 1992) lifted regulatory impediments to NGVs' development and also provided financial incentives.[33]

2010, is almost 40 percent higher than the cost of a comparable NGV (Civic GX). Although the Chevy Volt has a lower operating cost, its purchase price is much higher.

The study concluded that:

> Because the incremental cost of owning an EV [electric vehicle] exceeds that of owning an NGV, NGVs are in fact under many scenarios presently more cost-effective at reducing greenhouse gases compared to EVs, even though EVs may produce fewer emissions overall. This advantage becomes larger in regions with intensive coal generation or significantly lower natural gas prices. Our analysis shows that unless the purchase price of EVs can be reduced significantly in the short to medium term, *it is likely that NGVs will remain a more cost-effective choice in reducing greenhouse gas emissions*. (Emphasis added) (*See* London Economics Study, at 1.)

[32] Another factor might be the low number of available NGVs for prospective drivers. The high cost of modifying petroleum vehicles to use natural gas might continue to be a problem in limiting the availability of NGVs.

[33] *See* Kenneth W. Costello et al., *A Synopsis of the Energy Policy Act of 1992: New Tasks for State Public Utility Commissions* (Columbus, OH: National Regulatory Research

Notwithstanding this favorable legislation, in addition to low natural gas prices throughout most of the 1990s, the promising future for NGVs never came to fruition. Commissions should ask themselves: Will history repeat itself?

The fourth question relates to commission policy on ratemaking and the appropriate role of gas utilities in promoting NGVs. Under what conditions should commissions care about a utility's actions in promoting NGVs? Should commissions allow a utility to own and operate refueling stations?

B. Areas of commission inquiry

If commissions deem NGVs to be in the public interest, they should then determine:

1. Whether existing rules and regulations hinder the development of NGVs,

2. The most effective actions to take in removing uneconomical barriers,

3. Whether, to what extent, and how utilities should pursue the development of NGVs,

4. Whether gas utilities should provide NGV-related services as a core function or through an unregulated affiliate, and

5. The effect of utilities' NGV activities on customers and other regulatory objectives (e.g., cost-of-service rates, fair competition).

Concerning uneconomical barriers, appropriate responses might range from doing nothing and providing consumer education to compensating for the barriers by offering prospective NGV drivers financial incentives. Doing nothing is justified when the barriers do not produce large enough inefficiencies to offset the cost of intervention. An analogous situation exists when the government tries to intervene in markets with minor problems. Government policies frequently cause counterproductive results or mitigate a problem at a higher cost than necessary.[34] As an illustration, a commission might want to bolster the NGV market by allowing a utility to offer below-cost leasing rates for home refueling appliances. The aggregate cost of the subsidized rates to customers as a whole might exceed any benefits that arise out of this rate policy. On the other hand, doing nothing might produce inferior market performance when

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Institute, June 1993), at 59-62. The legislation recognized several impediments to NGV development, including state price regulation of refueling stations and other forms of regulation, lack of public information on NGVs, the high cost of NGVs, and the deficiency of refueling stations. One reason for the disappointing outcome was that the federal government decided not to mandate the purchase of AFVs by local governments and private fleets.

[34] *See*, for example, Clifford Winston, *Government Failure versus Market Failure: Microeconomics Policy Research and Government Performance* (Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, 2006); and Charles Wolf, Jr., "A Theory of Nonmarket Failure: Framework for Implementation Analysis," *Journal of Law and Economics*, Vol. 22, no.1 (April 1979): 107-39.

serious market problems exist. If, for example, there is little information on the benefits of NGVs over petroleum vehicles, car buyers could make uneconomical decisions.

State commissions must recognize the important role that they can play in developing the market for NGVs. The extent to which NGVs penetrate the market will depend mostly on economic factors, [35] federal and state environmental and energy policies, technological advancements, and the success of other AFVs. At the least, state commissions should attempt to remove those barriers that would impede the socially desirable development of NGVs. They need to walk a tightrope, however, between encouraging promotion that is excessively costly and risky to ratepayers and standing in the way of justifiable NGV development.

