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ALTERNATIVE-FUELED VEHICLES

Progress Made in Accelerating Federal Purchases, but Benefits and Costs Remain Uncertain

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The Honorable John D. Dingell
Chairman, Committee on Energy
and Commerce
House of Representatives

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy
and Power
Committee on Energy and Commerce
House of Representatives

In response to your requests, this report presents our analysis of the federal government's (1) efforts to accelerate acquisitions of alternative-fueled vehicles for federal use and (2) coordination of programs on alternative fuels. The report contains recommendations aimed at increasing the availability of alternative-fueled vehicles and refueling facilities and reducing the costs of these vehicles.

As arranged with your offices, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretaries of Energy, Defense, and Transportation; the Administrator, General Services Administration; the Postmaster General; the Administrator, Environmental Protection Agency; and other interested parties. We will also make copies available to others on request.

This work was performed under the direction of Victor S. Rezendes, Director, Energy and Science Issues, who can be reached on (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix VI.

Keith O. Fultz
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Executive Summary

Purpose

Alternative-fueled vehicles that use nonpetroleum fuels such as ethanol, methanol, natural gas, propane, and electricity have the potential to improve the nation's air quality and decrease the growing dependence on imported oil. The federal government has intensified its efforts to use these fuels and promote their use by others.

The Chairmen of the House Committee on Energy and Commerce and its Subcommittee on Energy and Power asked GAO to (1) identify any uncertainties about the benefits and costs of using alternative fuels, (2) assess federal efforts to encourage the development of refueling facilities for such fuels, (3) review federal efforts to accelerate acquisitions of alternative-fueled vehicles, and (4) evaluate efforts to coordinate federal, state, and local alternative fuels programs.

Background

Since 1991, the federal government has gradually increased its acquisition of alternative-fueled vehicles, so that approximately 7,800 such vehicles—about 2 percent of the federal fleet—were in operation by the end of 1993. The Department of Energy (DOE) has the primary responsibility for coordinating federal efforts on alternative fuels. A number of states and local communities have also initiated their own programs to encourage the use of alternative fuels.

The Energy Policy Act of 1992 requires that federal and state fleets and alternative fuel providers purchase an increasing percentage of alternative-fueled vehicles. Executive Order 12844, issued in April 1993, increases the purchase requirements for the federal fleet by 50 percent above the act's targets for fiscal years 1993 through 1995. Under the act, the Secretary of Energy may also require municipal and commercial fleets to purchase a certain percentage of such vehicles to meet goals for reducing petroleum use.

Results in Brief

Many believe that alternative fuels have the potential to improve energy security and air quality, while providing economic benefits. However, because of uncertainties, further evaluation is needed to determine the extent to which such benefits can be realized and at what cost.

Because alternative-fueled vehicles are often dispersed rather than concentrated in a few locations, federal efforts to encourage the development of refueling facilities have met with limited success. Also, the shortage of convenient refueling facilities has contributed to the low use

of alternative fuels: Operators of federal dual-fueled vehicles often chose to use gasoline because of its ready availability. Nevertheless, the ultimate success of alternative fuels programs depends on including nonfederal vehicles. DOE developed its Clean Cities Program for this purpose—to encourage state, local, and commercial interests to participate in alternative fuels projects within selected metropolitan areas. This program could potentially encourage the expansion of refueling facilities if certain problems can be solved.

DOE's estimates show that the federal government will fall short of meeting its accelerated targets for acquiring alternative-fueled vehicles. Because of the high cost of some factory-built vehicles, the government plans to convert many existing and new vehicles to operate on natural gas and propane. While conversions may result in more alternative-fueled vehicles and lower prices, they also raise some concerns about safety, emissions, and reliability. Limiting the number of different types of vehicles sought by federal, state, and local fleet operators could increase orders for the selected vehicles, encourage manufacturers to provide such vehicles, and decrease unit costs.

Finally, federal agencies have had some success in coordinating their programs on alternative fuels with state and local programs, but several challenges remain.

Principal Findings

Benefits and Costs of Alternative Fuels Are Not Well Understood

DOE officials are uncertain about the energy security and economic benefits that would be achieved by using alternative fuels, and a study is under way to address these uncertainties. Similarly, data from the Environmental Protection Agency (EPA) indicate that the extent of the air quality benefits of alternative fuels is unknown, and the agency is now addressing this question. Also, none of the agencies with experience using alternative-fueled vehicles has conducted a life-cycle cost analysis. The extent of the overall net benefits will depend heavily on expanding the use of alternative fuels beyond the fleets—the target of most current efforts—to the much larger private vehicle market. The potential for this expansion will depend on how alternative fuels compare with gasoline in cost, performance, and convenience.

Development of Refueling Facilities Has Been Limited

Federal and commercial fleet operators view the shortage of refueling facilities as a serious problem. For example, in some cases, vehicles capable of operating on methanol or gasoline are spread across a wide metropolitan area, with only one or two methanol stations to serve them. As a result, vehicle operators often fill their vehicles with gasoline. The resulting low use of alternative fuels has made it difficult to persuade fuel providers to install additional facilities. The low concentration of federal alternative-fueled vehicles in numerous locations has contributed to this problem, and current plans call for dispersing these vehicles to additional locations in 1994. Thus far, DOE and the General Services Administration (GSA) have not mandated a greater concentration of vehicles. Also, DOE has not yet implemented legislation requiring federal agencies to use alternative fuels unless the Secretary of Energy determines that doing so is not feasible.

To encourage greater development of refueling facilities, DOE developed the Clean Cities Program, which seeks to involve federal, state, local, and private interests in promoting alternative fuels. While this program has the potential to increase the use of such fuels, several problems—including confusion over implementing a fuel-neutral policy, difficulty in recruiting strong local leaders, and a potential shortage of funding—could impede the program's effectiveness.

Acquisition Strategy Is Influenced by High Costs

The federal government acquired approximately 6,800 alternative-fueled vehicles in fiscal year 1993 and plans to acquire an estimated 7,400 in 1994. At these levels of acquisition, the government will approach the 1993 target but fall far short—by about 3,800 vehicles—of the 1994 target set by Executive Order 12844. The limited availability of alternative-fueled vehicles from automobile manufacturers and their higher cost—especially the cost of natural gas vehicles compared with gasoline vehicles—make it difficult to reach the higher acquisition targets. Natural gas vehicles can cost from about $4,000 to $8,000 more than conventional vehicles.

To help meet acquisition targets, federal agencies are converting a number of vehicles to use alternative fuels. For example, in 1994 the Postal Service is planning to convert at least 2,000 vehicles and the Department of Defense about 1,250 vehicles to use natural gas. However, while less costly, converted vehicles may not be as desirable as factory-produced vehicles because converted vehicles are sometimes subject to less stringent emissions and safety requirements than factory models. Also, it is unclear whether acquiring more converted vehicles would encourage

automobile manufacturers to produce additional alternative-fueled vehicles. High production costs and the low volume of vehicle orders have precluded automobile manufacturers from providing all the different types of alternative-fueled vehicles requested by the government. Efforts to limit the number of different types and models of vehicles sought by federal, state, and other fleet operators could encourage vehicle manufacturers to improve the availability and price of such vehicles.

Coordination Remains Challenging

Federal agencies have worked reasonably well together to coordinate the acquisition of alternative-fueled vehicles. The Interagency Committee on Alternative Fuels and Low Emission Vehicles has provided an effective forum for coordination. However, several areas continue to present significant challenges, including defining the role of vehicles designated by EPA as inherently low-emission vehicles, coordinating the research efforts of the departments of Defense and Energy, and overseeing the granting of public access to federal refueling facilities. Also, the states are seeking more technical assistance, including objective comparative information on the life-cycle costs of alternative-fueled vehicles.

Recommendations

GAO is making several recommendations to DOE and GSA aimed at concentrating federal alternative-fueled vehicles in locations near refueling facilities and encouraging fuel providers to develop such facilities. GAO is also recommending that DOE implement legislation requiring federal agencies to use alternative fuels unless the Secretary of Energy determines that operating vehicles on such fuels is not feasible. Finally, GAO is recommending that DOE work with the states and local government agencies to limit the number of different types and models of alternative-fueled vehicles being sought.

Agency Comments

GAO discussed the facts in this report with the officials responsible for alternative fuel issues in a number of federal agencies, including DOE, GSA, and EPA. Chapter 1 lists the agencies and officials contacted. These officials generally concurred with the information presented and said the report represents a balanced and comprehensive assessment of federal efforts to promote alternative fuels. Where appropriate, GAO made revisions on the basis of these discussions. However, as requested, GAO did not obtain written comments on a draft of this report.

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Abbreviations

AFV	alternative-fueled vehicles
CNG	compressed natural gas
CRS	Congressional Research Service
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
EPACT	Energy Policy Act
FFV	flexible-fueled vehicle
GAO	General Accounting Office
GSA	General Services Administration
ILEV	inherently low-emission vehicle
INTERFUEL	Interagency Committee on Alternative Fuels and Low-Emission Vehicles
NHTSA	National Highway Traffic Safety Administration
OEM	original equipment manufacturer

Introduction

According to the International Energy Agency and the Department of Energy's (DOE) Energy Information Administration, petroleum will remain a critical fuel for the United States and other industrialized nations for many years. To lessen the nation's dependence on imported petroleum and reduce harmful emissions from the burning of petroleum-based fuels, the Congress has passed legislation and Presidents Bush and Clinton have signed executive orders that promote greater use of nonpetroleum, alternative motor fuels. In turn, federal agencies have created several programs to implement these laws and executive orders. Several states and local governments have undertaken similar efforts to help promote the use of alternative fuels.

Despite these efforts, one critical barrier has thus far prevented the widespread acceptance and use of alternative fuels and vehicles: a circle of interdependency between vehicle manufacturers and fuel providers that makes each hesitant to expand first. Manufacturers hesitate to produce large numbers of alternative-fueled vehicles (AFV) until alternative fuels are widely available, but fuel providers are reluctant to invest in new facilities in the absence of larger numbers of vehicles that use the new fuels. Other barriers include the higher costs of the vehicles or fuels, or both, and the lower performance of some vehicles. Consequently, neither a wide variety of reliable, inexpensive alternative-fueled vehicles nor an adequate network of refueling locations is yet available. Clearly, convenient refueling facilities are a key to stimulating significant numbers of consumers to purchase AFVs. Another key is making alternative fuels competitive with gasoline in cost and performance.

Alternative Fuel Options

Several alternative fuels can potentially replace gasoline and diesel fuel, the two conventional petroleum-based fuels most vehicles now use. They include electricity, ethanol, methanol, natural gas, and propane.

Because of their very limited range, electric vehicles are not yet practical for most applications. They also remain very expensive, and very few are in service in federal vehicle fleets. However, the federal government is involved in research and development on electric vehicles. Interest in these vehicles remains high because of (1) their potential for improving energy security and air quality, (2) a California mandate requiring automakers to offer zero-emission vehicles for sale in that state beginning in 1998, and (3) the possibility that other states may also adopt California's zero-emission vehicle mandate. Since the electricity to operate these vehicles can be generated from a variety of fuel sources at the power plant

(e.g., coal, natural gas, hydropower, nuclear energy), the actual benefits of electric vehicles for energy security and air quality are expected to vary.

The alternative fuels that most closely resemble gasoline are the alcohol fuels: methanol and ethanol. Both are liquid fuels that can be combined with gasoline in various proportions. Alcohol and gasoline mixtures must generally contain at least 85 percent alcohol to be classified as alternative fuels.[1] Theoretically, both methanol and ethanol can also be used in "neat" form (100 percent alcohol), and Environmental Protection Agency (EPA) officials believe that vehicles burning neat alcohol would produce significantly lower emissions than conventional-fueled vehicles. However, while transit buses burning neat methanol are currently in operation, practical light-duty vehicles capable of using neat ethanol or methanol are still under development. Furthermore, the exact air quality benefits of using alcohol fuels in combination with gasoline are uncertain, and more research is needed to determine the extent of these benefits. (See ch. 2 for additional information on benefits.)

Methanol, which is primarily made from natural gas, is commonly sold for vehicle use as M85, a mixture of 85 percent methanol and 15 percent gasoline. (M85 will be referred to as methanol throughout this report.) Vehicles that can operate on methanol and other mixtures of alcohol fuel and gasoline are called flexible-fueled vehicles (FFV). FFVs, discussed in greater detail later in this chapter along with other types of AFVs, require a special sensor to read the methanol-gasoline mixture and adjust the engine accordingly. Also, because methanol is somewhat more corrosive than gasoline, FFVs need special corrosion-resistant fuel system components. FFVs have been available from the three largest U.S. automakers in the past 2 years at prices only modestly higher than those of comparable conventional vehicles. Consequently, the federal government has already incorporated significant numbers of methanol FFVs into its fleet. Methanol fuel generally costs more than gasoline per mile driven. One reason for this cost difference is that the federal government and many states tax methanol at a higher effective rate than gasoline. Also, the energy content of methanol is about half that of an equal volume of gasoline.

E85, a mixture of 85 percent ethanol and 15 percent gasoline, is available on a very limited basis. It is generally more expensive than gasoline, even with federal and state subsidies. Ethanol is most often used not as an alternative fuel but as a component of E10, or gasohol, a mixture in which

[1]Alcohol content as low as 70 percent is permissible in certain circumstances, as determined by the Secretary of Energy.

10 percent ethanol is blended with 90 percent gasoline. Ethanol is produced primarily from corn in this country, although it can also be made from sugar and other renewable sources. Gasohol burns without difficulty in conventional gasoline-fueled vehicles, and federal and state tax subsidies make it cost-competitive with regular gasoline.

The gaseous fuels—natural gas and propane—also provide important alternatives. At normal temperatures, these fuels are gases and have a lower energy content per unit volume than liquid fuels. Therefore, vehicles that use these fuels require pressurized storage containers to compress more fuel into a given space in an effort to obtain adequate driving range. Because these fuels are used in closed, pressurized systems, they offer significant opportunities to reduce emissions from fuel evaporation, which are difficult to control in nonpressurized liquid fuel systems. Emissions from combustion also appear to be generally lower for gaseous fuels than for gasoline or diesel.

Natural gas is used in vehicles in two forms: compressed natural gas (CNG) and liquified natural gas. CNG is used frequently in light-duty vehicles, such as sedans, vans, and pickup trucks. Generally, the fuel is stored on the vehicle in one or more cylinders that can be pressurized to about 3,000 to 3,600 pounds per square inch. Achieving these pressures requires special compressor stations that can cost several hundred thousand dollars or more. Even at these pressures, CNG has a significant drawback: Because of CNG's lower energy density, the size and weight of the cylinders needed to store the fuels make it difficult to store enough fuel on the vehicle to achieve satisfactory driving range. However, natural gas has great appeal because, given well-designed vehicles, it has the potential to produce lower emissions than gasoline, it is less expensive on a cost-per-mile basis, and there are abundant domestic reserves. Consequently, although the acquisition cost is significantly higher for CNG vehicles than for conventional vehicles, the government has been striving to acquire increasing numbers of CNG vehicles for the federal fleet, and the automobile companies have started to offer more vehicles that use this fuel.

Liquified natural gas is used primarily in large vehicles such as long-haul trucks and transit buses. It requires large, heavy, insulated cylinders that can keep natural gas cool enough to remain in its liquid state. The advantage is that the liquid gas occupies less volume, allowing considerably more fuel to be stored in the container and significantly improving the driving range of larger vehicles.

Propane, also known as liquified petroleum gas, is a by-product of both natural gas production and petroleum refining. As a by-product, propane is in limited supply, and much of the propane available has been used as a feedstock for the chemical industry. Currently, none of the automakers produces a light-duty propane vehicle. However, a number of fleets use propane in converted conventional vehicles because propane (1) often costs less than gasoline and (2) offers greater driving range than CNG. However, because propane is also used as a fuel for heating buildings, variations in the severity of winters can sometimes cause significant fluctuations in its price and availability.

Alternative-Fueled Vehicle Options

This report focuses on light-duty motor vehicles, including passenger sedans, pickup trucks, and vans. Alternative-fueled versions of these vehicles in operation today fall into the following categories:

Dedicated Vehicle—A dedicated vehicle can operate on only one type of alternative fuel. For example, a vehicle that can operate only on CNG is known as a dedicated natural gas vehicle.

Flexible-Fueled Vehicle—An FFV can operate on a varying mixture of two fuels. Current methanol FFVs can run on pure gasoline or on any gasoline-methanol mixture up to 85 percent methanol. Ethanol FFVs operate using a similar range of gasoline-ethanol mixtures.

Dual-Fueled or Bi-Fueled Vehicles—Generally, both of these terms have been used to refer to vehicles than can run on two different fuels, typically one alternative fuel and one conventional fuel, but not at the same time. Such vehicles have separate storage tanks and fuel systems for the two fuels, and generally the operator can switch between the two fuels as desired. However, some newer dual-fueled vehicles are designed so that the alternative fuel must be used up before the switch to the conventional fuel can be made. Vehicles that can operate on either CNG or gasoline are examples of dual-fueled or bi-fueled vehicles.[2]

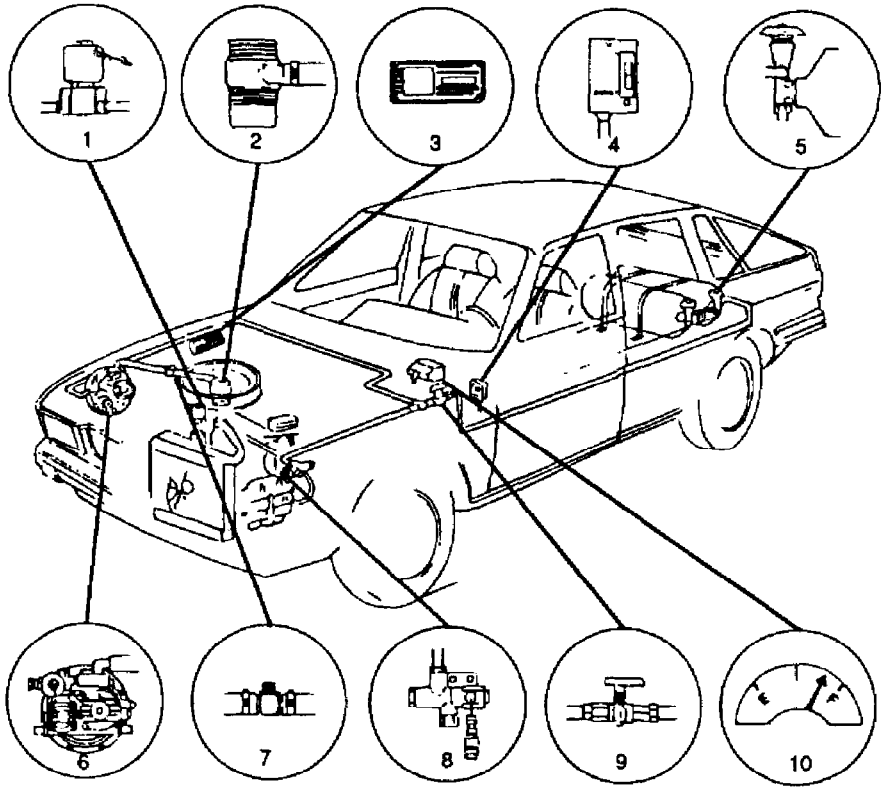
The different types of AFVs discussed above can be produced by an automobile manufacturer in its own production facility. Such vehicles are referred to as original equipment manufacturer (OEM) AFVs. Or, a conventional gasoline vehicle can be converted to use an alternative fuel.

[2]Recently, DOE has developed new definitions that make a distinction between bi-fueled and dual-fueled vehicles. Bi-fueled still refers to vehicles that can use either of two fuels, but not at the same time. Dual-fueled vehicles are now defined as those that have fuel tanks for two separate fuels but burn both fuels simultaneously.

To date, almost all alcohol FFVs have been produced by vehicle manufacturers. In addition, when manufacturers have made specific arrangements with other companies to install alternative fuel systems on their vehicles, the automobile manufacturer continues to provide factory-authorized service and warranty coverage. These vehicles may be considered equivalent to OEM AFVs. Many of the CNG vehicles now being offered are produced in this manner.

In an aftermarket conversion, a customer has a conversion company install an alternative fuel system on a conventionally manufactured vehicle. The majority of CNG and propane vehicles currently in use have been converted in this manner; vehicles are seldom converted to alcohol operation. Aftermarket conversions may result in either dedicated or dual-fueled vehicles. Figure 1.1 illustrates the components of a vehicle converted to use CNG.

Figure 1.1: Illustration of a CNG Vehicle System



Components of a CNG Conversion

1. An automated shut-off valve to cut off fuel to the engine when it is not running.
2. An air/gas mixture and carburetor combination suitable for dual-fuel use.
3. Ignition system adjustment.
4. A fuel selector switch to permit the selection of CNG or gasoline.
5. The fuel cylinders to store the CNG, including a pressure relief device.
6. A pressure regulator to reduce the pressure of the CNG for supply to the carburetor.
7. Supply lines which connect the above components.
8. A refueling connection to receive the probe of the refueling hose.
9. A master shut-off valve.
10. A fuel gauge to indicate the remaining fuel quantity.

Source: Natural Gas Vehicle Coalition.

Federal Legislation and Programs

The Alternative Motor Fuels Act of 1988 and the Energy Policy Act of 1992 (EPACT) included the expansion of alternative fuel use among their primary goals. The Alternative Motor Fuels Act authorized funding for the

purchase of ethanol, methanol, and natural gas vehicles for the federal fleet and required the collection of data on the operation of these vehicles. The act also provided incentives for the automobile companies to begin producing AFVs.

EPACT provides for the gradual phase-in of AFV purchase requirements for light-duty vehicles, such as cars and light pickup trucks. The requirements initially apply to the federal fleet, then, by rule to be promulgated by the Secretary of Energy, to state fleets and those operated by companies that provide alternative fuels. EPACT requires that regulations for alternative fuel providers and state fleets be issued by January and April of 1994, respectively. However, DOE does not expect to propose such regulations until the summer of 1994.

Finally, requirements for AFV purchases may also apply to other private fleets and municipal fleets if deemed necessary by DOE to meet the goals for displacing petroleum-based motor fuels contained in the act. The law provides the Secretary of Energy with two options for requiring private and municipal fleets to increase the percentage of AFVs they acquire, depending on the progress made toward reaching the displacement goals. With the exception of the first 3 years in which the federal requirements apply, when the purchase of specific numbers of AFVs is mandated, the law requires that AFVs make up set percentages of the covered fleets' annual vehicle acquisitions. With respect to alternative fuel providers and private municipal fleets, the Secretary has the authority, in certain instances, to revise the percentage requirements downward if appropriate. Table 1.1 summarizes the schedule for phasing-in these acquisition mandates.

Table 1.1: Phase-in of AFV Acquisition Mandates Under EPACT

Year	Federal fleets	State fleets	Alternative fuel provider fleets	Private and municipal fleets: first option	Private and municipal fleets: second option
1993	5,000	[a]	[a]	[a]	[a]
1994	7,500				
1995	10,000				
1996	25%	10%	30%		
1997	33%	15%	50%		
1998	50%	25%	70%		
1999	75%	50%	90%	20%	
2000	75%	75%	90%	20%	
2001	75%	75%	90%	20%	
2002	75%	75%	90%	30%	20%
2003	75%	75%	90%	40%	40%
2004	75%	75%	90%	50%	60%
2005	75%	75%	90%	60%	70%
2006	75%	75%	90%	70%	70%

[a]A blank cell indicates that the category is not applicable.

EPACT also recognizes additional alternative fuels that were not covered by the Alternative Motor Fuels Act and establishes a number of data collection and reporting requirements to be carried out by DOE and other agencies. In addition, EPACT provides for individual and corporate tax deductions for qualified clean-fuel vehicles and certain refueling properties as well as tax credits for qualified electric vehicles.

The Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991, while not directly promoting alternative fuels, nonetheless contain important provisions that could encourage the acquisition of AFVs and the use of alternative fuels. For example, the Clean Air Act Amendments call for some states to establish programs requiring certain fleets in heavily polluted areas to acquire vehicles that emit low levels of certain pollutants, and some of these vehicles could operate on alternative fuels. The transportation legislation authorizes funding for transportation-related projects and programs that have air quality benefits. Under certain circumstances, alternative fuels programs may be eligible for this funding.

In addition, past administrations and the current administration have issued executive orders to encourage the federal use of alternative fuels and accelerate federal plans for acquiring AFVs. On January 5, 1981, President Carter issued Executive Order 12261, requiring federal agencies to use gasohol—gasoline blended with 10 percent alcohol—whenever feasible. On April 17, 1991, President Bush signed Executive Order 12759, calling for the federal government to decrease its consumption of petroleum fuel and acquire the maximum practicable number of AFVs. And on April 21, 1993, President Clinton signed Executive Order 12844, increasing by 50 percent EPACT's federal AFV acquisition goals for fiscal years 1993 through 1995 and establishing a Federal Fleet Conversion Task Force (Task Force) to develop recommendations on methods of rapidly expanding the availability of alternative fuels and AFVs. The Task Force issued an interim report, with a number of recommendations to the President, in August 1993. The President accepted the report in December 1993, and the Secretary of Energy has stated that DOE will implement those Task Force recommendations that are consistent with EPACT. Specific elements of these recommendations are discussed in several sections of this report.

To comply with these laws and executive orders, federal agencies have undertaken various initiatives that affect the development and use of alternative fuels and vehicles. For example, DOE is responsible for providing federal leadership on the acquisition and use of AFVs. This responsibility includes helping agencies develop multiyear acquisition plans, collecting data on the vehicles' performance, and funding the higher acquisition cost of an AFV relative to a conventional vehicle or the conversion of a vehicle to use an alternative fuel. DOE has also developed a Clean Cities Program to promote the use of AFVs and the development of refueling facilities at the local level.

The General Services Administration (GSA), responsible for managing a major portion of the federal vehicle fleet, provides AFVs to federal agencies by either purchasing the vehicles from the automakers and then leasing them to other agencies or negotiating vehicle purchase contracts on behalf of other agencies. GSA also works with fuel providers to encourage the development of alternative refueling facilities.

The Department of Defense's (DOD) Advanced Research Projects Agency has received funding for research, development, and demonstration projects involving electric and natural gas vehicles and refueling facilities. The United States Postal Service (Postal Service) has an alternative fuels

program in which some of its mail hauling vehicles are converted to use CNG. EPA has developed regulations and guidance for the Clean Fuel Fleet Program, which will assist states in developing rules that require some fleets to acquire vehicles that emit low levels of certain pollutants. Appendix I provides additional information on the laws, executive orders, and program activities discussed here.

State and Local Efforts to Promote Alternative Fuels

Various state governments have initiated their own programs and activities to promote the use of alternative fuels and vehicles. The impetus behind many of these efforts has been to (1) satisfy federal mandates on attaining cleaner air, (2) improve the nation's energy security status, and (3) promote local economic growth. For example, California has promoted alternative fuels both to help address its severe air pollution problem and to become less dependent on imported oil. Some states also promote particular alternative fuels because they are large producers of those fuels. For instance, Texas, a leading producer of natural gas and propane, has promoted these fuels in its efforts to improve air quality. The Texas program includes an aggressive schedule requiring most publicly operated fleets operating in the state to phase in the acquisition of AFVs.

Several local communities have also initiated efforts to include alternative fuels as part of their strategy to address air quality problems. For example, the city of Denver has passed an ordinance requiring certain fleets to acquire AFVs. Appendix II provides additional details about state and local alternative fuels programs.

Manufacturers and Fuel Providers Are Locked in a Circle of Interdependency

Despite the many federal, state, and local efforts and the growing commitment from fuel providers and automobile manufacturers, the problem of who will expand first in providing alternative fuels and AFVs has yet to be resolved. There are still not enough AFVs available at favorable prices, there are still not enough alternative refueling facilities, and neither industry group is able to take the risk of getting too far ahead of the other. This interdependency of the fuel providers and automobile manufacturers is commonly referred to as "the chicken and egg problem."

According to DOE officials, the Congress recognized this problem when it enacted EPACT. Through various measures, such as fleet acquisition mandates and tax incentives, the law attempts to encourage the production of AFVs and the development of refueling facilities. Executive Order 12844 attempted to enhance the effectiveness of certain of these

EPACT measures by increasing federal acquisition targets and encouraging federal, state, local, and private cooperation in addressing the problem of interdependency.

The Federal Fleet Conversion Task Force described the interdependency problem as a critical obstacle to advancing the widespread use of alternative fuels and AFVs. In its first interim report, the Task Force noted that the lack of widespread alternative refueling facilities creates a disincentive to purchase and operate AFVs. The Task Force pointed out that conversely, automobile companies have been unable to sell large numbers of AFVs and that this lack of strong demand for AFVs is prompted in part by the inadequacies in refueling facilities. This circle of interdependency discourages the development of additional AFVs and results in higher unit costs for the AFVs that are produced.

The Task Force recommended that the federal government undertake an aggressive, coordinated effort to resolve this ongoing problem. The Task Force considers its recommendation for a Presidential Clean Cities Initiative, which builds on DOE's Clean Cities Program, a positive first step towards removing the barriers and providing the incentives to resolve the problem. These programs are described in greater detail in Chapter 3.

Objectives, Scope, and Methodology

We conducted this study for the Chairman, House Committee on Energy and Commerce, and the Chairman, Subcommittee on Energy and Power, House Committee on Energy and Commerce. As agreed with the requesters' offices, we identified uncertainties relating to the overall benefits and costs of using alternative motor fuels (ch. 2). We also assessed federal efforts, such as the Department of Energy's Clean Cities Program, to encourage the development of refueling facilities for alternative fuels (ch. 3). In addition, we reviewed federal efforts to accelerate the acquisition of AFVs, taking into account the potential impacts of converting existing vehicles to use alternative fuels (ch. 4), the federal fleet's experiences to date using these vehicles (app. III), and the need to develop uniform standards and regulations for AFVs (app. IV). Finally, we evaluated the coordination of federal, state, and local alternative fuels programs (ch. 5).

To address these objectives, we contacted seven federal agencies—DOE and GSA, because of their primary roles in carrying out alternative fuel programs; EPA and the Department of Transportation, because of their roles in developing automobile emissions and safety standards,

respectively; and DOD, the U.S. Department of Agriculture, and the Postal Service, because of those agencies' large numbers of fleet vehicles.

We also attended several meetings of the working groups of the Federal Fleet Conversion Task Force, met with several of their members, and reviewed the Task Force's first interim report to obtain information on the development of a public- and private-sector plan for accelerating the commercialization, production, and market acceptance of AFVs nationwide.

We also contacted state and/or local energy and environmental agencies in seven states (California, Colorado, Georgia, Illinois, Michigan, New York, and Texas) and Washington, D.C. We selected these locations on the basis of discussions with federal agency officials and our knowledge that many of these locations have undertaken significant initiatives to promote clean or alternative transportation fuels. Some were also selected to provide geographic coverage. Our selection of state and local agencies is not all inclusive. We recognize that other states and localities may also have undertaken significant initiatives to encourage greater use of clean or alternative fuels. In addition, we contacted fuel providers, automobile manufacturers and conversion companies, and other industry and governmental organizations. Appendix V lists the nonfederal agencies and organizations we contacted during our review.

To identify uncertainties about the overall benefits and costs of using alternative motor fuels, we agreed with the requesters' offices that we would determine what is known about the extent to which the use of alternative fuels would provide energy security, environmental, and economic benefits and about the potential related costs. To make this assessment, we interviewed federal agency officials and reviewed numerous agency reports and records on these issues, including the results of the Federal Fleet Conversion Task Force.

To assess federal efforts to encourage the development of alternative refueling facilities, we interviewed federal agency officials and fuel providers and reviewed applicable records to (1) identify the process for developing alternative refueling facilities, (2) determine the locations of these facilities and the extent to which development has occurred for the different alternative fuels, and (3) determine the extent to which federal agencies are using alternative fuels. We also obtained and evaluated information on the Clean Cities Program, which was originally proposed by DOE and adopted as one of the primary recommendations by the Task

Force. The intent of this program is to accelerate the use of alternative fuels by coordinating public and private efforts to acquire AFVs and establish the necessary refueling and repair infrastructure. In Atlanta, Georgia, the first location chosen as a pilot "Clean City" by DOE and the one that has progressed most, we met with representatives of Clean Air Transportation-Atlanta to discuss the city's experiences in implementing the program.

To review federal efforts to accelerate the acquisition of AFVs, we reviewed EPACT and Executive Order 12844, which established AFV acquisition mandates for the federal fleet. We also reviewed the federal agencies' plans and policies as well as the funding available for acquiring AFVs or for converting conventional vehicles to use an alternative fuel. In addition, we gathered information on the comparative availability and cost of AFVs acquired from the automobile manufacturers and those acquired from conversion companies, the extent to which the AFV acquisition targets may be met with vehicles from these two sources, and the advantages and disadvantages of acquiring AFVs from original equipment manufacturers versus aftermarket conversion companies.

To obtain information on federal agencies' experiences with the operation, fueling, and maintenance of AFVs, we conducted structured interviews with GSA fleet managers in nine major metropolitan areas: Atlanta, Baltimore, Chicago, Denver, Detroit, Los Angeles, Houston, New York, and Washington, D.C. We recognize that these data may not be representative of the experiences of all the users of AFVs in the federal fleet. However, we obtained similar data from other sources. For example, we obtained information from the Alternative Fuels Data Center on the demonstration AFVs that DOE purchased under the Alternative Motor Fuels Act of 1988. In addition, we reviewed the California fleets' experiences with AFVs reported in a 1993 survey conducted by the National Association of Fleet Administrators. We also reviewed studies and reports prepared by federal agencies that use AFVs to further document information on experiences with these vehicles.

To obtain information on the emissions and safety regulations and other standards being developed for alternative fuels and AFVs, we interviewed officials from EPA and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) and industry representatives and reviewed applicable documents from these organizations.

To evaluate the coordination of federal, state, and local alternative fuels programs, we interviewed and reviewed correspondence from officials in the seven federal agencies, the seven states mentioned above, the local energy and environmental agencies, the coordinating associations of these agencies, and industry organizations. We also reviewed the missions of the federal agencies to identify potential concerns about coordination. From the above sources, we identified the major efforts to coordinate alternative fuel programs. The information we obtained from the state and local agencies we contacted also may not be representative of all such agencies. When possible, however, we obtained supplementary information from regional organizations representing several states and reviewed other reports, such as the report of the federal, state, and local programs and regulations working group of the Federal Fleet Conversion Task Force. In addition, we reviewed DOE's progress in implementing several provisions of EPACT that provide for coordinated alternative fuel programs.

We conducted our work from May 1993 to May 1994 in accordance with generally accepted government auditing standards. We discussed the factual content of the report with responsible agency officials in DOE's Office of Alternative Fuels and Office of Energy Demand Policy; GSA's Fleet Management Division and Automotive Commodity Center; EPA's Office of Regulatory Programs and Technology; the Department of Transportation's NHTSA and Federal Highway Administration; DOD's Office of the Deputy Undersecretary of Defense for Environmental Services; and several offices involved in the procurement and management of fleet vehicles within the U.S. Postal Service. The agency officials contacted generally concurred with the information contained in this report. Several of the officials stated that the information reported provides a balanced and comprehensive assessment of alternative fuels issues. The agency officials suggested changes to update or clarify the information presented, and we incorporated such changes into the report where appropriate. However, as agreed with the requesters' offices, we did not obtain written agency comments on a draft of this report.

Potential Benefits and Costs of Using Alternative Fuels Are Uncertain and Depend on a Number of Interrelated Factors

The primary objectives of encouraging the development and use of alternative motor fuels are to improve energy security, decrease environmental pollution, and provide economic benefits through the production and use of domestic fuels. Although the use of alternative fuels may help achieve such benefits, further evaluation is needed to determine the extent to which these benefits can be realized and the costs of using such fuels.

Questions about whether alternative fuels can help realize some or all of the potential benefits may not be fully answered until the use of alternative fuels goes beyond fleets and the fuels are widely accepted by the general public. As discussed in chapter 1, most current efforts are directed at increasing fleets' use of alternative fuels. To gain acceptance by the general public, alternative fuels will need to be competitive with existing fuels in availability, cost, and performance.

Energy Security Benefits Are Not Well Understood

Alternative motor fuels have the potential to improve energy security by displacing imported oil in the transportation sector. However, the exact nature and extent of these benefits and the potential offsetting costs are not well understood.

In 1991, the United States consumed about 17 million barrels of oil per day, accounting for over one-fourth of the world's daily oil consumption. Furthermore, in 1991 oil imports accounted for about 40 percent of domestic petroleum consumption. According to DOE's Energy Information Administration, the transportation sector is almost completely dependent on petroleum as an energy source and currently accounts for about two-thirds of total domestic oil consumption. The Energy Information Administration projects that petroleum imports will continue to rise, reaching about 60 percent of domestic consumption by 2010.[1] This rise is expected because of lower oil prices, which discourage domestic oil production while stimulating consumption.

Our review of federal and state initiatives directed at encouraging the increased use of alternative motor fuels, and many studies on their use, showed that improved energy security is one of the major incentives for these initiatives. For example, the Federal Fleet Conversion Task Force stated in its August 1993 report that the increased use of alternative fuels rather than gasoline or diesel fuels can significantly reduce the United

[1]This projection, published in January 1994, is based on the Energy Information Administration's "reference case" assumption of world crude oil prices at $18.20 a barrel in 1992, $20.72 a barrel in 2000, $24.90 a barrel in 2005, and $28.16 a barrel in 2010, in 1992 dollars.