C. Ratemaking criteria

A major task of commissions is to ensure "just and reasonable" rates for services that they have determined the utility should perform. In the context of NGVs, such rates should have the following features:

1. *They reflect the costs of an efficient or prudent utility.* Assume that NGVs require the utility to expand its infrastructure to accommodate NGVs or spend money on educating customers. Commissions should determine that these costs are not excessive before allowing utility recovery. Excessive costs are more likely when the ratepayers, rather than the utility's shareholders, bear the risks of bad investments and other imprudent utility activities.

2. *They reflect the cost of serving different customer classes and of providing different services.* Deviations from this principle of ratemaking require that commissions articulate the advancement of a specific public-policy or ratemaking objective. Assume, for example, that a commission believes that NGVs should be an integral part of a state energy policy and have observable environmental and national security benefits. It can then justify approving below-cost rates or subsidies that would "jump-start" the market for NGVs. In this instance, price discrimination advances some articulated social objective that the commission decided would offset the inefficiencies from subsidies or non-cost rates. If utilities want to use ratepayer

[35] Economic factors affect the life-cycle cost of vehicles. The relevant cost is the annual cost of owning, operating, and maintaining vehicles. Cost depends, therefore, on the purchase price of a vehicle, the miles traveled, fuel cost and efficiency, and maintenance cost. Compared to petroleum vehicles, NGVs are more expensive to purchase but cheaper to operate and maintain. In purchasing an NGV, consumers must trade off the higher initial cost for cost savings over time. The same tradeoff exists when prospective consumers are contemplating whether to purchase an electric vehicle or NGV. Electric cars have a higher purchase price than comparable NGVs but lower operating costs. Similarly to energy efficiency in the home, consumers might undervalue energy-cost savings and focus on the initial cost, resulting in uneconomical decisions and overestimation of the payback period. Uncertainty over the operating performance of NGVs and the availability of refueling stations might also discourage the purchase of NGVs.

money to promote NGVs, they should have the burden of proof to demonstrate public benefits or future benefits to funding ratepayers.[36] But even if utilities can show public benefits, an equity problem arises from non-ratepayers' receiving a portion of these benefits without contributing any funds (i.e., being "free riders").

3. *They allow the efficient or prudent utility a reasonable opportunity to earn a rate of return commensurate with its cost of capital.* "Just and reasonable" rates entail commissions' allowing a utility a reasonable opportunity to earn its authorized rate of return when it acts prudently and efficiently. Assume that a utility makes capital investments to expand its distribution system or storage facilities to accommodate NGVs. If the commission previously approved these investments and determined that the utility managed them prudently, it should then allow the utility to earn an adequate rate of return on those investments.

4. *They should reflect fair treatment of the utility's customers and shareholders.* The term "fair" has different meanings. It refers to the treatment of different customers and classes of customers, as well as the utility's shareholders. One interpretation is that a commission's decision determining rates for NGV-related services should not be "arbitrary or capricious." Another is that funding for the development of the utility's infrastructure to accommodate NGVs or spending money in promoting NGVs should balance the risks and benefits. Risk allocation pertains to both the risks among different customers and the risk to customers as a group and the utility's shareholders. Assume that the shareholders and owners of NGVs are the sole beneficiaries of promotional activities. Good regulatory policy dictates that the general ratepayer is held harmless from utility activities to invest and spend other money on accommodating and promoting NGVs.

D. Specific questions on cost recovery and NGV development

Development and promotion

1. Should commissions develop a policy toward NGVs? If they do, what elements should a policy include (e.g., a specified cost-benefit test, the role of utility affiliates, criteria for cost recovery and pricing)?

2. When are NGVs in the public interest? How can utilities demonstrate this condition to commissions (e.g., that the social benefits of NGVs exceed the social costs)?

[36] Third-party or external benefits exist when the pricing mechanism fails to include the social costs from imported oil. These costs include threats to national security and the higher pollutant levels emitted from petroleum vehicles.

3. What role should commissions play in overseeing and approving a utility's plan or strategy for NGVs? Should utilities consider NGVs as part of the integrated resource planning (IRP) process?[37]

4. What role should utilities play in promoting NGVs (e.g., marketing, rate incentives, education,[38] shareholder-funded investments in refueling stations; working and partnering with potential fleet customers, manufacturers of NGVs, and fueling equipment providers)? What are the criteria for utilities to assume a specific role?