States' dependence on foreign oil and increase energy security by diversifying the transportation sector's fuel supply.

Proponents of alternative fuels believe that our energy security could be enhanced and the economic impact of oil supply disruptions could be lessened to the extent that alternative fuels are produced domestically, are not petroleum based, or are obtained from more diverse or less volatile areas of the world. However, the precise extent to which using alternative fuels may improve energy security is a complex issue and not well understood. The Federal Fleet Conversion Task Force recently recommended that additional research be done to assess the benefits of AFVs in reducing oil imports and the economic impacts on various strategies to reduce oil imports. Also, DOE issued a Domestic Natural Gas and Oil Initiative in December 1993 aimed at reducing the nation's reliance on imported oil by stimulating domestic production of natural gas and oil. The initiative calls for a reexamination of the costs and benefits of increased oil imports. During 1994, DOE plans to head an interagency team to assess the near- and long-term implications for energy security, the environment, and the economy of the nation's rising dependence on oil imports.

Extent of Environmental Benefits Is Uncertain

Another major reason for encouraging the use of alternative motor fuels is to improve air quality by reducing the pollutants produced by the petroleum-based fuels used in the transportation sector. EPA officials believe that if sufficient resources were devoted to developing optimized, dedicated AFVs, significant reductions in emissions could be achieved for these vehicles in comparison with conventional motor vehicles. However, a number of uncertainties exist on the extent to which these benefits can be achieved.

Motor vehicles, which are a major contributor to air-quality problems in urban areas, are responsible for about two-thirds of all carbon monoxide and at least one-third of all emissions of hydrocarbons and nitrogen oxides. Hydrocarbons and nitrogen oxides react in the atmosphere to form ozone, a primary ingredient of urban smog. In addition to these pollutants, motor vehicles emit approximately one-half of the nation's toxic air pollutants. EPA and others generally recognize that most alternative fuels will reduce carbon monoxide, ozone, and toxic air pollutants when compared with conventional gasoline. However, the petroleum and automobile industries disagree with EPA on the extent of these reductions.

Another uncertainty is the extent to which conventional vehicles that use new cleaner-burning gasoline—known as reformulated gasoline—will be used rather than AFVs. The Clean Air Act Amendments of 1990 require the use of reformulated gasoline in certain locations starting in 1995. Other locations may also voluntarily adopt the requirement to use reformulated gasoline. As with alternative fuels, the extent to which reformulated gasoline will be used and the extent of the environmental benefits it will provide are uncertain.

Because limited documentary evidence is available supporting the claims of the emissions benefits of using both alternative fuels and reformulated gasoline, further evaluations are planned or under way. In December 1992, EPA had developed a draft research strategy for evaluating the air quality benefits of alternative fuels in comparison with those of conventional and reformulated gasoline. Noting the uncertainties about the potential benefits and risks, the draft strategy outlines a number of long-term research needs, including a focus on the effects on the levels of ozone and toxic air emissions of using alternative fuels.

Also, DOE has collected only limited data on the emissions, operations, and performance of AFVs. In a July 1993 report to the Congress on the Federal Alternative Fuel Program Light Duty Vehicle Operations, DOE reported that there are inadequate emissions data to draw any statistically valid conclusions about the benefits of AFVs concerning emissions characteristics. DOE reported that it has developed a test plan for more extensive and comprehensive testing of the emissions of the light-duty vehicle fleet it has in service.

In a 1991 study evaluating the use of alternative motor fuels, the Congressional Research Service (CRS) also reported a significant amount of uncertainty about the extent of the environmental benefits of some alternative fuels. It reported, for example, that fuels such as 100-percent ethanol or methanol can result in less damaging emissions than conventional gasoline. However, ethanol and methanol are currently used in a mixture of 85 percent of the alternative fuel and 15 percent gasoline in conventional engines modified to use these fuel mixtures. Furthermore, the CRS study and other studies on alternative fuels point out that although some types of emissions may be lower, other types of emissions could be higher when alternative fuels are used. For example, although the use of methanol may reduce emissions of ozone-forming hydrocarbon and toxic

air emissions, its use may increase formaldehyde emissions from tailpipes.[2] The CRS study reports that, in general, emissions of nitrogen oxides and carbon monoxide tend to be lower from engines running on methanol mixtures containing over 85 percent methanol but that emissions from individual vehicles vary considerably. CRS' study suggests the need for further tests of the effect on emissions of using some alternative fuels. The Federal Fleet Conversion Task Force also recommended in its August 1993 report that further research be done to identify the environmental benefits of various types of AFVs.

Economic Benefits and Costs Need Further Analysis

The use of alternative motor fuels may provide economic benefits. However, the extent to which these benefits may be realized and the costs associated with using AFVs need further analysis.

DOE, the Federal Fleet Conversion Task Force, and others have stated that the use of domestically produced alternative fuels may increase employment in the domestic fuel industry and reduce oil imports and thus the nation's trade deficit. While employment may increase in energy-related employment and trade, there is no reason to believe that overall domestic employment would be similarly affected or that the trade deficit would decrease. We believe that overall domestic employment is more closely linked to the total quantity of goods and services in the economy and the prices Americans pay for those goods and services, while the trade deficit depends on national savings and investment rates. For example, if alternative fuels cost consumers more than conventional fuels, consumers would have less to spend on other goods and services, thus reducing the demand for such goods and services and the employment used to produce them. Total employment in this situation may change little. In addition, if consumers bought more domestically produced alternative fuels, countries that currently export fuel would have fewer dollars to buy American goods and services. Thus, lower imports of oil could indirectly lead to lower exports in other sectors of the economy, in which case the trade deficit would remain essentially unchanged. On the other hand, we believe economic benefits would be achieved if alternative fuels could be produced at a lower cost than conventional fuels. In this case, the U.S. standard of living would improve because the funds consumers would save could be spent in other areas.

[2]EPA officials point out that certain compounds in gasoline emissions react in the atmosphere to form formaldehyde. Therefore, they believe that the overall formaldehyde pollution from methanol and gasoline vehicles may be similar.

According to DOE officials, while some preliminary analyses show economic benefits to using alternative fuels, limited quantifiable information or analysis exists on such benefits. In connection with a review required by section 502 of the Energy Policy Act of 1992, DOE is currently undertaking a comprehensive study of the economic feasibility of using alternative fuels to displace a certain percentage of motor fuels. According to the study's methodology, the benefits are dependent on several factors, including the prices of alternative fuels, and the efficiencies of AFVs. As discussed above, the Federal Fleet Conversion Task Force also recommended that additional research be conducted to identify the economic benefits of various types of AFVs.

With respect to costs, EPACT requires that DOE—in acquiring, reporting, and providing information on the use of AFVs—develop data on the life-cycle costs of AFVs. (Life-cycle costs are the total costs of purchasing the vehicle and operating it over its life.) Also, in requiring increased purchases of AFVs for the federal fleet, Executive Order 12844 (Apr. 21, 1993) provides that the federal government consider and minimize life-cycle costs in the acquisition of such vehicles. However, to date, information on the life-cycle costs of AFVs is limited, and DOE has not yet conducted an analysis of such costs for these vehicles compared with gasoline-fueled vehicles.

DOE officials said that given the AFVs' early state of technology development, the information needed to perform a reasonable life-cycle analysis is not yet available. For example, they told us that the most extensive data available so far on any group of AFVs is the data from the Alternative Fuels Data Center on the 65 methanol FFVs purchased for the first year of the Alternative Motor Fuels Act demonstration. However, 40 of those vehicles were preproduction Ford Tauruses that were, in effect, research and development vehicles. As expected, they had many maintenance and performance problems while the start-up problems were ironed out. Under these conditions, the data on performance, down-time, and maintenance costs could not be considered representative of a normal production vehicle. According to the DOE officials, the AFVs have to be in use longer and reach a level of maturity before any life-cycle analyses performed allow for realistic comparisons with mature gasoline vehicles. According to a DOE official, an analysis of life-cycle costs will be conducted within the next few years after DOE gains further data on AFVs' operations.

In 1992, the Center for Naval Analyses conducted a study of AFVs for the Department of Navy, including an analysis of the life-cycle costs of AFVs

compared with conventional vehicles. Because (1) factors such as future vehicle costs and fuel prices are uncertain, (2) current operational data on AFVs are limited, and (3) the AFV industry is undergoing rapid change, the study concluded that the Department of Navy should not make a commitment to a single fuel at this time. It identified the need for additional information on the operations and costs of AFVs to reduce present uncertainties.

Although the Postal Service has not conducted a study of the life-cycle cost of the AFVs is uses for carrying mail, it reported that CNG dual-fuel conversion kits have, in the past, cost between $2,000 and $2,500 above the base price of a conventional vehicle.[3] However, it also reported the annual operating and maintenance costs were $224 lower for its CNG vehicles than for its conventional vehicles.

Based on our review of the current cost data on AFVs and alternative fuels—which to date are is available on only a limited number of AFVs and limited operating experiences—and discussions with federal agencies and private industry officials, the current life-cycle costs of AFVs are generally higher than those of gasoline-fueled vehicles. The main factors that affect these higher costs include the incremental cost of purchasing AFVs or converting conventional vehicles to use an alternative fuel; higher maintenance and repair costs for some types of AFVs; and higher fuel costs for certain fuels, such as ethanol and methanol. Also, although there is no experience to date on the resale of AFVs, resale prices may be lower than those of their gasoline-fueled counterparts because of higher purchase costs, lower performance, and the limited number of refueling facilities available.

Widespread Public Acceptance Is Necessary to Fully Realize Potential Benefits

The Federal Fleet Conversion Task Force recently reported that to achieve the anticipated energy security, environmental, and economic benefits of alternative fuels, the fuels must penetrate beyond use by the fleets to widespread use by the general public. Current efforts to promote AFVs is primarily directed at the fleets. However, the extent to which the general public will accept and use these fuels remains uncertain.

[3]Under a contract awarded in February 1994, the cost of converting Postal Service vehicles to use CNG will range from $1,800 to $2,300.

Low Number of Fleet Vehicles Provides Limited Potential for Alternative Fuels to Displace Oil

As discussed in chapter 1, EPACT mandates that the federal government purchase an increasing percentage of AFVs starting in fiscal year 1993 and that the states purchase AFVs starting in model year 1996. The act may also result in private fleets having to purchase AFVs in model year 1999. Even so, the number of vehicles in the federal fleet (estimated at about 565,000) is small. Even adding the number in the state, county, and municipal vehicle fleets (about 2.9 million) and the total number of private fleet vehicles (about 10 million), the total is small compared to the total number of vehicles on the road (about 190 million). As recognized by the Federal Fleet Conversion Task Force, for alternative fuels to make a significant contribution in providing energy security, environmental, and economic benefits, their use must extend beyond the fleets.

The extent to which alternative fuels will displace petroleum appears limited. At this time, DOE is not projecting that alternative fuels will significantly displace petroleum-based fuels. DOE's estimate is that under EPACT's fleet requirements and state incentives, alternative fuels will replace about 400,000 barrels of gasoline per day by 2010—about 4.7 percent of the total estimated gasoline consumption. Also, an additional 500,000 barrels—or about 8 percent of the estimated gasoline consumption—could be replaced by nonpetroleum-based oxygenates, such as ethanol blended with gasoline. As required by EPACT, DOE is currently determining the technical and economic feasibility of meeting the act's goals to replace 10 percent of petroleum-based fuels by 2000 and 30 percent by 2010.

In March 1994, CRS issued a report on the impact of highway fuel taxes on cost considerations for AFVs.[4] CRS reported that the Omnibus Budget Reconciliation Act of 1993, with its 4.3 cent per gallon deficit reduction tax on transportation fuels, has added to the economic hurdles that alternative fuels and AFVs must overcome. CRS concluded that under the current tax policy, use of alternative fuels will replace less than 10 percent of gasoline usage by 2010 and alternative fuels will not achieve significant penetration of the market among operators not covered under the current mandates. CRS' report discusses various tax policy options to foster greater penetration of the market by AFVs.

[4]Impact of Highway Fuel Taxes on Alternative Fuel Vehicle Economics, CRS, Mar. 16, 1994.

Uncertainties Affect Potential AFV Penetration Beyond Fleet Use

We previously reported on the experiences of Brazil, Canada, and New Zealand in using alternative fuels.[5] That report suggested that the extent to which the general public would purchase and use alternative fuels depends on whether alternative fuels are competitive with gasoline in terms of the costs of AFVs and alternative fuels, vehicle performance, and the convenience of refueling. As suggested above and discussed in more detail in appendix III, the limited experience with alternative fuels to date indicates that major hurdles need to be overcome if these fuels are to become competitive with gasoline and thus more widely accepted by the general public.

Other studies have discussed the importance of developing the extensive refueling facilities needed if the public is to accept and use alternative fuels. For example, according to a Ford Motor Company official, a company-sponsored survey shows that the public wants extensive refueling facilities in place before considering the purchase of an AFV. Also, in a 1993 survey conducted by the National Association of Fleet Administrators of 167 drivers of methanol FFVs in California, the drivers were asked whether they would purchase an AFV for personal use as their next vehicle. Although the drivers generally were satisfied with the AFV fleet vehicles, most would not buy an AFV for themselves, primarily because of the shortage of refueling stations, reduced driving range on methanol, and higher fuel costs. More detailed information on this survey is presented in appendix III.

Conclusions

Because of the limited use of alternative fuels to date, there is limited experience with and information on the use of such fuels. Accordingly, the benefits and costs of using alternative fuels in terms of energy security, the environment, or the economy are uncertain. DOE's and EPA's recommended, planned, or ongoing studies or analyses, when completed, should help address a number of these uncertainties. Also, as DOE gains more experience in using AFVs, it plans to develop information on the life-cycle costs of AFVs so that such information can be provided to potential purchasers and users of AFVs.

Although there are uncertainties with respect to the overall benefits and costs of using alternative fuels, the Congress has decided that it is reasonable to begin, in a measured way, introducing and gaining experience with AFVs, starting with federal fleets. The remainder of this

[5]Alternative Fuels: Experiences of Brazil, Canada, and New Zealand in Using Alternative Motor Fuels (GAO/RCED-92-119, May 7, 1992).

report addresses DOE's and GSA's efforts to promote the use of AFVs, federal efforts to accelerate acquisitions of AFVs, the experiences of federal users of AFVs, the efforts to develop uniform standards for fuels and vehicles, and the coordination of federal and state alternative fuel programs.

Efforts Are Under Way to Increase the Number of Refueling Facilities for Alternative Fuels

As a result of legislation and executive orders, the federal government is endeavoring to act as the initial catalyst for the development of the technology and refueling facilities necessary for the broad acceptance of AFVs. Introducing AFVs into the federal fleet has provided valuable experience in the development of AFV technology and has been the impetus for the development of the first alternative fuel refueling facilities in many locations. The need for more refueling sites has been the principal problem faced by federal fleet managers. However, the development of refueling facilities beyond the initial sites has been slow, and the federal government's ability to encourage the installation of more refueling facilities is hampered by the dispersement of AFVs in numerous locations and the low use of alternative fuels.

To enhance the impact of federal efforts, GSA and DOE may have to encourage the placement of higher concentrations of AFVs in fewer locations and aggressively negotiate with fuel providers for additional refueling facilities in concert with these AFV placements. Success in establishing an adequate number of refueling facilities, however, depends on the involvement of vehicle operators beyond the federal fleet. To this end, DOE's Clean Cities Program seeks to enhance the combined federal, state, and local efforts on alternative fuels in specific locations and encourage the involvement of private fleet operators. The program shows potential to encourage the construction of refueling facilities. Early experience with the first Clean City in Atlanta demonstrates such potential, but unresolved problems may impede the program's effectiveness.

Efforts Have Been Made to Introduce AFVs Into the Federal Fleet and Develop Refueling Facilities

Starting with AFVs acquired under the Alternative Motor Fuels Act of 1988, the federal fleet has expanded its acquisition of AFVs and gained experience in their operation. GSA believes this has contributed to the development of AFV technology and helped encourage the establishment of refueling facilities in a number of locations. However, the experience of the fleet has shown that establishing refueling facilities beyond these initial locations is problematic.

Federal AFV Fleet Has Grown

The first 65 methanol AFVs were introduced into the federal fleet in 1991. Since then the federal fleet has grown: About 6,300 AFVs were operating in the fleet managed by GSA at the end of 1993. In addition, the Postal Service had over 1,300 of its own mail-carrying AFVs in operation and various agencies owned and managed about 200 more AFVs, bringing the government total to about 7,800 AFVs operating at the end of 1993.

Efforts to Develop Refueling Facilities

Refueling sites for federal AFVs are generally established without formal contractual arrangements. Typically, GSA or another federal agency, through discussions with the fuel industry, agrees to place a set number of AFVs in a particular location, and the fuel provider agrees to provide a commercial refueling facility. The success of this approach depends on the willingness of the fuel provider to build a facility without a guaranteed level of fuel usage and the government's ability to concentrate adequate numbers of AFVs near the refueling facility to ensure that sufficient volumes of fuel are purchased to make the facility economically viable.

Using this process, the federal government has thus far encouraged the development of a limited number of alternative refueling facilities. For example, GSA has identified 51 privately owned alternative fuel facilities that were established as a result of its placement of AFVs. Another 15 facilities have been established by federal agencies on their property. Many of these federal facilities are equipped with a small CNG compressor designed to handle the few CNG vehicles assigned to the site.

Nationwide, fuel providers have been somewhat more responsive to installing CNG refueling stations than to installing methanol or other stations. Most metropolitan areas with FFVs have only one or two methanol stations, while areas where CNG vehicles are located have generally seen more development of CNG refueling facilities. CNG may have cost and other advantages over methanol that make it more attractive for use by some commercial fleets.

Fleet Experience Suggests Need for Increased Number of Refueling Facilities

According to most of the GSA fleet managers we contacted in nine major metropolitan areas, the lack of sufficient refueling facilities for alternative fuels is the most significant problem in operating an AFV. For example, some GSA fleet managers described the difficulties of having several hundred methanol vehicles located in different parts of a metropolitan area but only one or two stations to service the vehicles. Appendix III provides a more detailed discussion of the fleet managers' experiences with AFVs.

The lack of an adequate number of alternative refueling facilities experienced by the federal fleet has been corroborated by other fleet managers. For instance, in a 1993 survey of its California members, the National Association of Fleet Administrators identified similar dissatisfaction with the inadequate number of methanol facilities in California, despite the fact that California has the nation's most highly

developed methanol refueling network, with about 50 stations. The survey reported that the greatest barrier to the use of alternative fuels is the inadequate number of refueling facilities. Officials of the New York and California state energy agencies also noted that the lack of alternative refueling facilities is a significant barrier to the successful implementation of legislative requirements on the use of alternative fuels.