5. What role should utilities play in the installation of home refueling appliances?

6. Are refueling stations public utilities with natural-monopoly characteristics? How can commissions know when the refueling business is "workably competitive"?

7. How can a commission create a "level playing field" between utility-owned and third-party refueling stations?[39]

8. What role should gas utilities play in the refueling function (e.g., deliver gas to a refueling station owned by a third party or to a self-owned refueling station; utility partnership with gasoline service-station owners)? When should utilities leave the NGV refueling business?[40] Would the NGV market develop more quickly and

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[37] If commissions do, they might ask: How can utilities justify the development of NGVs when their plan includes energy-efficiency initiatives and pricing that encourage less natural gas consumption? One answer is that residential and other existing customers might be consuming natural gas beyond the level that is socially optimal (e.g., they underestimate the present value benefits from energy efficiency), while gas consumption for NGVs is below the optimal level (e.g., existing drivers of gasoline vehicles should switch to AFVs such as NGVs because they do not account for the higher environmental and "national security" costs of gasoline vehicles).

[38] Whether the gas utility should disseminate information on the merits of NGVs depends on its incentive to distribute unbiased information. Instead, it might be preferable to have the regulator or the state energy office, if they deem the growth of NGVs to be in the public interest, disseminate this information. On the other hand, if commissions found it appropriate for utilities to promote NGVs, disseminating information might be an integral part of that activity.

[39] This question presumes that, especially in a nascent NGV market, the preferred policy is to allow the coexistence of utility-owned and third-party refueling stations. An "uneven playing field" in favor of the utility can discourage entry by third parties and forestall the time that refueling stations could compete with each other.

[40] A legal question is: Does state law grant a commission authority over the resale of natural gas (e.g., by a third-party operator of a refueling station)? If so, then the follow-up question is whether federal law preempts state law. Some commissions have ruled that the EPAct of 1992 preempts state law in the sale of natural gas for use as a vehicle fuel unless a contrary state provision was in place. Specifically, EPAct of 1992 stipulates that the transportation or sale of natural gas for use in NGVs by any entity not otherwise a public utility

competitively without gas utilities' owning refueling stations?[41]

9. Under what conditions should commissions allow a utility affiliate to provide refueling and other NGV-related services? What general policy should commissions have toward diversification by the utility's parent company or the utility itself into the NGV market?[42]

Cost recovery and ratemaking

1. What is the appropriate ratemaking method for NGV-related services provided by a utility (e.g., cost of service, promotional rates, separate rates for customers with home refueling appliances)?[43]

2. Who should pay for initial infrastructure development? If ratepayers fund this development, how should utilities recover the expenditures? Should commissions limit recovery to "start-up" activities that would help bolster the NGV market?

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shall not be considered a transportation or sale of natural gas within the meaning of any state law and regulation in effect before January 1, 1989. (*See* Kenneth W. Costello et al., *A Synopsis of the Energy Policy Act of 1992: New Tasks for State Public Utility Commissions* (Columbus, OH: National Regulatory Research Institute, June 1993), at 59.

In Idaho, the Public Utilities Commission ruled that the term "public utility" includes those persons or entities who "in turn deliver or resell a utility commodity (e.g., natural gas) to the public or some portion thereof for compensation." The commission, however, ruled that EPAct of 1992 gave the federal government supremacy over state law with regard to the resale of natural gas for vehicles. (*See* Idaho Decision.) The California Public Utilities Commission, as another example, has ruled that persons operating service stations that resell compressed natural gas for vehicular use, other than public utilities, are not subject to rate regulation by the commission.

[41] If the utility-owned station receives ratepayer funding and other regulatory-approved advantages, other entities might decide not to compete. The outcome would likely be a smaller number of refueling stations in the long term.

[42] One related question is: If a commission allows a gas utility or its parent to own and operate a refueling station, should the station operate as a separate unregulated affiliate or as part of the regulated utility?