Development of Refueling Facilities Is Hampered by Low Concentrations of AFVs and Low Use of Alternative Fuels

The federal government's ability to influence the development of alternative refueling facilities is hampered by the way in which federal AFVs are dispersed and by the low use of alternative fuels. For example, in a number of locations, GSA, which manages most federal AFVs other than mail-carrying vehicles, has placed AFVs in concentrations too low to encourage the development of refueling facilities. Furthermore, even when enough AFVs have been placed in a metropolitan area to theoretically support a refueling facility, all the AFVs are not necessarily operated near the existing refueling sites. As a result, vehicle operators often do not use the alternative fuels, and the development of additional refueling facilities has been slow.

Alternative-Fueled Vehicles Have Been Widely Dispersed

While it is not the only federal agency responsible for placement of federal AFVs, GSA is responsible for placing the majority of them. However, placement decisions are strongly influenced by recommendations from DOE, which works closely with federal agencies to develop their plans for requesting and placing AFVs.

GSA officials describe a number of factors, some beyond GSA's control, that have combined to produce the current pattern of dispersement of federal AFVs. For example, GSA's decisions are influenced by the need to place federal AFVs in approximately 22 areas that have not attained national air quality standards under the Clean Air Act (known as nonattainment areas)[1] and the 125 metropolitan areas that are covered by EPACT's mandates for federal fleet acquisitions. In addition, GSA officials are constrained by the need to satisfy the mission needs of the agencies that lease its vehicles and by the fact that the agencies may lease vehicles from other sources if GSA does not adequately meet those needs. Still another factor is GSA's need to work within its normal replacement cycle—generally 3 years for passenger

[1]This number could vary: It could be exactly 22 if it corresponded with the 22 nonattainment areas covered by the Clean Fuel Fleet requirements of the Clean Air Act Amendments. It could be fewer than 22 if some states choose to opt out of the Clean Fuel Fleet Program and adopt other types of emissions reductions strategies instead. Or, it could be more than 22 if additional states decide to adopt AFV mandates as part of their state implementation plans (the plans that describe how they will comply with the air quality standards of the Clean Air Act).

automobiles and 6 years for light-duty trucks and vans—sending AFVs to replace conventional vehicles when those vehicles reach the end of their useful lives. In addition, GSA officials point out that the funding available to cover the higher acquisition cost of AFVs limits the total number of these vehicles that GSA can acquire and place each year. Finally, if an agency also purchases its own vehicles, GSA's AFV placement plan can be influenced by the agency's own plans to purchase and place AFVs to meet its requirements under the Clean Air Act Amendments, EPACT, and Executive Order 12844.

In response to these requirements and constraints, GSA has placed AFVs in more locations and in lower concentrations than appears optimal for achieving the greatest impact on the development of refueling facilities. Placing AFVs in low concentrations results in low demand for alternative fuels. This, in turn, means that fuel providers do not have the economic incentive to build or expand refueling facilities in these areas. Methanol and CNG fuel providers have indicated that approximately 200 AFVs are generally needed to make a refueling facility economically viable, assuming the vehicles use the fuel all or most of time. As the following examples show, in many cases this level of concentration has not been achieved for both methanol and CNG vehicles, which make up most of GSA's AFV fleet.

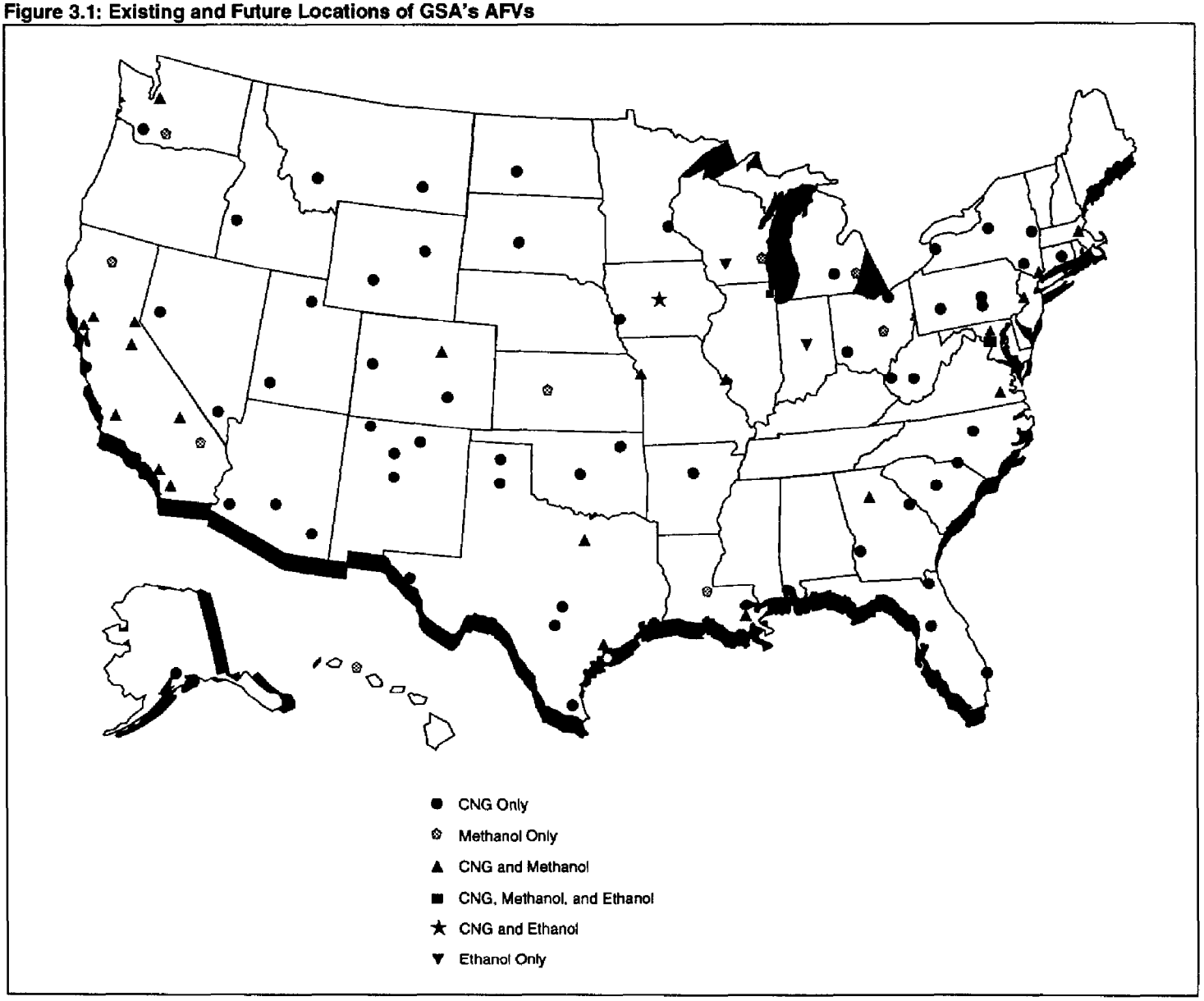
By the end of 1993, GSA had placed about 5,400 methanol FFVs in 29 locations throughout the country. Of these sites, 13 had fewer than 200 methanol vehicles, the number fuel providers consider necessary to support a single refueling site. In fact, these sites averaged only 44 vehicles each, and plans for 1994 show that none of the locations was scheduled to receive enough additional FFVs to bring its total to 200 or more. The 16 other sites with methanol vehicles did have fleets of 200 or more.

Similarly, by the end of 1993, GSA had placed about 800 CNG vehicles in 60 different locations. None of these locations had 200 or more vehicles, and most of the sites had fewer than 25 vehicles. Moreover, although GSA's plans show that the agency expected to procure over 3,000 CNG vehicles for 1994, only three sites were scheduled to receive enough additional vehicles to bring the total count to 200 or more. In fact, for 1994 GSA planned to send small numbers of CNG vehicles to 18 new sites that had not previously had these vehicles.

The preceding discussion is based partially on GSA's placement plans for 1994 as they existed before two accidents in early 1994 involving the

rupture of CNG fuel cylinders on nonfederal AFVs. These accidents have led to events that may require GSA to alter its plans. As a result of the accidents, General Motors is recalling all 1992 CNG pickup trucks and is either replacing each vehicle with a gasoline-powered model or refunding the purchase price of the vehicle. General Motors has also cancelled plans to produce CNG vehicles in model year 1994. Figure 3.1 illustrates GSA's planned widespread placement of AFVs throughout the United States before the accidents. At this time, it is unclear how future placement of federal AFVs will be affected. Chapter 4 discusses this issue in greater detail.

Figure 3.1: Existing and Future Locations of GSA's AFVs



Source: Based on a GSA illustration.

As part of its proposal under Executive Order 12844, the Federal Fleet Conversion Task Force recommended that federal AFVs be placed in a selected number of priority locations over the next 3 years as part of a

Presidential Clean Cities Initiative. However, since the Task Force designated 38 locations for this initiative, if vehicles were placed in all locations, the recommendation might not result in a greater concentration of federal AFVs. Moreover, in January 1994 the Task Force proposed another initiative that would enable local planning groups in the designated cities to recommend the specific types of AFVs to be used in their areas. In evaluating these recommendations, the federal government would give priority in federal placements of AFVs to those cities deemed to have demonstrated the greatest commitment to the development of their alternative fuels programs. As of May 1994, it appeared that some version of this proposal would be adopted. If this occurs, in addition to complying with federal legislation and satisfying the agencies' vehicle replacement and mission needs, GSA will also have to consider the preferences of local communities in allocating federal AFVs.

Methanol Usage Is Low

GSA has reported to the Congress that the 65 methanol FFVs included in the data collection program required under the Alternative Motor Fuels Act have methanol usage rates of over 90 percent. This usage rate does not appear to be typical of all FFVs in the fleet. Information reported to GSA by methanol fuel providers indicates that federal FFVs are consuming low volumes of methanol. For example, we found that the only methanol station in Washington, D.C., sold an average of 914 gallons of methanol per month from January through October 1993. Spread over the 508 federal FFVs located in Washington in October 1993, this amounts to only 2 gallons per vehicle. However, only a small portion of these vehicles are actually using any methanol. According to GSA's records, only 37, or 7 percent, of the vehicles used any methanol in October 1993. In Detroit, where two methanol stations are located, the stations sold, on average, about 930 and 350 gallons of methanol, respectively, per month during the same period. Spread over the 220 federal FFVs then located in Detroit, this sales volume equates to an average methanol consumption of about 6 gallons per vehicle. GSA's method of measuring the percentage of alternative fuel versus gasoline used by its FFVs has limitations and is discussed in more detail below.

The high methanol usage rate reported for the 65 FFVs in the data collection program can be attributed to the placement of these vehicles near existing methanol refueling sites and the cooperation of the federal agencies participating in the program. A GSA fleet manager explained that the managers of the participating agencies have paid special attention to the demonstration vehicles to ensure that they use methanol as much as possible. The GSA fleet manager believes that such scrutiny would not be

possible for the entire federal AFV fleet because of the number of vehicles involved.

In light of the low concentrations of vehicles and low fuel usage rates, methanol providers told us that they have had little incentive to install more than a few stations in each city. On the other hand, GSA officials said there have been instances in which they have placed methanol vehicles in a location on the basis of a verbal commitment from a methanol provider to install a refueling facility, only to have the provider decide subsequently not to install the facility. According to records in DOE's Alternative Fuels Data Center, as of August 1993, 12 states and the District of Columbia had methanol facilities available. However, only three states had more than one methanol refueling facility in the entire state.

According to GSA fleet managers in several large metropolitan areas, low methanol usage rates are associated with the assignment of FFVs to numerous user agencies, whose local managers do not always require drivers to use methanol and do not always ensure that FFVs remain near methanol refueling facilities. One GSA manager said that, although he knows which agencies have FFVs, he does not have sufficient control over individual agency managers to ensure that they require methanol use or keep the FFVs in locations where methanol refueling is convenient. Moreover, until recently, GSA fleet managers were unable even to track where the FFVs were kept. Under these circumstances, FFVs—because they can operate on gasoline in lieu of methanol—have operated on gasoline much of the time.

As part of the solution to this problem, GSA officials said that a vehicle tracking system has recently been instituted that allows GSA to identify by zip code where a vehicle is kept. GSA fleet managers said that this system allows them to monitor whether AFVs are housed near available refueling facilities. This information could make it easier for GSA managers to work with officials of the user agencies to ensure that AFVs are initially placed and subsequently remain near refueling facilities. Where agency needs prevent this placement, the system could also provide GSA with the information needed to reassign the AFVs to other agencies that can keep them housed near refueling facilities. However, GSA officials cautioned that the effectiveness of this approach will depend on frequent and accurate updates of the information on vehicle location in the system, and this information must be provided by the user agencies.

CNG Usage Is Low

The small number of CNG vehicles in operation at each location and the low number of miles being traveled in these AFVs contribute to low volumes of CNG consumption. Only four cities had more than 50 of the 809 CNG vehicles placed in 60 locations before 1994. In addition, a recent GSA analysis found that dedicated CNG vehicles are achieving only 29 percent of the average monthly mileage achieved by their gasoline-fueled counterparts. GSA attributed this low mileage to the inability of the dedicated CNG vehicles to meet the agencies' travel needs because of the limited vehicle range and lack of widespread refueling facilities.

Despite the limited number of CNG vehicles in operation and the low volumes of fuel used by these vehicles, CNG fuel providers have sometimes been willing to install facilities in anticipation of increased demand for CNG in the future. For example, a Colorado CNG supplier estimated that about 2,000 CNG vehicles would be operating in that state by the end of 1993. Meanwhile, the American Gas Association identified at least 30 operating CNG refueling facilities in Colorado during 1993, or an average of about 70 vehicles per facility.

There appear to be several reasons why CNG providers are sometimes willing to take the risk of investing in new facilities in advance of larger vehicle populations. Often the fuel supplier is a local utility that has the financial resources to install CNG refueling compressors. In some cases, the utility can spread the cost of CNG refueling facilities among all their ratepayers, making it easier to pay for the equipment. Moreover, since CNG is cheaper and less heavily taxed than most other alternative fuels, CNG providers believe that their fuel appeals strongly to commercial fleets. Therefore, CNG fuel providers have the incentive to build new facilities in anticipation of future increases in the CNG vehicle populations of these fleets.

The CNG vehicles acquired by GSA, unlike the methanol FFVs, have thus far been dedicated vehicles that cannot use gasoline. However, in the future at least one automobile manufacturer plans to offer several models of bi-fueled vehicles that can use gasoline in place of CNG. Indications are that a number of federal agencies would prefer these vehicles to dedicated AFVs. Agencies will also be acquiring significant numbers of vehicles converted to use CNG, many of which will be bi-fueled versions. Therefore, the problems that have contributed to low methanol usage rates could potentially affect CNG usage as well.

System Is Needed to Measure Alternative Fuel Usage

In order to improve alternative fuel usage rates for federal FFVs, it is important to know how much methanol is actually being consumed. Also, as the government begins procuring bi-fueled CNG vehicles that have the option of using gasoline, the measurement of CNG usage rates will become important. However, GSA officials told us the agency lacks a comprehensive system to accurately measure alternative fuel use by federal AFVs. Currently, GSA's information management system cannot readily combine information on gasoline purchases from the major oil companies with information on alternative fuel purchases from other suppliers. Therefore, it has not been feasible to accurately calculate the percentage of alternative fuel use for the federal AFV fleet overall.

As discussed earlier, usage rates have been calculated for the small group of demonstration vehicles closely tracked under the Alternative Motor Fuels Act. In addition, GSA reported methanol usage rates in four locations in its October 1993 report to the Congress. However, according to GSA officials, these rates were not based on a direct measurement of fuel use. Instead, they were calculated on the basis of various assumptions, including estimates of the number of miles traveled by FFVs and the number of miles per gallon achieved operating on methanol and gasoline.

To address this issue, GSA is attempting to develop a better system to measure the alternative fuel usage rate of all its FFVs. GSA officials believe that improvements currently under way in the agency's information management system will enable them to accurately track FFVs' gasoline use. Then, by manually entering into the system data on methanol purchases, the agency will be able to compare the gasoline and methanol usage of each FFV. Unfortunately, this system will still not be fully automated because the methanol data must be entered manually. This is necessary because while gasoline for federal FFVs is generally purchased using the U.S. Government National Credit Card, most methanol suppliers currently do not accept that card. Thus, usage information on gasoline and methanol comes to GSA separately.

As discussed above, usage rates for individual CNG vehicles have not previously been an issue for GSA because all of its CNG vehicles have been dedicated vehicles, using only CNG. However, the purchase of bi-fueled CNG vehicles in the future will require a measurement system similar to that described above for methanol.

Ultimately, GSA hopes to develop a fully automated measurement system. To make this possible, the federal credit card will have to be accepted by

all the alternative fuel providers and oil companies. The number of fuel providers that will have to be included in the system is likely to be quite large, taking into account the oil companies, the methanol suppliers, and the many local companies that supply CNG. According to GSA officials, gaining general acceptance of the credit card by all alternative fuel providers will be a lengthy and difficult task, since many fuel providers lack the sophisticated billing systems needed to use the card readily. Appendix IV provides additional information on the federal credit card system and current efforts to modernize it.

Several Options Could Encourage the Development of Additional Refueling Facilities

As discussed previously, the purchase of AFVs for the federal fleet appears to be having a modest positive impact on the establishment of refueling facilities for alternative fuels, but managers of both federal and nonfederal fleets still consider the number of available refueling sites inadequate. Moreover, past patterns of federal vehicle dispersement and low use of alternative fuels suggest that simply buying more AFVs without regard to where they are placed or what fuel they use may not provide sufficient incentives for fuel providers to construct new facilities. However, GSA and DOE can take several actions to encourage alternative fuel providers to build new refueling facilities. These actions include concentrating AFVs at fewer locations and in closer proximity to existing refueling facilities, negotiating commitments between the government and fuel providers to coordinate placements of vehicles and refueling facilities, and enforcing the EPACT requirement that AFVs use alternative fuels.

AFVs Could Be Concentrated in Fewer Locations and Near Refueling Facilities

As discussed above, GSA, in consultation with DOE, has thus far dispersed AFVs among numerous locations, resulting in low concentrations of vehicles in a number of locations. The Federal Fleet Conversion Task Force views concentration of federal AFVs as essential to supporting commercial alternative fuel refueling facilities. We discussed various measures with DOE and GSA officials that could result in greater concentration of federal AFVs.

We asked GSA officials about the feasibility of requiring that all GSA-leased vehicles scheduled for replacement in priority areas be replaced by AFVs,[2] if comparable AFVs are available. These officials said that such a requirement could be imposed, but they prefer that the agencies

[2]The term "priority areas" is used here in a generic sense. In practice, these areas could be any locations designated as key destinations for AFVs, such as the priority cities identified by the Federal Fleet Conversion Task Force, or the areas designated by DOE as Clean Cities. DOE's Clean Cities Program is discussed later in this chapter.

voluntarily accept AFVs for their fleets. GSA officials believe that imposing strict requirements would harm the working relationship between GSA and its customers and would be counterproductive in the long run.

For vehicles that are purchased by the agencies themselves, DOE exerts some influence over placement decisions through its annual review of the agencies' AFV acquisition plans. Each agency that buys its own vehicles is responsible for meeting its own AFV acquisition goal, and each submits a plan to DOE indicating where it intends to locate its AFVs. Generally, these plans call for the wide dispersement of AFVs to the locations that best meet the agencies' needs. In the past, DOE has requested revisions to any plans that included placing AFVs in areas that lack refueling facilities, but DOE has chosen not to use this review process to aggressively demand greater concentrations of AFVs. Instead, DOE has sought to reach mutual consent with the agencies on where AFVs should be placed.

Rather than an outright mandate to concentrate AFVs in a few locations, GSA could provide incentives to agencies to voluntarily place AFVs in the desired locations. For example, GSA might consider providing larger discounts for leasing or purchasing AFVs designated for priority areas. Although GSA currently offers agencies a 10-percent discount on monthly leasing rates for all AFVs that are operated on alternative fuels—regardless of where they are located—such discounts could be applied only to vehicles designated for priority areas. Alternatively, the current 10-percent discount could be increased for agencies operating AFVs in these areas. Also, when agencies buy, rather than lease, their own vehicles, GSA could explore the feasibility of offering a discounted price on AFVs that will be assigned to priority locations.

According to GSA officials, the funding needed to offer discounts to AFV users must be made up by charging other customers higher rates, so increasing the current discounts would be difficult. While they agree that selectively applying the discounts could increase the concentration of AFVs, they oppose this use of discounts because they consider it unfair to vehicle users in nonpriority locations. It is unclear, however, how limiting the discounts currently provided on leased AFVs to those in priority areas would be more unfair than not providing discounts to conventional vehicle users, which is the current practice. The possibility that conventional vehicle purchasers could be charged a higher price to pay for discounts on AFV purchases in priority areas raise more of an equity question, but such trade-offs are often made to achieve policy objectives.

As previously discussed, the recently developed system for tracking vehicles by zip code, if regularly updated, could help ensure that AFVs are placed and remain in locations near alternative fuel refueling facilities. However, the GSA managers we interviewed were still developing the methods for updating and using the tracking system. It remains to be seen whether GSA will aggressively use the system to relocate AFVs when agencies no longer operate them near facilities that offer alternative fuels.

Agencies Could Negotiate More Aggressively With Fuel Providers

As another strategy, DOE and GSA could more aggressively negotiate with fuel providers in priority areas to convince them to construct refueling facilities in locations where the federal agencies would agree to place a given number of AFVs. As previously mentioned, GSA has some success in using this approach, and DOD and the Postal Service have been able to convince natural gas suppliers to install CNG facilities near several military and post office locations. However, fuel providers told us they want the government to make firmer and longer-term commitments to place AFVs in specific locations, and they also want assurances that the alternative fuel will be used before they build additional facilities.

In response, DOE and GSA could bring to the negotiating table data on the number of current and planned federal AFVs operating near the proposed site; estimates of fuel usage by these AFVs; and assurance, as discussed in the following section, that the vehicles will be required to use alternative fuel if the facility is built. Because federal AFVs operating near such a refueling facility may be insufficient by themselves to economically support it, DOE and GSA could also develop and present to fuel providers information on state, local, and commercial AFVs that operate near the proposed site.

In addition, when necessary, DOE could exercise its existing authority to share the costs of constructing refueling facilities where federal AFVs would obtain alternative fuels. DOE officials said they have opposed cost-sharing thus far and have not requested funding for this purpose, believing that commercial fuel providers will provide the necessary investment capital if the government places large numbers of AFVs in service. However, as will be discussed in chapter 4, this option was among those DOE was considering as a possible use for funding that became available as a result of cancelled vehicle orders in early 1994.

EPACT's Alternative Fuel Use Requirement Could Be Enforced

Section 302 of EPACT requires that federal dual-fueled vehicles[3] use alternative fuels unless the Secretary of Energy determines that operating on such fuels is not feasible. The Secretary has not made such determinations, even though there are few alternative fuel stations in most metropolitan areas. In addition, DOE and GSA currently have no way of determining whether individual AFVs use alternative fuels. To give fuel providers greater assurance that alternative fuels will be used in AFVs, DOE could establish a system in which agencies would be required to operate dual-fueled vehicles on alternative fuels unless the agency has received a specific determination from the Secretary that such fuel use is not feasible. Agencies could also be informed that the Secretary is unlikely to make a determination that alternative fuel use is not feasible in priority areas where alternative refueling facilities are reasonably available. A DOE official told us that the agency has thus far chosen not to aggressively enforce this provision, preferring instead to seek voluntary commitments to use alternative fuels until more refueling facilities become available.

Clean Cities Concentrate Efforts on Alternative Fuels to Spur Development of Refueling Facilities

Recognizing the shortage of refueling facilities for alternative fuels, DOE adopted the Clean Cities Program, which seeks to involve federal, state, local, and private interests in promoting alternative fuels. This program aims to accelerate and expand the use of AFVs in urban communities and provide refueling and maintenance facilities for their operation. By involving vehicle users, fuel suppliers, and various levels of government, the program can more readily address the barriers to constructing alternative fuel refueling facilities and can enhance public awareness of AFVs. While the program holds promise for achieving these goals, the first Clean Cities Program faces several problems that may need to be resolved if the program is to reach its full potential.

Cities Included in the Program

The Clean Cities Program grew out of a demonstration project in Atlanta that began in June 1992 when DOE assembled a group of alternative fuels stakeholders, including government agencies, alternative fuel providers, vehicle manufacturers, and fleet administrators to discuss and address barriers to building alternative fuel refueling facilities. DOE saw potential in this approach to coordinating public and private interests in the area of alternative fuels and developed its Clean Cities Program, which as of May 1994 had been expanded to 10 locations—Atlanta, Austin, Boston, Chicago, Denver, the Florida Gold Coast (Miami region), Las Vegas,

[3]According to both DOE and GSA officials, EPACT uses the term "dual-fueled vehicle" in a broad sense to refer to any AFV that can use both a conventional and an alternative fuel, whether simultaneously or separately. Thus, the term here also refers to FFVs.

Philadelphia, Washington, D.C., and Wilmington. DOE hopes to expand the program to include 50 cities by 1996.

An interested city applies to DOE to become designated as a Clean City by outlining its proposed implementation strategy. The strategy for each Clean City includes certain core elements established by DOE, such as a government-industry partnership. However, because the proposals, known as concept documents, are initiated locally, details on the approach, participants, and organization may vary. In addition to the concept document, all participants sign a memorandum of understanding that describes their commitments and responsibilities. Once DOE designates a city as a Clean City, the agency's role is that of facilitator, providing technical guidance and support. In addition, DOE encourages federal agencies to place as many AFVs in each Clean City as possible. Most Clean Cities have a steering or advisory committee and various working groups organized by the fuel providers. Each working group represents a specific fuel and is made up of many industry representatives that have developed a business plan and made a financial commitment to developing refueling facilities.

Potential Benefits of the Clean Cities Program

Government and industry officials cited the Clean Cities Program as a good mechanism for coordinating the efforts on alternative fuels of federal, state, and local governments and other stakeholders. In addition, the Federal Fleet Conversion Task Force endorsed the program in its report to the President. The program provides an avenue for participants to meet and discuss issues surrounding alternative fuels and barriers to the development of refueling facilities. In the view of participants, the program makes the development of a self-sustaining network of alternative fuel refueling facilities more likely because of the concentration of AFVs in a limited number of locations. They also cited the program as a way to heighten the public's awareness of alternative fuels and to provide public relations benefits to assist fuel providers in marketing the fuels to fleets.

Initial Success of the Atlanta Program

In Atlanta, the Clean Cities Program has achieved some initial success. Some participants told us that the opportunity to meet and discuss alternative fuels issues with other stakeholders on a regular basis would not have occurred without the program. The program has also resulted in plans to significantly increase the number of refueling facilities. For example, Atlanta's CNG working group has already installed 8 public CNG

stations in the area and plans to add 10 more stations in 1994. Finally, the Clean Cities approach has helped to define a role for DOE in promoting local efforts on alternative fuels. In Atlanta, the actions of DOE officials from both headquarters and the regional support office suggest that DOE can serve as a catalyst to motivate local government and business interests to promote alternative fuels.

Obstacles Faced by the First Clean City

Although the Clean Cities Program has achieved some initial successes in Atlanta, some participants say the Atlanta program has also faced obstacles that might jeopardize the success of the approach. Since we focused our review on the Atlanta program, it is not clear whether these obstacles are start-up problems unique to Atlanta or would apply elsewhere. To the extent that the problems Atlanta experienced are systemic, they could lessen the chance for other locations to successfully implement the Clean Cities Program. On the other hand, to the extent that other Clean Cities observe and learn from Atlanta's experience, the chances for success in other locations could actually be enhanced.

Views Differ on Alternative Fuel Neutrality

The Clean Cities Program is a fuel-neutral program; that is, any fuel supplier can actively participate as long as it makes the required financial commitment to install refueling pumps and applies to the program as part of an industry effort, not as an individual company. While this approach is favored by many officials inside and outside of the program for several reasons discussed below, others believe that only one or two fuels should be chosen for each Clean City. One participant in the Atlanta program told us choosing one fuel would further concentrate resources and lead to an even faster development of refueling facilities, in keeping with the program's concept.

DOE agrees that choosing one or two fuels per location could help concentrate efforts to encourage refueling facilities, but in keeping with the concept of fuel neutrality, DOE's policy is to leave the choice of fuels up to the locality. With the potential for at least five alternative fuels within a Clean City, resources may be diluted by purchasing the many different types of AFVs needed to support the refueling facilities for each fuel. However, choosing one or two fuels is difficult because of the political ramifications of leaving some fuels out of the program. In Atlanta, three fuels—CNG, electricity, and propane—are included in the program. Consideration has also been given to adding a methanol working group, but one had not been formed as of May 1994.

While concentrating resources by choosing one or two fuels may benefit the Clean Cities Program, state and local officials we spoke with inside and outside of the program cited various reasons for maintaining fuel neutrality in each Clean City. For example, they said promoting competition among several fuel providers helps bring the price of the fuels down. Furthermore, locations that choose one fuel run the risk of choosing a fuel that may not be economical or suitable for local fleets in the long run. Finally, there may be a role for several different fuels in some locations because the fuels have different applications that meet the fleets' various needs.

Need for a Strong Local Leader

The Atlanta program is headed up by a chairman and vice chairman whose responsibilities are to provide guidance and leadership to the program. Several current participants in the Atlanta program feel that program leaders need more clout to ensure that the participants meet their commitments. One participant said the program's leaders need more authority to make hard decisions about what participants will bring to the table in terms of vehicle numbers and refueling facilities. Another participant said program leaders should be in a position to make a choice, if necessary, about which fuels will be included.

The development of strong leadership has proven difficult for several reasons. First, according to the program's Chairman, leaders are currently limited to volunteers from among program participants. These individuals generally have full-time duties with the organizations they represent and must carry out their leadership responsibilities on a part-time, volunteer basis. A lack of volunteers for leadership positions suggests that most participants are not interested in acting as leaders because of the demanding time commitment. In fact, besides the Chairman, representing the local business community, the only other person to volunteer for a leadership role was a regional DOE official. The Chairman also told us the leadership role is made more difficult by the fact that there is no mechanism in place for demanding that participants follow through on their commitments for more vehicles or refueling facilities. He said he is concerned that participants might drop out of the program if he makes such demands.

A strategic plan developed for the Atlanta program by a local consulting firm suggests a system for developing stronger local leadership. The plan suggests that the group hire an executive director and a communications coordinator to provide leadership, direction, and effective marketing strategies for the program. The plan suggests that the executive director,

to ensure the requisite clout in the business community, be a retired executive with strong leadership skills but, to ensure objectivity, not someone tied to the alternative fuels industry. However, program participants have not yet adopted the strategic plan because of funding limitations.

Potential Shortage of Funds

According to the consultant who prepared the strategic plan for the Atlanta program, participants are reluctant to fund the program's administrative and marketing costs and pay for an executive director and a communications coordinator. He warned that a lack of funding could lead to the demise of the program. He said that without funding, the program cannot gel and progress to the next level because marketing strategies will be hindered and the need for strong leadership will not be resolved.

The strategic plan addresses this lack of funding by recommending that the group reorganize as a nonprofit organization in order to obtain funding from a variety of sources. In addition, the plan recommends that working group members contribute financially to the program to fund marketing and other costs because they directly benefit from the program's marketing strategies and public relations. However, the fuel providers participating in the program expressed concern that funding program costs in addition to installing refueling facilities may be too expensive. One fuel provider said that funding the program costs would be particularly burdensome for those companies participating in the program in more than one location.

Different Financial Commitments From Fuel Providers

Certain participants in the Atlanta program are concerned that some fuel providers will enjoy the public relations benefits of the Clean Cities Program without making a financial investment. They said that because the current participants have already invested a lot of time and money in the program, they want the additional fuel providers that join the program to make similar financial commitments.

To participate in the program, fuel providers are required to make a financial commitment, but no minimum amount is specified. This is because the costs of refueling facilities for the different fuels vary. For example, a methanol refueling unit at an existing station costs between $40,000 and $60,000, a propane unit about $30,000, and a CNG unit about $250,000. Because of this cost difference, the program's developers decided it was unreasonable to require the same financial investment from all fuel providers.

Uncertainties About Placement of Federal Vehicles

The placement of AFVs is an integral part of the Clean Cities Program. If the program is to succeed, GSA and other fleets need to commit to placing a certain number of vehicles so fuel providers have a better indication of the market. Currently, fuel providers have only a vague idea of what vehicles the government will provide. And, as noted earlier, there is no guarantee that these vehicles will use the alternative fuels if they are dual-fueled or flexible-fueled vehicles.

During 1993, federal AFVs were not placed in Atlanta in the way the program participants desired. For example, GSA sent 118 methanol vehicles to Atlanta in 1993, even though there were no methanol stations in Atlanta until 7 months after the vehicles arrived. Meanwhile, GSA sent only 20 CNG vehicles to Atlanta, although CNG refueling facilities were already available. Because of the lack of appropriate vehicles, the fuel providers feel that their investments in refueling facilities investments are at risk. The perception among some participants is that GSA is not fully committed to the program.

GSA responded that the agency intended to place more CNG vehicles in Atlanta but that DOE, at the time, did not have the funds to pay for the higher costs of more CNG vehicles. Therefore, GSA sent methanol vehicles to Atlanta instead because of their much lower costs. GSA officials also said that placing FFVs in a location before the refueling facilities are in place is a legitimate strategy for encouraging fuel providers to install methanol facilities.

Conclusions

DOE and GSA expressed reluctance to employ several more aggressive actions that could improve the concentration of AFVs and increase alternative fuel use. While DOE and GSA are hesitant to impose stricter requirements on other federal agencies, preferring to rely on voluntary cooperation, the evidence suggests that their nonprescriptive approach may not be enough to achieve the goals of the federal AFV program. The potential for increased dispersement of federal AFVs and continued low usage rates for alternative fuels suggests that some of the more demanding measures discussed in this section should be seriously considered.

Concentrating AFVs in fewer locations and closer to refueling facilities could increase the amount of alternative fuels used in those locations and in turn increase the incentive for fuel providers to establish more refueling facilities. DOE's Clean Cities Program has the potential to increase the AFV market and spur the development of such facilities by concentrating

federal, state, local, and private AFVs in selected urban areas. The first Clean Cities project in Atlanta has achieved some success using this approach. However, the program could be enhanced if GSA and DOE concentrated federal AFVs in this location, particularly those AFVs for which refueling facilities are already available.

Recommendations

To learn more about the benefits and costs of AFVs and provide greater incentives for alternative fuel providers to install refueling facilities, we recommend that the Secretary of Energy, in cooperation with the Administrator of GSA, develop a more aggressive strategy to concentrate federal AFVs in priority locations, such as the cities in the Clean Cities Program. One way to accomplish this goal might be to offer additional discounts on federal purchases and leases of AFVs to agencies that agree to place them in priority locations.

To facilitate alternative fuel use, we recommend that the Administrator of GSA use the agency's new vehicle tracking system to ensure that the federal fleet's AFVs remain near alternative fuel refueling facilities. If an agency moves an AFV to a location that lacks refueling facilities, GSA should attempt to reassign that vehicle to another agency that will operate it where fuel is available.

To ensure alternative fuel use and provide greater incentives to alternative fuel providers, we recommend that the Secretary of Energy implement the existing legislation requiring that dual-fueled federal vehicles not use conventional petroleum-based fuels unless the Secretary determines that using alternative fuels to operate the vehicles is not feasible.

Within priority locations, such as Clean Cities, we recommend that the Secretary of Energy and the Administrator of GSA enhance their ability to convince alternative fuel providers to install refueling facilities by developing (1) data on the location and operation of federal, state, and local AFVs and (2) estimates of the potential fuel usage in such vehicles. As a last resort, DOE could use its existing authority to share the costs of developing refueling facilities in some locations.

Federal Government Strives to Influence the Availability and Cost of AFVs Through Acquisitions

The federal government is attempting to increase the availability and lower the cost of AFVs made by original equipment manufacturers (OEM) by acquiring more of these vehicles for its fleet. Although, as previously noted, the federal fleet is not large enough to singlehandedly drive the market, federal efforts appear to have encouraged the introduction of several new AFV models since 1990. However, the higher cost of AFVs compared with the cost of conventional vehicles, in conjunction with limited funding to pay the extra cost, makes it difficult for the government to increase its AFV acquisitions. Moreover, reaching higher acquisition targets is complicated by the federal government's efforts to achieve better balance among the fuels its AFVs use by procuring greater numbers of gaseous-fueled vehicles. This presents a challenge because gaseous-fueled vehicles are considerably more expensive than the available alcohol-fueled vehicles that could also be purchased to meet acquisition targets.

To meet the overall acquisition targets for AFVs and obtain more CNG vehicles in the short term, the government is converting significant numbers of existing vehicles to CNG use through aftermarket conversions. While converted vehicles are less costly than OEM models, they also have some technical disadvantages. Moreover, it is unclear whether acquiring more converted vehicles will have a positive or negative effect on the availability of AFVs from the automobile manufacturers. In the long term, the federal government may be able to encourage the manufacturers to produce the models of AFVs it wants at lower prices by making a greater effort to limit the number of different types of AFVs sought by federal, state, and local fleet operators. Limiting the types could increase orders for the remaining vehicles, encourage manufacturers to provide such vehicles, and decrease unit costs.