[43] Home refueling appliances allow NGV owners to refuel their vehicles overnight in their homes, from their existing natural gas line. Residential customers with a home refueling appliance would tend to have higher annual load factors (i.e., a higher ratio of average usage to peak demand) than other residential customers. Utilities can, consequently, serve those customers at a lower average cost, and thereby economically justify charging them a lower rate than other residential customers.

3. Who should pay for any NGV promotional or development costs (e.g., R&D expenditures, marketing, customer education)?

4. How should commissions treat the costs associated with home refueling appliances (e.g., rate-basing, lease agreement between the utility and the customer)?

5. How should commissions treat the costs associated with central refueling stations owned by the gas utility?

6. How should commissions review those utility costs paid to an affiliate for the provision of services associated with NGVs?

Appendix: The Current Status of NGVs and Their Outlook

Where Do NGVs Stand Today?

NGVs currently have a minor presence in the U.S. transportation market. NGVs account for only about 110,000 of the 250 million motor vehicles in this country.[44] They originate either from new vehicles produced by an original equipment manufacturer (OEM) or the conversion of existing gasoline or diesel vehicles to NGVs.[45]

The majority of NGVs are either heavy-duty vehicles that travel limited distances (e.g., transit buses, school buses) or other fleet vehicles, such as refuse haulers, taxis, utility vehicles, and delivery trucks. Compared to petroleum vehicles, NGVs have (1) limited refueling availability, (2) higher vehicle costs, (3) shorter driving ranges, and (4) heavier fuel tanks. The combination of these factors largely explains the limited acceptability and use of NGVs in the U.S.

Most of the attention paid to AFVs so far has centered on electric plug-in and hybrid vehicles. Perhaps surprisingly to some readers, electric vehicles have higher life-cycle costs than NGVs.[46] Although electric vehicles do not directly consume fossil fuels that emit pollution, the incremental production of electricity might involve the burning of fossil fuels, such as coal. If state commissions encourage the promotion of electric vehicles, should they not have the same policy toward NGVs? Like electric vehicles, NGVs will reduce our dependency on foreign oil as well as contribute to a cleaner environment.

With regard to the economic factors affecting NGVs, an MIT study explained that:

> The economic attractiveness of CNG [compressed natural gas] vehicles is determined by vehicle incremental cost, mileage driven per year and gasoline-CNG fuel price spread… Previous studies have shown that payback times of three years or less are needed for substantial market penetration. For recent fuel price spreads, low vehicle incremental cost (e.g., $3,000) and high mileage are

[44] *See* RFF Study. In the same year, natural gas accounted for just 0.2 percent of the fuel used by all highway vehicles.

[45] Conversion of a gasoline or diesel fuel vehicle to an NGV requires changes in the fuel storage tank, the fueling receptacle or nozzle, and the engine. EPA regulations, according to some observers, have made conversions uneconomical. Vehicle owners consider conversion costs as upfront costs that they compare with the discounted fuel-cost savings and other benefits from conversion.

[46] *See* study cited in footnote 33.

necessary to meet this requirement. Also, the rate of penetration of CNG vehicles, even if economic, will depend on the provision of refueling infrastructure.[47]

A big challenge for NGVs is expanding the refueling infrastructure to include more stations and other sources of refueling.[48] Another challenge is narrowing the price difference between a conventional vehicle and an NGV. Overcoming the first challenge will demand a much higher number of NGVs to economically justify the building of more refueling stations. But achieving that would first require the building of more refueling stations—a classic chicken-and-egg problem that might justify some form of governmental or utility assistance. The second challenge might require government incentives to lower the purchase price of an NGV and stimulate the building of new refueling stations.[49]

In its *Annual Energy Outlook 2010*, the U.S. Energy Information Administration (EIA) highlighted obstacles that NGVs face in the heavy-duty market:

> Despite the price advantage that natural gas has had over diesel fuel in recent years (an advantage that is projected to increase over time in the Reference case), other factors—including higher vehicle costs, lower operating range, and limited fueling infrastructure—have severely limited market acceptance and penetration of natural gas vehicles…In addition to concerns about driving range and refueling, the residual value of HDNGVs [heavy-duty natural gas vehicles] in the secondary market is likely to be an important consideration for buyers. Also, purchase decisions can be influenced by other factors, such as weight limits on highways and bridges, which can make the considerable additional weight of CNG or LNG tanks a significant drawback in some market segments…The importance of range and refueling infrastructure barriers suggests that the best near-term market penetration opportunity for HDNGVs, some of whose incremental costs are already covered by tax credits, could be in *the market for centrally fueled fleets that operate primarily within a limited distance from their base*.[50] [Emphasis added]

The market barriers identified earlier, however, do not necessarily represent market failures or problems that justify subsidies or other forms of governmental or utility assistance. In

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[47] See The Future of Natural Gas, at 51.