Federal Purchases of OEM Vehicles Can Improve Availability, but Number of Conversions Is Increasing

Since the federal government began procuring AFVs for its fleet in 1990, the limited number of AFV models available from the automobile manufacturers has made it difficult for federal fleet operators to obtain the types of AFVs they need. While there is evidence that federal procurements have had some influence on automobile manufacturers' decisions to produce new models, more vehicle choices are still needed. By increasing federal acquisition targets for AFVs, Executive Order 12844 attempts to encourage the automobile manufacturers to develop and produce more AFV models. However, a lack of funds to cover the continuing high incremental cost of AFVs—that is, the difference between the cost of AFVs and the cost of conventional vehicles—makes it difficult for the government to meet these higher acquisition targets.

Increased Acquisitions Can Improve Availability of AFVs

Since 1990, using funds provided under the Alternative Motor Fuels Act and EPACT, the federal government has been able to acquire over 6,000 AFVs from the automobile manufacturers, and it appears that federal acquisitions have had some impact on the production decisions of these companies. For example, the automakers have responded to federal vehicle solicitations over the past several years by offering methanol compact sedans, CNG pickups, and CNG compact sedans and minivans. In December 1993, at the urging of the federal government and several states, one automaker also agreed to produce a limited number of mid-size ethanol sedans, despite earlier indications that the automobile manufacturers had decided not to produce any ethanol vehicles in 1994. While federal orders alone would not likely be sufficient to sustain continued production of these vehicles, DOE and GSA officials believe that federal requests were an important factor in the automakers' decisions to begin offering these models.

However, despite improvements in the availability of AFVs, there is a continuing need for additional options that combine particular vehicle models and fuel choices. For example, federal agencies have requested methanol pickups and four-wheel drive vehicles that operate on methanol and CNG, but these combinations are not yet available. In addition, a number of federal agencies have expressed interest in several models of ethanol and propane vehicles, but for 1994 the automobile manufacturers plan to produce no light-duty propane vehicles and only 50 ethanol sedans.

Status of Efforts to Meet Acquisition Targets

As shown in table 4.1, EPACT established federal acquisition targets of 5,000 light-duty AFVs for 1993 and 7,500 light-duty AFVs for 1994. To encourage the automobile manufacturers to expand the availability of these vehicles, Executive Order 12844 called for accelerated acquisition targets of 7,500 AFVs for 1993 and 11,250 for 1994 for the federal fleet, which annually purchases or leases approximately 50,000 new light-duty vehicles. Table 4.1 shows the numbers of AFVs expected to be acquired with 1993 and 1994 funds.[1] Because recent events, including General Motor's decision not to produce 1994 CNG models, have resulted in significant changes from earlier estimates, the table provides two estimates for 1994.

[1]We have followed DOE's approach of counting AFV acquisitions according to the fiscal year of the funding used to acquire the vehicles, as opposed to the year in which the vehicles are actually delivered or placed in service, which is often different.

Table 4.1: Acquisition Targets and Estimated Acquisitions of AFVs

Fiscal year	Number of AFVs required by EPACT	Number of AFVs required by E.O. 12844	Estimated number of AFVs from automakers	Estimated number of converted AFVs	Estimate of total AFVs acquired
1993	5,000	7,500	3,210	3,546	6,756
1994[a]	7,500	11,250	6,900	4,150	11,050
1994[b]	7,500	11,250	4,005	3,415	7,420

[a]DOE's January 1994 estimate.

[b]DOE's May 1994 revised estimate.

The 1993 figure for AFVs acquired from the automakers includes GSA's own purchases of 3,032 AFVs, reported to the Congress by the agency in October 1993, and 178 additional AFVs that other agencies purchased through GSA-negotiated contracts. However, the number of vehicles to be converted with 1993 funds is still an estimate, because many of these vehicles will not actually be converted until 1994 or later. The estimate is based on the amount of 1993 funds set aside by DOE for conversions and on estimates by DOD and the Postal Service of planned conversions using 1993 funds.

As the table illustrates, federal acquisitions of AFVs for fiscal year 1993 are expected to surpass EPACT's 5,000 vehicle target but fall short of the accelerated target of Executive Order 12844. Because Executive Order 12844 was issued after the period for placing 1993 orders for new vehicles had closed and because additional 1993 funds were unavailable, GSA was unable to acquire additional AFVs from manufacturers to reach the new goal set by the order. However, aftermarket conversions, in combination with AFVs purchased from the automakers, enabled the government to acquire approximately 6,750 AFVs with 1993 funds, coming to within about 750 vehicles of the executive order's target of 7,500.

DOE's estimates in January 1994, based on a compilation of acquisition plans submitted by federal agencies, indicated that EPACT's fiscal year 1994 target of 7,500 AFVs would be surpassed and that the federal government would come within 200 vehicles of meeting the executive order's target of 11,250. Had these original DOE estimates been fulfilled, total acquisitions for fiscal year 1994 would have reached 11,050 AFVs. Of this number, DOE estimated that GSA would purchase from the manufacturers approximately 6,600 AFVs, most of which would be leased to other agencies. Several

agencies, including the departments of Agriculture and the Interior, were also expected to purchase some of their own AFVs through GSA, totaling approximately 300 vehicles. According to DOE, acquisitions from the manufacturers in 1994 would thus have totaled 6,900. In addition, DOE had planned to fund the conversion of 150 vehicles to propane for various agencies and had estimated that DOD and the Postal Service would each convert 2,000 vehicles to operate on CNG using 1994 funds.

However, this optimistic view of the government's chances of meeting the enhanced 1994 target has been tempered by recent developments. Most significantly, plans to procure AFVs from the manufacturers during 1994 have been altered because General Motors has decided not to produce 1994 model-year versions of several new types of CNG vehicles, including sedans, vans, and pickups, for which GSA had already awarded contracts. The company made this decision after CNG cylinders failed, in early 1994, on two General Motors CNG pickups owned by utility companies. These vehicles were the same type used in the federal fleet.[2] General Motors plans to thoroughly investigate and validate the safety of CNG cylinders before resuming production of CNG vehicles, and it appears that the company will not begin producing CNG vehicles again until at least model year 1995. The federal government had ordered 2,500 of these CNG vehicles.

As a result of General Motors' decision and other adjustments to agencies' vehicle orders, GSA estimated in May 1994 that the government would purchase 4,005 AFVs—mostly methanol FFVs—from the manufacturers using fiscal year 1994 funds. This includes 234 AFVs that other agencies will purchase for themselves under the GSA contracts.

In addition to the reduced number of OEM vehicles, the number of aftermarket conversions expected to take place using 1994 funds has also decreased since the January 1994 estimate. DOE still plans to use 1994 funds to pay for approximately 150 propane conversions and now plans 10 electric vehicle conversions as well. The Postal Service still plans to use 1994 funds to convert at least 2,000 existing vehicles to use CNG.[3] However the Department of Defense (DOD), which DOE had asked to convert 2,000 vehicles with 1994 funds, plans instead to convert 1,255 vehicles to CNG for fiscal year 1994. (Discussions between DOE and DOD about the number of

[2]Concerns about CNG cylinder safety were reinforced by a previous accident, in August 1993, involving a converted sedan operated by a utility company.

[3]According to Postal Service officials, conversion of more than 2,000 vehicles for 1994 is possible, but no definite plans have been made.

conversions DOD will undertake are described in ch. 5.) DOD also expects to convert some vehicles to electricity using 1994 funds, but as of May 1994, no estimates were available of the number of vehicles involved.

Overall then, the most recent estimates indicate that federal procurements of AFVs for 1994 will include 4,005 OEM vehicles and 3,415 converted vehicles, for a total of 7,420 AFVs. Thus, the government is expected to nearly meet EPACT's target of 7,500 vehicles but would fall short—by about 3,800 vehicles—of the accelerated executive order target of 11,250.

On the other hand, the number of AFVs acquired may be higher than the estimates suggest because DOD and the Postal Service may convert additional vehicles and because DOE may choose to adjust the government's acquisition strategy in light of General Motors' decision. Funds earmarked for the incremental cost of the 2,500 General Motors vehicles are still available. DOE is considering several ways in which these funds could be used. Since the deadlines for ordering additional 1994 AFVs from other manufacturers have passed, the remaining options include delaying procurements until 1995, when additional CNG vehicles become available from General Motors or other manufacturers; converting more existing vehicles to CNG or propane; and diverting a portion of the funds to pay for refueling facilities. However, as of May 1994, DOE had not yet determined which option or combination of options would be the most practical and best contribute to the long-term goals of the government's alternative fuels effort.

Converted Vehicles Are Being Used to Help Meet Acquisition Targets

The limited number of AFV models available from the manufacturers, the high cost of some models that have been offered, and the limited availability of appropriated funds to cover these costs have influenced the government's strategy in attempting to reach the accelerated acquisition targets. Although the government's long-term preference is to obtain AFVs from the manufacturers, federal agencies are finding it convenient and cost-effective in the short term to rely on aftermarket conversions to obtain the AFV models they require. DOE, DOD, and the Postal Service have pursued the opportunity to obtain a wider choice of gaseous-fueled AFVs at lower cost than OEM vehicles. This strategy has offered a means of procuring more vehicles with the funds available, and therefore is one way of meeting acquisition targets.

AFVs produced by the automobile manufacturers have generally cost considerably more than the conventional vehicles they replace, and this

has been especially true of CNG vehicles. This incremental costs exists for several reasons. According to GSA officials, it is not just extra production costs that make AFVs more expensive than conventional vehicles. Another important factor is the lack of competition among the automakers when they bid on AFVs, since each of them makes different types of AFVs. In contrast, competition is strong among the automakers to win the government's conventional vehicle contracts, enabling GSA to obtain quite favorable prices for these vehicles. As a result, the gap between the prices for conventional vehicles and AFVs is likely wider than it would be if there were competitive bidding for both types of vehicles.

Still another factor that sometimes contributes to high incremental costs is the fact that some fuel configurations are only available on larger vehicle models. When a larger model AFV is used when a smaller conventional model would suffice, the extra cost of the larger vehicle is generally considered part of the incremental cost. For the federal fleet, this is currently exemplified by the 1994 ethanol FFV, which is only available as a mid-size sedan. In most agencies, this vehicle will replace a compact gasoline-fueled sedan, so the extra cost of the larger model becomes part of the incremental cost.

Although higher incremental costs for AFVs continue to exist, some changes have occurred. For example, vehicle contracts awarded by GSA indicate that the incremental cost is lower in 1994 for several AFV models that were offered in previous years. However, this decrease appears to result from higher prices for the gasoline models to which the AFVs are compared, rather than actual decreases in AFV prices. Moreover, the incremental cost for two models, the mid-size ethanol and methanol sedans, increased substantially this year because the manufacturers offered these alcohol options at no cost last year as part of a special, one-time incentive. Table 4.2 shows the incremental cost of AFV models that were offered to the government in both 1993 and 1994.

Table 4.2: Incremental Cost of AFVs Available in 1993 and 1994

AFV model	Incremental cost for 1993	Incremental cost for 1994	Change in incremental cost
Compact sedan: methanol FFV	$721	$527	($194)[a]
Mid-size sedan: methanol FFV	$0	$551	$551
Mid-size sedan: ethanol FFV	$0	$551	$551
Full-size, 8-passenger van: dedicated CNG	$5,858	$3,811	($2,047)
Full-size cargo van: dedicated CNG	$5,127	$4,067	($1,060)
Full-size pickup: dedicated CNG	$7,954	$8,026	$72

[a]Parentheses indicate negative numbers.

In addition, several AFV models were offered for the first time in 1994 at high incremental costs. As previously discussed, production of some of these vehicles will now be delayed until at least model-year 1995. It is uncertain what effect, if any, this delay will have on prices. In the meantime, the comparisons that follow are based on prices in the 1994 vehicle contracts that GSA awarded to the automobile manufacturers before the decision to delay production. Although the specific pricing details may change, the trends may be instructive.

As table 4.3 shows, the AFV versions of several models cost over 50 percent more than their gasoline-fueled counterparts. Compared with dedicated CNG vehicles, the incremental costs for the new bi-fueled vans, pickups, and full-size sedans are relatively lower. This difference occurs in part because the fuel storage configuration of these vehicles does not require the removal of the existing gasoline tank or the mounting of several CNG cylinders under the chassis, as is typically the case with dedicated CNG vehicles. The incremental costs of the smaller vehicles listed in this table appear relatively high, in part because of the high cost of CNG components relative to the lower base price of these vehicles.

Table 4.3: Incremental Cost of AFVs First Offered in 1994

AFV model	1994 price of AFV	1994 base price of gasoline vehicle	1994 incremental cost of AFV	Incremental cost as a percentage of base price
Compact sedan: bi-fueled CNG	$13,585	$8,777	$4,808	55%
Full-size sedan: bi-fueled CNG	$16,437	$12,632	$3,805	30%
7-passenger minivan: dedicated CNG	$20,608	$12,649	$7,959	63%
12-passenger full-size van: bi-fueled CNG	$20,008	$15,334	$4,674	30%
15-passenger full-size van: dedicated CNG	$22,293	$15,070	$7,223	48%
Full-size cargo van: bi-fueled CNG	$17,610	$12,917	$4,693	36%
Full-size pickup: bi-fueled CNG	$17,638	$11,671	$5,967	51%
Small pickup: dedicated CNG	$19,298	$10,851	$8,447	78%
Small pickup: bi-fueled CNG	$17,252	$10,851	$6,401	59%

In comparison, under a recent conversion contract awarded by DOE, it will cost in the range of $3,800 to $4,000 to convert most light-duty vehicles to operate on CNG; this is somewhat below the incremental cost of most CNG vehicles offered by manufacturers. Moreover, under another DOE award, converting vehicles to use propane will cost between $2,400 and $2,600. While the lack of OEM propane vehicles makes it impossible to compare costs directly, the cost of propane conversions is expected to be considerably less than the incremental cost of all the CNG vehicles available from the manufacturers.

The awards from which these prices are quoted are the first awards resulting from a DOE effort to develop contracts for aftermarket conversions through its National Renewable Energy Laboratory. Under these contracts, selected regional contractors will convert a variety of vehicles owned by various federal agencies to run on natural gas or propane, with DOE paying the conversion cost. The first awards were made in the spring of 1994 to two regional contractors in the Denver and Washington, D.C., areas, and others are expected to be made during the remainder of 1994.

One strategy for meeting the higher acquisition targets would be to use most of the available incremental funding to procure larger quantities of alcohol-fueled vehicles, which are almost all built by the automobile manufacturers and have much lower incremental costs than gaseous-fueled AFVs. While the government has followed this strategy, it has also attempted to increase its purchases of gaseous-fueled vehicles, particularly those that use CNG, in order to provide a more balanced overall fuel mix for the fleet. In addition, some agencies, such as DOD, have found CNG vehicles more suitable for meeting their mission requirements. Thus, earlier plans for acquiring OEM vehicles in 1994 included approximately equal numbers of alcohol-fueled and CNG vehicles. Again, this strategy has been affected by General Motors' decision to delay production of several types of CNG vehicles that the government had planned to procure in 1994. However, it uncertain at this time to what extent the shortfall in CNG vehicles might be made up from other sources.

Another strategy for meeting the higher acquisition targets involves converting a significant number of vehicles, thereby permitting the acquisition of more gaseous-fueled vehicles while still making it feasible to approach the targets established by Executive Order 12844. For fiscal year 1993, DOE had available appropriations of $7 million to cover the incremental costs of AFVs. In striving to meet the 1993 acquisition goals, DOE set aside more than half of this money—$4.35 million—to pay for aftermarket conversions. In addition, the Postal Service and DOD's Advanced Research Projects Agency used 1993 funding to pay for approximately 2,400 conversions. For fiscal year 1994, DOE received $18 million to cover the incremental costs of AFVs. As mentioned above, DOE originally intended to use a portion of this money to pay for just 150 propane conversions, but the number of conversions could increase depending on which options DOE adopts in response to the decreased availability of vehicles from General Motors. As discussed above, DOE officials anticipate that the Postal Service and DOD will again pay for large numbers of converted vehicles that may be counted toward the overall 1994 federal acquisition target for AFVs.

The Postal Service has been converting mail-carrying vehicles to run on CNG for a number of years and plans to continue doing so through 1995, with the potential for more conversions in the future depending upon a reassessment of vehicle technology, fuel availability, and cost. In 1993, the Postal Service reported paying from $2,000 to $2,500 to convert its vehicles to CNG. Under a new contract awarded in February 1994, this cost decreased somewhat to between $1,800 and $2,300, despite more stringent

specifications needed to meet new emissions, safety, and performance requirements. According to Postal Service officials, the lower costs largely resulted because they are converting a large quantity of identical mail-carrying vehicles. Therefore, they were able to take advantage of competition for their large volume order. In addition, since all the vehicles were the same, the conversion kits could be standardized, preassembled, shipped intact, and installed in each vehicle without individual modifications. As a result, conversion costs for the Postal Service remain considerably below the cost of OEM natural gas vehicles.

DOD's Advanced Research Projects Agency received funding of $10 million for fiscal year 1993 to be used for research, development, and demonstration projects for natural gas vehicles and infrastructure. The agency has indicated that about 500 vehicles will be converted to CNG with a portion of this 1993 money, while 117 vehicles will be converted to electricity. For 1994, the Congress appropriated another $15 million for this program, a portion of which will pay for about 1,255 CNG conversions and an unknown number of electric conversions. DOD officials agreed that conversion costs for CNG vehicles under any contracts entered into by DOD will likely be in the $3,800 to $4,000 range obtained under DOE's CNG conversion contract.

Thus, although the accelerated acquisition targets were intended to encourage OEM production by increasing the demand for AFVs, federal fleets, at least in the short term, are converting significant numbers of vehicles to meet these targets. However, it is not clear what effect this trend will have on the automobile manufacturers. Federal fleets that choose converted vehicles will not contribute to the desired increase in purchases of AFVs from the manufacturers. But, to the extent that the manufacturers respond to competition from conversion companies, continued interest in converted vehicles may indirectly influence the manufacturers to increase their in-house AFV offerings or to continue pursuing various forms of partnerships with conversions companies as a means of increasing model availability. Additional information on this latter trend is presented later in this chapter.

Finally, although conversions are less costly and offer more choices than factory-built OEM vehicles, converted vehicles also appear to have certain limitations in terms of safety, emissions, warranty coverage, and overall quality. These limitations and the trade-offs involved in using converted vehicles ought to be well understood by those making the choice. The following section discusses both the advantages and the limitations of

converted vehicles in greater detail and describes several new developments that may improve their quality and usefulness.