[48] An adequate infrastructure would also include maintenance and repair shops for NGVs.

[49] Tax incentives and other financial inducements have greatly assisted in the nascent development of alternative fuel vehicles (AFVs). Bipartisan support for NGVs and other AFVs will likely extend and expand governmental assistance in the future. But the current political environment might erase some if not all assistance, for budgetary reasons if for no other reason. Incentives under debate in the U.S. Congress at the time of this writing encompass fuel, infrastructure, and vehicle tax incentives. The fuel tax incentive expired at the end of 2009, and the other two tax incentives will expire at the end of 2010.

[50] *See* EIA Analysis, at 33.

different contexts, market dynamics through technological improvements and better consumer information are often sufficient for mitigating, if not eliminating, these barriers.

The Outlook for NGVs

Electric plug-in and hybrid vehicles so far have received the most attention, but the situation could change in the future if NGVs and biofuels overcome certain obstacles and become more economical and acceptable to future vehicle owners.

The consensus among experts is that NGVs and electric vehicles can coexist to displace a portion of the market for conventional vehicles in urban fleets. The most promising markets for NGVs, based on the latest evidence, are commercial and government fleets. Specifically, NGVs' best bet is high-mileage urban (light and heavy) fleets with central refueling. The economic attractiveness of NGVs, compared to conventional vehicles, depends significantly on the life-cycle fuel savings. Fuel savings, in turn, hinge on the price spread between natural gas and gasoline or diesel fuel in addition to the number of miles driven.

The niche market for electric vehicles is the light-duty market.[51] NGVs and electric vehicles, therefore, have complementary features that together can reduce our dependency on foreign oil and improve our environment. Few analysts foresee NGVs as the predominant vehicle in any of the transportation markets. Almost all predict that petroleum vehicles will continue to dominate the motor vehicle market in the U.S. for the foreseeable future.[52]

Some analysts point to the likelihood that electric vehicles will increase the demand for natural gas more than NGVs will, to the extent that the additional electricity production will come from gas-fired generating facilities. The energy consulting firm IHS CERA expressed this view in a recent report:

> The infrastructure needs and higher costs will likely limit significant growth in natural gas vehicles…Very significant policy support would be needed, which would compete with policy support for higher efficiency, biofuels, and electric vehicles. The most likely growth market for natural gas in transportation would be through the electric power sector.[53]

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[51] According to most experts, NGVs as passenger cars are unlikely to develop as much as electric vehicles. Semi-trailer trucks are also unlikely candidates for natural gas. In one sense natural gas can produce large benefits because these trucks have high mileage and low fuel economy—features that would account for high fuel-cost savings from using natural gas. Because of their limited range, however, gas-fueled trucks would have to make more fill-ups, which truckers traveling long distances might find unacceptable.

[52] One exception is if the U.S. adopts stringent greenhouse gas legislation, which seems remote at the time of this writing. Such legislation could dramatically drive up the cost of gasoline and diesel fuel, at least relative to natural gas and other sources of energy that emit less carbon dioxide.

[53] *See* IHS CERA Study, at ES-7.