Recent Initiatives Address Some Weaknesses of Converted Vehicles

The role of converted vehicles in AFV programs is evolving as various federal actions influence quality and price and as manufacturers enter into new relationships with conversion companies. Aftermarket conversions have historically been available at lower prices than OEM vehicles, but various government and industry officials have been critical of converted vehicles, citing a reputation for inconsistent quality. Recent federal actions have the potential to improve the quality of these vehicles, but prices may also rise, narrowing their price advantage over OEM vehicles. And despite improvements, converted vehicles will likely continue to offer somewhat less assurance of emissions benefits, safety, problem-free warranty coverage, and overall quality than fully engineered OEM vehicles. Recently, formal agreements between manufacturers and qualified vehicle converters appear to be gaining acceptance, and vehicles produced under these arrangements offer some of the advantages of both OEM and converted vehicles.

Types of Converted Vehicles

Vehicles can be converted to operate on alternative fuels by several different procedures. The closest to OEM vehicles are new vehicles converted by authorized vehicle converters, or "upfitters," under formal agreements with the manufacturers. Such vehicles are generally sold and serviced by the manufacturers' dealerships. Aftermarket conversions occur when new or used vehicles are brought to a conversion company by the customer so that a conversion kit can be installed. In most of these cases, the manufacturers have no knowledge of or responsibility for the conversion work.

Several types of firms are involved in the conversion industry. First, there are the manufacturers of conversion equipment. Some of these, such as cylinder manufacturers, produce only certain elements of a conversion system. Others not only produce components but also assemble complete conversion kits that include all the key elements needed to convert a vehicle. Second, there are the companies that merely install conversion kits. These companies range from authorized installers that enjoy technical support from the kit manufacturers to so-called "mom and pop" enterprises that install whatever off-the-shelf conversion equipment they can obtain. Finally, there are several firms that perform both functions, not

only manufacturing their own conversion components but also maintaining their own installation facilities.

Impacts of New Federal Legislation, Regulations, and Solicitations on Conversion Quality

Several recent or imminent federal actions could potentially increase the quality of conversions. EPACT bars federal agencies from acquiring converted vehicles unless warranty agreements between the manufacturers and the conversion companies are in effect. DOE representatives believe that only well-qualified conversion companies will be able to reach such agreements with the manufacturers. In addition, recent DOE and Postal Service solicitations included specifications that placed challenging technical demands on conversion companies, so that only firms with sophisticated engineering and quality control capabilities could qualify for the awards. Finally, according to EPA officials, the agency will soon issue new emissions standards and certification procedures covering gaseous-fueled vehicles and converted vehicles.[4] Officials from the National Highway Traffic Safety Administration (NHTSA) also note that the agency is in the process of issuing and clarifying various safety requirements that cover converted CNG vehicles. (App. IV provides a detailed discussion of these actions by EPA and NHTSA.) Firms wishing to remain in the conversion business will need the expertise and resources to meet these stricter emissions and safety requirements.

Advantages of Converted Vehicles

Converted vehicles are expected to retain a cost advantage over OEM vehicles for several reasons. First, conversion companies' costs for meeting emissions standards may remain lower than automobile manufacturers' costs, even though, according to EPA officials, pending EPA regulations will for the first time include procedures for certifying that converted vehicles meet federal emissions standards. Conversion companies' certification costs may be lower than comparable manufacturers' costs because conversion companies will be permitted to use special EPA procedures for small volume manufacturers to demonstrate that the vehicles they convert meet the requirements for durability of emissions control systems. These procedures are generally less costly than the full durability testing normally required of automobile manufacturers. However, the extent of this cost advantage is not clear because the manufacturers are also allowed to use the small volume manufacturers' procedures for a limited number of vehicles. It is uncertain

[4]Certification procedures are the steps that EPA requires an automaker or converter to go through to demonstrate that a vehicle meets a specified emissions standard. The procedures include emissions testing and compliance with related regulatory provisions, such as labeling, warranty, and recall requirements.

whether the manufacturers will apply any of this allowance to the certification of AFVs. Automakers' representatives have indicated that they would find it helpful to be granted more latitude to use the small volume manufacturers' procedures for certifying AFVs.

Another cost advantage of converted vehicles is that customers wishing to acquire AFVs can have vehicles they already own converted. Not only is the cost of the alternative fuel system itself generally lower for a conversion than for an OEM vehicle, but this approach allows customers to avoid the cost of purchasing new vehicles when existing vehicles are still serviceable. Similarly, conversions could also help eliminate situations in which customers are forced to pay extra for a larger vehicle than they really need because a smaller vehicle is not available from an automaker in an AFV version. The federal government has encountered this problem in at least two instances, when it had to buy mid-size FFV sedans and full-size CNG pickups rather than the compact sedans and small pickups it would have preferred.

Another advantage of converted vehicles is that a wider variety of AFV models and sizes is available through conversions, supplementing those produced by the automobile manufacturers. Because conversion companies can adapt conversion components to a wide variety of existing vehicles more rapidly than the automakers can bring new AFVs to market, conversions make it possible for many different kinds of fleets to obtain the types of AFV models they need and begin using AFVs sooner than would otherwise be possible. Furthermore, because greater model availability appears to increase the speed with which AFVs can be placed in service, the use of converted vehicles could accelerate the demand for alternative fuels and thus help encourage more rapid development of alternative fuel refueling facilities.

Disadvantages of Converted Vehicles

Despite the advantages of converted vehicles in terms of price and model availability, our discussions with government and industry officials suggest that these vehicles will continue to offer somewhat less assurance of quality than fully engineered OEM vehicles. New regulations intended to ensure that converted vehicles meet emissions and safety standards have been or will soon be issued. Nonetheless, in some circumstances, the new requirements appear to offer somewhat less assurance of satisfactory emissions and safety levels for converted vehicles than the requirements that apply to OEM vehicles.

For example, using the small volume manufacturers' procedures, some conversion companies will be able to certify that the emissions systems of engines in converted vehicles meet durability requirements by referring to data on previously tested engines of a similar design. In contrast, automobile manufacturers are normally required to operate a test engine for a full 100,000 miles to demonstrate such durability. Thus, the chance that the emissions control systems of some converted vehicles will deteriorate over time may be somewhat greater than is the case with fully tested OEM vehicles.

In addition, even though new procedures will soon be in place for the emissions certification of converted vehicles, there is no guarantee that all conversion companies will follow these procedures. As explained in greater detail in appendix IV, vehicles converted to satisfy the requirements of EPA's Clean Fuel Fleet Program or to obtain tradeable emissions credits must be certified. However, the certification procedures are voluntary for other converted vehicles. Converters of these vehicles may choose to remain subject to the earlier anti-tampering rules, which EPA officials concede are less effective than certification at ensuring that vehicles meet emissions standards.

A study prepared in 1993 by the city of Houston raised further concerns about the emissions benefits of converted vehicles. This study found that vehicles in the city fleet converted to use CNG generally produced higher emissions than OEM natural gas vehicles and provided virtually no emissions benefits in comparison with gasoline- and diesel-fueled vehicles with improved emissions control systems. The National Association of Fleet Administrators, some of whose members have experience with converted vehicles, has cited the Houston study in calling on the federal government and the states to exercise caution in imposing mandates that could make it necessary for fleets to convert vehicles if suitable OEM vehicles are not available.

Ensuring the safety of converted vehicles also appears to be a somewhat more difficult task than it is for OEM vehicles. According to a NHTSA official, the agency has greater authority to regulate the safety of new vehicles than that of converted vehicles. Manufacturers of new vehicles and vehicle equipment must positively certify that these products meet federal motor vehicle safety standards. New CNG cylinders installed on converted vehicles will be covered once the requirements for cylinders are issued. On the other hand, NHTSA's effort to ensure the overall fuel system integrity of converted vehicles must also rely in part on the agency's authority to

forbid converters to render the vehicles' existing safety systems inoperative. Thus, regulating the safety of converted vehicles is partially based on an approach which is less direct and appears to be less easily enforced than the approach applied to OEM vehicles.

In addition to these emissions and safety issues, there are other concerns about the technical quality of conversion components as well as the quality of installation. For competitive reasons, the automobile manufacturers have generally been unwilling to provide aftermarket conversion companies with detailed technical data on vehicles' emissions systems and onboard computers. This makes it difficult for makers of conversion components to produce equipment that is fully integrated with a vehicle's existing systems and also makes satisfactory installation more difficult. This limitation can have negative impacts on both the emissions and performance of a converted vehicle. Moreover, the same conversion kit, even if well-engineered, may be installed by different installers. The performance of the vehicle can vary considerably, depending upon the competency of the installer.

Finally, warranty costs are expected to be higher for converted vehicles. For example, an official at the National Renewable Energy Laboratory who is responsible for DOE's conversion contract told us that contractors were expected to include an extra cost increment in their proposals to account for anticipated higher warranty costs. Although there will be written agreements between manufacturers and converters, warranty coverage will be more complex than it is for OEM vehicles because of the involvement of two or even three parties in these agreements—the automaker, the kit manufacturer, and the installer.

Need for Data on Converted Vehicles

To address the various concerns about the quality of converted vehicles, better data are needed on their performance, emissions characteristics, safety, and maintenance records. While there are considerable differences of opinion about the quality of converted vehicles, most of the opinions appear to be based on anecdotal information. Because the Postal Service, DOE, and DOD are about to convert significant numbers of vehicles under new contracts, it is an opportune time to begin collecting uniform data on a large number of the latest generation of converted vehicles.

DOE's Alternative Fuels Data Center provides a centralized location to store data on these vehicles. The Center is planning to collect data on selected conversions performed under the DOE contract recently awarded

by the National Renewable Energy Laboratory, of which the Center is a part. However, the Director told us that collecting consistent, comparable data on a sample of converted vehicles will be a challenging task because of the large number of possible combinations of different base vehicles, conversion kits, and installers. The Postal Service and DOD's Advanced Research Project Agency have indicated that they will collect data on their converted vehicles that could be incorporated into the data base at the Center.

Automakers' Contracts With Qualified Upfitters

Some manufacturers are responding to calls for greater model availability and to increased competition from aftermarket conversion companies by developing relationships with qualified upfitters that will convert specially prepared factory vehicles to use alternative fuels. These vehicles will have some of the advantages of OEM vehicles in that they will be sold and serviced at manufacturers' dealerships, and the upfitters will have access to engineering data that manufacturers do not normally share with aftermarket converters. This information should enable manufacturers of conversion components to design better equipment at lower cost. In addition, these vehicles may also offer some of the advantages of converted vehicles, in that price and model availability should be somewhat better than that of OEM vehicles built entirely in-house. In practice, AFVs produced in this way may be viewed as essentially the same as OEM vehicles, and automakers hope to make the role of the outside conversion companies virtually invisible to their customers.

Coordination of Federal, State, and Other Fleet Purchases Could Increase AFVs' Availability and Decrease Prices

Federal officials have been calling for automobile manufacturers to produce the wide variety of AFVs needed by federal agencies at prices low enough to permit the government to meet its acquisition targets while maintaining a fleet with a balanced mix of different fuels. However, the automobile manufacturers contend that the high design and production costs for AFVs, coupled with low sales volumes, make it infeasible for them to rapidly expand their product offerings or lower the prices of AFVs significantly. A potential solution to this problem is the coordination of AFV purchases by federal, state, local, and commercial fleets.

Reasons for Limited Availability and High Prices

According to the automobile manufacturers, the limited models of AFVs available and their high prices result from low sales volumes coupled with the high costs of design and production. High investment costs for the design, certification, and production of AFVs must be spread over a very

small number of vehicles, contributing to high prices. High costs and low sales also discourage the automakers from investing in additional models, since the chances for making a profit from the investment are slight. In addition, AFVs are more expensive because they require special components that are often more costly than those used on conventional vehicles. These so-called variable costs are especially high for CNG vehicles, which require expensive fuel storage cylinders.

Need for Higher Volumes and Longer Lead Time

According to the automakers, much larger sales volumes are needed before it will make economic sense for them to significantly increase the number of AFV models they produce. Similarly, only higher sales volumes will enable them to spread their investment costs over enough units to allow them to substantially reduce the prices of AFVs. Representatives of the automobile manufacturers estimated that a volume of approximately 10,000 units annually of the same AFV model for a single manufacturer would be enough to justify, on a strictly economic basis, the continued production of a model or the design of a new one.[5]

In addition to higher volumes, the automobile manufacturers also cite a need for longer lead times to enable them to adequately plan for the introduction of new AFV models. The typical cycle for a major redesign of a conventional vehicle is 4 to 5 years, and similar lead times would be appropriate for designing new AFV models. However, in the automakers' view, the government has not adequately planned its long-range vehicle needs and has not offered the kind of long-term commitment to purchase AFVs of particular types that would enable the producers to proceed confidently with vehicle development programs.

Limited Impact of Federal Fleet Alone

Despite current efforts to accelerate the acquisition of AFVs, the federal government by itself does not purchase enough vehicles to justify expanded production of AFVs. The expanded target for 1994 federal purchases of all types of AFVs is 11,250 vehicles, barely more than the threshold of 10,000 vehicles of a single model type the automakers need for economical production. Because federal purchases are divided among the three domestic automobile manufacturers and across several model and fuel types, their impact is further diluted. By themselves, federal purchases are clearly not enough to drive the market in the long term,

[5]A GSA official mentioned several examples of conventional vehicles in which even volumes in excess of 10,000 vehicles were not enough to convince automakers to continue producing certain models. For example, as part of their overall marketing strategies, Ford and Chrysler decided to discontinue production of the Tempo and Acclaim, respectively, despite sales of well over 10,000 units annually.

although such purchases may be a necessary initial step in the development of a viable AFV industry.

Feasibility of Combined Procurements

We asked GSA officials whether they could directly purchase AFVs on behalf of other fleets as a means of combining purchases and providing the larger volumes the automakers need. GSA officials responded that, to accomplish this, changes would have to be made in existing laws and regulations that prohibit GSA from purchasing vehicles on behalf of state and local governments (except the District of Columbia) or commercial enterprises. Also, differences in vehicle specifications, time schedules, and delivery arrangements could make this option unacceptable to many nonfederal fleets. Moreover, it appears unnecessary to take this step, because automakers are simply looking for increases in the total orders of specific AFV models. The mechanism for purchasing these vehicles, whether combined or separate, is immaterial.

Limiting the Number of Different AFVs Ordered

Rather than combining AFV purchases, a more feasible strategy could be to limit the number of different models of AFVs ordered by various entities to help demonstrate the potential for increased sales volumes that the automakers are seeking. In fact, EPACT requires that the federal government coordinate with state and local governments to the extent practicable and encourages DOE to coordinate federal and state AFV acquisitions as part of the state and local incentives programs authorized by the law.[6]

The automobile manufacturers point out that the federal government has tended to request different models of AFVs than those required by certain other fleets. They say, for example, that the federal government has consistently asked for compact sedans for many applications, while commercial fleets tend to favor mid-size sedans. The automobile manufacturers suggested that the federal government change this requirement to bring it in line with what commercial fleets want. Similarly, an official of the National Association of Fleet Administrators pointed out that, currently, fleets at various levels have very specific, often one-of-a-kind, specifications. He suggested an effort to encourage all kinds of fleets to order the same AFV models by developing common AFV specifications.

[6]Section 409 of EPACT authorized a total of $50 million in federal grants over 5 years to help the states implement alternative fuel plans and purchase AFVs.

The Federal Fleet Conversion Task Force endorsed this concept when it recommended that the federal government review its AFV specifications and consider matching them with those of state and local governments, so that purchases could be more readily coordinated. More specifically, the Task Force also recommended that the federal government consider increasing its acquisition of mid-size AFV sedans. However, it should be noted that federal law currently requires the use of compact sedans in many situations, and the use of larger vehicles than necessary by federal employees would appear wasteful to the public. Moreover, using mid-size sedans could be more costly, since the base cost for the larger vehicles as well as their fuel costs would likely be higher. Moreover, DOE officials told us that, because of tightening budgets, state and local governments are also using more and more compact sedans.

Under another approach to coordinating purchases, the federal government would actively seek to influence the acquisition plans of other government entities. For example, DOE officials at the agency's regional offices might work with state officials to agree to order the same types of AFVs from the manufacturers. DOE officials told us they have not previously pursued such a strategy but that since the Federal Fleet Conversion Task Force has called for stronger action to aggregate purchases, DOE may consider adopting this approach in the future.

A less aggressive way to influence automobile manufacturers would be to obtain better information on the planned AFV purchases of nonfederal fleets in response to EPACT, the Clean Air Act, and various state laws and to provide such information to the manufacturers. During 1992, DOE attempted to collect 5-year planning information from state governments, with a view to aggregating the states' planned AFV orders and providing the information to automobile manufacturers to demonstrate increased demand. However, an automobile company official told us that he viewed this information as incomplete and unreliable, and therefore of little use in helping his company make decisions about future AFV production and pricing. He pointed out that the data were collected before the October 1992 passage of EPACT, with its purchase mandates for state fleets.

During 1993, DOE began another effort to collect 5-year planning data from the states, awarding a new contract for this effort to an organization representing state energy officials. DOE officials believe this organization will be in closer touch with state AFV programs than the previous contractor and that, having evaluated the requirements of EPACT, states are in a better position now to estimate their future needs for AFVs.

Consequently, DOE officials believe the current effort will yield more useful information than the previous one.

To date, DOE has not developed specific plans to collect this type of comprehensive data from local or commercial fleets. However, this type of data would appear necessary to comply with the requirements of EPACT's section 503, which requires the Secretary of Energy to develop annual estimates of the numbers of each type of AFV likely to be in use in the United States for the following year and the probable geographic distribution of these vehicles.[7] We asked officials of one automobile company whether data provided by the federal government on the acquisition plans of local governments and commercial fleets would be useful to them. They responded that, thus far, DOE has had difficulty predicting federal and state governments' future requirements for AFVs. Given this history and the much larger number of local and commercial fleets, these automobile company officials said they doubted the federal government could successfully estimate future purchases by local governments and private fleets.

On a more limited basis, DOE's Clean Cities Program could provide an opportunity to estimate the combined federal, state, local, and commercial requirements for AFVs in several large metropolitan areas. It might also provide an opportunity for these groups to review and discuss their vehicle requirements, with a view to ordering greater numbers of the same vehicle models, as discussed earlier in this section.

Conclusions

While progress is being made to increase the acquisitions of AFVs in the federal fleet, DOE's estimates show that the federal government will fall short of meeting the accelerated targets established by Executive Order 12844, particularly for fiscal year 1994. Several factors contributed to this shortfall, including the high incremental cost of acquiring AFVs, the limited funding available to pay the extra cost, and a recent decision by one of the automobile manufacturers not to produce planned CNG vehicles because of two fuel cylinder failures.

Because of the limited availability and high cost of some OEM vehicles, the government plans to convert many vehicles to use alternative fuels as part of its strategy to meet the AFV acquisition goals. An increase in federal acquisitions of new AFVs and conversions of existing federal vehicles has

[7]Although EPACT required that DOE begin these estimations as of October 1, 1993, the agency has delayed implementation of this requirement for 1 year.

helped influence vehicle choice and lower prices. However, it is unclear whether acquiring more converted vehicles would encourage automobile manufacturers to produce additional AFVs in the future. Such an increase will likely require a higher vehicle sales volume than the federal government alone can provide.