A report by Resources for the Future (RFF) identifies several challenges that NGVs face:

> Yet even proponents of natural gas concede that these vehicles [NGVs] face significant obstacles to capturing a major share of the market. Irrespective of the vehicle type, there are concerns regarding economics—the equivalent gasoline or diesel vehicle is cheaper, although fuel costs are likely to be higher—as well as concerns about safety and availability of refueling stations. The latter is the "chicken and egg" problem: Vehicle users will not buy NGVs until they believe there are enough refueling stations, but there is little motivation to build an NGV refueling infrastructure until a sufficient number of vehicle owners demand the fuel. There are other concerns as well. The cruising range and cabin space of light-duty vehicles may be insufficient. Heavy-duty trucks may also have inadequate range unless they are fueled by liquefied natural gas (LNG). Intermediate weight trucks, buses, and refuse trucks already use natural gas in significant numbers, but represent a relatively small market.[54]

Economic assessments have shown that all AFVs will continue to require financial and other forms of subsidies for an indefinite period to have a discernible presence in the transportation market.[55] The NGV market, for example, will need assistance to reduce the price of NGVs and stimulate the development of fueling stations. The hope is that new technological advancements will ultimately make NGVs competitive with petroleum vehicles.[56] These advancements can lower the weight of the vehicle tank, as well as the cost of conversion kits and refueling stations. Another hope is that the cost of NGVs will substantially decline as the scale of production increases.

Increased penetration of NGVs should occur simultaneously with the availability of additional refueling stations.[57] Increased vehicle production should lead to higher demand for NGVs, as economies of scale would drive down vehicle prices.

A factor in favor of NGVs over petroleum vehicles is the expectation of a growing gap between natural gas and oil prices in the future. Most forecasts call for the ratio of oil to natural

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[54] See RFF Study, at 2.

[55] One exception to the need for continued subsidies is if the price of gasoline and diesel fuel soars to extremely high levels. Another exception is if the country enacts a stringent carbon policy that would drive up petroleum prices relative to natural gas prices.

[56] NGVs are a mature technology that has gained wide support in several countries. The technological improvements referred to here are mostly incremental in nature with the effect of making NGVs more economical.

[57] A higher number of refueling station can overcome what some refer to as the "range anxiety." This condition, which constitutes a major barrier to NGV development, exists because of drivers' concern over finding stations to refuel when necessary. NGVs have a shorter range than comparable gasoline or diesel-fuel vehicle because of increased vehicle weight and the lower energy density of natural gas. A larger fuel tank can increase the driving range of an NGV, but at the loss of fuel efficiency, cargo space, and payload.

gas prices to rise between 2010 and 2030.[58] This increase should enhance the economic attractiveness of NGVs.

NGVs will also become more competitive if Congress passes legislation on carbon dioxide restrictions. AFVs as a whole would benefit from driving up the cost of operating petroleum vehicles relative to electric vehicles and NGVs. A business-as-usual world, according to most analysts, would not result in rapid growth of NGVs in the U.S. transportation market. A MIT study, for example, projected that:

> Development of the U.S. vehicular transportation market using compressed natural gas (CNG) powered vehicles offers opportunities for expansion for natural gas use and reduction of CO_2 emissions, but it is unlikely in the near term that this will develop into a major new market for gas or make a substantial impact in U.S. oil dependence. However, significant penetration of the private vehicle market before mid-century emerges in our carbon-constrained scenario. Liquefied natural gas (LNG) does not currently appear to be economically attractive as a fuel for long-haul trucks because of cost and operational issues related to storage at -162 degrees Centigrade.[59]

Finally, a big challenge for NGVs is convincing the general public that NGVs are "green," similarly to the way in which many people perceive hybrid vehicles. Hybrid cars have become popular even though to many owners they are not economical. One important reason is that people want to show their neighbors, friends, and others that they are contributing to a cleaner environment. In other words, many people purchase hybrid cars for non-economic reasons. Would they buy NGVs for the same reasons? At this point, the jury is still out. Consumers might shift toward NGVs in moderate numbers if the economics change in favor of NGVs over other AFVs and petroleum vehicles.[60]

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[58] *See*, for example, U.S. Energy Information Administration, *Annual Energy Outlook 2010*, May 2010.

[59] *See* The Future of Natural Gas, at xiv.

[60] Even if the economics are favorable, consumers might still not shift to NGVs. They might, for example, have less-than-adequate information on the economic benefits of NGVs. Inertia can also inhibit them from switching to a non-petroleum vehicle even when it would be in their self-interest. Finally, consumers might focus on the initial higher cost for NGVs, paying inadequate attention to the life-cycle cost. Responding to these market problems might justify governmental and utility intervention.