DOE has attempted to inventory state governments' plans to acquire AFVs as a means of demonstrating the potential for higher sales volume. From the manufacturers' perspective, however, the problem appears to be the widely different needs of federal, state, and local government and private fleets for AFVs. A more aggressive strategy appears necessary to generate larger sales volumes for particular AFV models.

Recommendations

To encourage automobile manufacturers to improve the availability of AFVs and lower their prices, we recommend that the Secretary of Energy work with federal, state, and local government and private fleet operators to minimize the different types of vehicle makes and models included in their acquisition plans. One way to accomplish this could be to develop common specifications for the major uses of AFVs and encourage fleet operators to adopt these common specifications when buying vehicles.

Efforts to Coordinate Alternative Fuels Programs Are Under Way, but Some Issues Remain Unresolved

EPACT requires federal agencies to coordinate their efforts to acquire significant numbers of AFVs for the federal fleets. DOE and GSA, the primary agencies responsible for this coordination, have made reasonable efforts to carry out this responsibility. In addition, with its large fleet, the Postal Service has played an important role in coordinating alternative fuel activities with other federal agencies. To assist with this coordination, the agencies have formed various groups to discuss their programs, strategies, and concerns. However, in some areas, coordination issues are still evolving.

The federal government has also attempted to coordinate alternative fuels programs at the state and local level. The Federal Fleet Conversion Task Force has been instrumental in this effort. The Clean Cities Program also holds promise as a coordinating mechanism, as discussed previously. However, state and local officials believe stronger federal coordination would be helpful on issues such as the need for (1) clearer guidelines from EPA on the credits available for alternative fuels programs, (2) technical guidance on AFVs from DOE, and (3) a comprehensive source of information on the financial assistance available for alternative fuels programs. Meanwhile, state and local officials expect no major conflicts in coordinating their alternative fuel programs with those of the federal government or neighboring jurisdictions. However, fleet operators are concerned about the financial and administrative burdens they may face in meeting the requirements of an increasing number of state and local alternative fuels programs.

Efforts to Coordinate AFV Programs Among Federal Agencies

EPACT requires federal agencies to coordinate their vehicle acquisition and placement. The three organizations with primary responsibility for these actions are DOE, GSA, and the Postal Service. Each of these agencies must submit an annual report to the Congress on the status of its efforts concerning AFVs.

DOE is the lead agency for coordinating federal AFV programs under EPACT and provides incremental funding for purchasing AFVs and converting existing vehicles to use an alternative fuel.[1] The agency also collects data on all federal agencies' needs for AFVs over a 5-year period. DOE reviews these requests, negotiates necessary changes to meet the overall goals, and works with GSA to procure the requested vehicles.

[1]To date, the Postal Service has used its own funding to convert its mail-carrying vehicles to use CNG. In addition, DOD is using its funds to pay for conversions.

Because one of GSA's responsibilities is to purchase vehicles for federal use, the agency is heavily involved in negotiating with automakers and determining vehicle specifications. GSA is also involved in negotiating with fuel providers to develop refueling facilities for alternative fuels and provides federal drivers with a list of such facilities in their area. Furthermore, through its purchases of OEM vehicles, GSA obtains access to authorized dealerships for maintenance and repair in each location where there are federal AFVs. In various forums, including meetings of the Interagency Motor Equipment Advisory Committee, GSA, with assistance from DOE, has also provided guidance to federal agencies on the operation of AFVs. This committee, made up of federal agencies, was formed by GSA to increase efficiency and economy in the day-to-day operation and maintenance of vehicles in the federal fleet.

The Postal Service has the single largest fleet in the federal government and communicates with DOE to confirm that its AFV program fits in with the overall federal acquisition program for AFVs. Furthermore, the Postal Service makes some of its refueling facilities available to other federal agencies.

Coordinating organizations from a broader range of federal agencies support these activities. The Federal Interagency Energy Policy Committee (the "656 Committee") was established by section 656 of the Department of Energy Organization Act and assists with policy-making on federal energy management issues. In 1991, the United States Navy organized the Interagency Committee on Alternative Fuels and Low-Emission Vehicles (INTERFUEL) to serve as a coordinating committee for federal agencies to address common issues affecting the management of AFV programs and activities. In 1993, INTERFUEL became an official work group of the 656 Committee.

The INTERFUEL work group assists federal agencies with the implementation of alternative fuels programs. Through INTERFUEL, agency officials meet periodically to coordinate and disseminate information among federal agencies involved in implementing the Clean Air Act, the Alternative Motor Fuels Act, executive orders 12759 and 12844, EPACT, and related regulations. Such information can include data on usage of alternative fuels and AFVs, technical advancements, and testing and evaluation. This information is disseminated at meetings or through memorandums to the agencies.

The Federal Fleet Conversion Task Force has also contributed to the federal government's coordination efforts. The group brought together federal agency officials but had the broader purpose of including representatives of each level of government as well as industry. The Task Force's coordination efforts are discussed later in this chapter.

Current Issues in Federal Agencies' Coordination Efforts

While federal agencies have made reasonable efforts to coordinate their AFV programs, there are some areas in which coordination is still evolving. These areas include (1) different points of view regarding inherently low-emission vehicles (ILEV), (2) the role of DOD in relation to DOE regarding AFV research and demonstration projects, and (3) public access to federal alternative fuel facilities. Since all three issues are complex, a detailed review of them would require additional work beyond the scope of this assignment. We gathered sufficient information to identify these as potential coordination issues that may merit further attention, and we present an overview here.

Inherently Low-Emission Vehicle Program Raises Concerns

EPA developed ILEV standards as part of the Clean Air Act's Clean Fuel Fleet Program.[2] These standards require that vehicles meet stringent standards for tailpipe emissions and also have essentially no emissions that evaporate from the fuel system throughout the useful life of the vehicle. Although the ILEV standards are not mandatory, as discussed below, fleets may earn valuable benefits by purchasing these vehicles. Appendix I provides further information on this program.

The Federal Fleet Conversion Task Force created some controversy by deliberating on a tentative proposal that the federal government purchase a large number of ILEVs—80 percent of federal AFV purchases—for its fleet. After much discussion, the Task Force recommended that a much smaller number of ILEVs be purchased—5 percent of federal acquisitions for fiscal year 1994.

EPA—because of its focus on clean air—favors purchasing large numbers of ILEVs because the agency believes they are among the vehicles with the lowest levels of emissions. It appears likely that the only vehicles that will be able to meet ILEV emissions standards are dedicated AFVs. EPA officials have serious concerns about the air quality benefits of FFVs and dual-fueled vehicles.

[2]The Chairman of the House Committee on Energy and Commerce has requested GAO's opinion on whether the Clean Air Act, as amended, authorizes EPA to establish ILEV standards for certain purposes. A separate opinion will be issued.

While DOE does not disagree with the ILEV concept, the agency is more open to FFVs and converted vehicles, many of which are dual-fueled, as a way of getting large numbers of AFVs in operation to achieve its objective of promoting the development of refueling facilities. Although, as discussed previously, there is now no guarantee that these vehicles will actually be operated on alternative fuels, DOE believes that the presence of large numbers of vehicles capable of using alternative fuels will induce fuel providers to invest in alternative fuel refueling facilities.

DOE is also concerned about the potential implications of an ILEV purchase requirement on the policy of fuel neutrality. While DOE is striving to implement a policy that includes a wide variety of vehicles, the only types of vehicles that are currently able to meet the ILEV standards are dedicated CNG and electric vehicles.[3] Furthermore, uncertainties exist about whether manufacturers will choose to produce large volumes of ILEVs in the short term—a concern to DOE in meeting the AFV acquisition targets of EPACT and Executive Order 12844. DOE officials stated that they are working with EPA to address this issue.

While EPA made the ILEV program voluntary, automobile manufacturers are concerned that the program will be voluntary in name only. Their concern stems from the fact that incentives will encourage states to adopt an ILEV program. Under the Clean Air Act Amendments, states earn credits for measures they include in their state implementation plans that help reduce pollution and demonstrate progress toward attainment of national air quality standards. Because of their lower emissions, ILEVs will yield more credits for pollution reduction than other AFVs. Since credits are extremely important to states in meeting clean air requirements, this could encourage states to mandate the use of ILEVs. In addition, EPA has stated that without significant numbers of ILEVs, fleet programs cannot demonstrate meaningful air qualify benefits. This set of circumstances, coupled with the Task Force's recommendation of a minimum 5-percent purchase requirement for the federal fleet, has caused some to question whether the program is voluntary. The automakers are concerned about ILEV mandates because they will feel considerable pressure to supply the vehicles that meet these standards. They say that supplying such vehicles would divert resources away from other clean air projects mandated by the Clean Air Act, such as onboard diagnostics systems that would alert drivers if their vehicles' pollution control systems deteriorated below federal standards.

[3]EPA officials believe that dedicated ethanol, methanol, and propane vehicles, once they are designed, will also be capable of meeting the ILEV standards.

DOD's Vehicle Research Projects

DOD's Advanced Research Projects Agency has been appropriated funding for research, development, and demonstration of electric and natural gas vehicles and related refueling facilities. The agency's 1993 funding included $25 million for electric vehicle research and $10 million for natural gas vehicle research. In 1994, funding amounts were increased to $46.25 million for electric vehicle research and $15 million for natural gas vehicle research.

Under the Alternative Motor Fuels Act and EPACT, DOE is designated as the primary agency to sponsor alternative fuels programs. For fiscal year 1993, DOE had available $58 million for the research and development of advanced electric vehicles and batteries and a total of $29.1 million for research, development, demonstration, and purchase of other AFVs.[4] According to DOE officials, about $15 million of the $29.1 million is for activities concerning CNG. DOE's estimated 1994 funding for electric vehicles and the agency's other alternative fuels programs is $74.7 million and $43.6 million, respectively. About $27 million of the 1994 funds for its other alternative fuels programs are for CNG activities, according to DOE officials. Since DOD and DOE are each receiving funding for alternative fuels research and development programs, it is crucial for the two agencies to coordinate their activities in order to minimize duplication of efforts and work to complement each other's research activities. The Congress emphasized this need by requiring such coordination in DOD's Appropriation Act for Fiscal Year 1994.

DOE officials have expressed concern about how DOD's funds for alternative fuels research and demonstration are spent, and in particular the amount of funding DOD plans to allocate to building CNG refueling facilities on military bases in relation to planned spending on vehicle purchases. DOE's position is to encourage commercial refueling facilities rather than to invest in federally owned facilities. DOE has been trying to convince DOD to spend as much of its natural gas funding on vehicles as possible. This is based on DOE's long-standing position that if AFVs are placed in service, private fuel providers will respond by installing refueling facilities to meet the demand such vehicles create.

DOD officials cited several reasons for their use of a portion of the funds appropriated to the Advanced Research Projects Agency to develop CNG refueling facilities on or near military bases. These include the following:

[4]The funding for programs other than electric vehicles covers not only activities regarding light-duty AFVs but all other activities, such as programs for heavy-duty vehicles, data collection, and the development of training materials.

- The appropriations language recommends demonstration projects, and DOD believes that a true demonstration must include not only vehicles, but also refueling facilities, data collection, and training.
- Few commercial refueling facilities currently exist near military installations, whereas facilities on or near a base are often necessary to adequately support the military's primary mission.
- DOD believes that investing in refueling facilities rather than larger numbers of converted vehicles will indicate a long-term commitment to alternative fuels and will encourage automakers to produce more AFVs.

DOE and DOD officials have begun to address potential coordination problems. For example, coordination efforts for electric vehicle research include (1) a Coordination Task Force for Electric and Hybrid Systems led by DOE; (2) participation of staff from each agency in the evaluation of technical proposals for new work sponsored by the individual agencies; and (3) participation in the Interagency Advanced Power Group, a federal membership organization that fosters the exchange of information to avoid duplication of effort among those conducting research and development in advanced power fields.

For natural gas research, the coordination thus far has consisted of meetings between the agencies at which DOE provides input on DOD's natural gas research and development projects. For example, the agencies have exchanged information on planned numbers and placement of natural gas vehicles, and DOE has made suggestions on DOD's plans. However, according to both DOE and DOD officials, they have not been able to reach consensus on the level of DOD funding used to convert vehicles. While DOE requested that DOD convert 2,000 vehicles to CNG in fiscal year 1994, as of May 1994, DOD planned to convert only about 1,250 vehicles.

Public Access to Alternative Refueling Stations Located on Federal Facilities

As discussed in chapter 3, the lack of an adequate number of refueling facilities has been identified as a major problem that has prevented greater acceptance of AFVs in the marketplace. To help address this problem, the Clean Air Act requires that federal agencies located in nonattainment areas covered by the Clean Fuel Fleet Program open their fueling facilities to the public, if feasible, when commercial facilities are not available. In areas not covered by the Clean Fuel Fleet Program but where EPACT requirements are in effect, that law stipulates a preference that federal AFV fleets use commercial facilities but allows them to use federally owned facilities if necessary. The Federal Fleet Conversion Task Force

recommended that federally owned facilities in these areas should also be made available to the public.

In an effort to comply with the Clean Air Act's requirement and abide by the Task Force's recommendation, some federal agencies have made or plan to make efforts to open some refueling facilities to the public. For example, two key agencies—the Postal Service and DOD—have committed to open their facilities wherever feasible. These agencies have large fleets, and circumstances have sometimes made it practical or necessary for them to build on-site facilities. According to Postal Service officials, of 12 on-site facilities completed or under way as of May 1994, 3 are slated to be open to the public. DOD officials told us that the Navy and the Marine Corps plan to build CNG refueling facilities at 13 sites on California bases. Of these, one will be open to the public while the remaining facilities will not, primarily because the facilities will be located in secure locations accessible only to military personnel. On the other hand, DOD has supported the development of seven additional commercial facilities, accessible to the public, near California military bases.

The Postal Service is moving away from developing its own on-site facilities. Postal Service officials now believe that commercial refueling facilities will more effectively serve their future needs. On the other hand, as discussed previously, DOD officials continue to view on-site facilities as necessary in some situations.

Officials of both agencies further explained why it is not feasible to grant public access at every federal refueling facility. Postal Service officials explained that, because of the physical layout of some of their locations, public access would interfere with Postal Service operations. DOD officials said that, along with national security issues, they are concerned with (1) the possible need to hire a station attendant or install metering equipment at unattended facilities, (2) the drawbacks of entering into commercial business in competition with the private sector, and (3) liability issues.

When agencies determine that public access to their facilities should be denied, there is currently no independent review to determine that these decisions are reasonable. The Clean Air Act Amendments of 1990 provide that the federal facilities where covered fleets are refueled make clean alternative fuel available to the public during reasonable business times, subject to national security concerns, if such fuel is not commercially available for retail sale to the public in the vicinity of the facility. EPA

proposed regulations interpreting these provisions of the act in October 1991. However, after considering comments on these proposed regulations, EPA decided to issue guidance rather than promulgate regulations. This guidance, issued in March 1993, describes the circumstances in which EPA believes the granting of public access is appropriate.

Similarly, there are no procedures that cover federal fuel facilities in areas outside of those included in the Clean Fuel Fleet Program. EPACT states a preference for commercial stations to service the mandated fleets in those areas. Therefore, in implementing EPACT, DOE does not encourage federally owned facilities and has not developed any procedures for public access when such facilities do exist. However, if such facilities are to be made public, as the Federal Fleet Conversion Task Force recommended, DOE would be a logical agency to coordinate this process and determine if exemptions are justified in certain circumstances. DOE is studying this recommendation but has not made a decision on its implementation.

Efforts Are Under Way to Coordinate Federal AFV Programs With State and Local Governments

The federal government has initiated some coordination efforts that strive to assist state and local governments with various issues related to alternative fuels. In our conversations with state and local officials, they mentioned additional areas in which improved coordination and assistance with legislative requirements would be useful. EPA and DOE officials acknowledged they had only recently begun efforts to address some of these concerns.

Current Federal Efforts to Coordinate With State and Local Governments

The federal government has employed a variety of strategies to coordinate federal alternative fuel programs with state and local government programs. Some examples of these coordination strategies include the Clean Cities Program and the Federal Fleet Conversion Task Force's efforts, discussed in chapter 3, and various federal programs to disseminate information explaining EPACT and Clean Air Act requirements and offer information on alternative fuels.[5]

The wide representation found on the Federal Fleet Conversion Task Force put the group in a unique position to coordinate with the different

[5]It should be noted that the examples presented are not meant to include every federal coordination effort under way. They are meant to show the types of endeavors the federal government has undertaken. While there may be other efforts that we have not included in this report, we are reporting the coordination strategies that state and local officials told us they found helpful.

levels of government. The Task Force comprised a broad range of federal, state, and local government officials as well as fleet, automobile manufacturer, and fuel provider officials. An example of this type of coordination was the Federal, State and Local Programs and Regulations Working Group established by the Task Force, which focused on the coordination of governmental AFV programs at all levels.

Another federal coordination effort involves workshops sponsored by DOE and EPA to explain EPACT and Clean Air Act requirements. These workshops are presented to state and local officials responsible for carrying out federal legislative requirements at the state level. Public and private fleet operators are sometimes invited to attend the workshops as well. In another example of federal coordination, DOE and EPA developed a report and a national teleconference to offer guidance to state officials and fleet operators on how to meet EPACT and Clean Air Act requirements using AFVS.

In addition, DOE entered into a contract in 1992 with the National Conference of State Legislatures. Under the agreement, this organization will provide technical assistance to state lawmakers on alternative fuel legislation under consideration in the various states through such means as a telephone hotline and periodic briefing papers.

Finally, DOE has instituted an alternative fuels hotline to assist the public with questions on AFVs. Several officials we spoke with at the state and local levels said they had used the hotline and found it quite helpful. In addition to answering questions, the hotline operators refer callers to others with experience in using AFVs or implementing alternative fuel programs.

Areas Where Stronger Coordination May Be Useful

While several efforts are under way at the federal level to coordinate alternative fuels programs with state and local governments, DOE officials told us that coordination with state and local governments had just begun. Several officials that we spoke with from state and local agencies told us that more coordination in some areas may be useful. Specifically, states mentioned the need for (1) more guidance from EPA about the credits they can earn under their state implementation plans for programs that involve AFVs that meet various emissions standards, (2) more technical guidance on alternative fuels issues, and (3) a comprehensive source of information on the financial assistance available for alternative fuel programs.

Guidance on Air Pollution Credits

Some of the state officials we spoke with identified the need for more specific guidance on the amount of air pollution credits AFVs could receive as part of state implementation plan to reduce emissions. Under the Clean Air Act Amendments, states that do not meet federal air quality standards are required to periodically submit plans to EPA that describe their strategies to control air pollution and demonstrate progress toward attainment of the national standards. Each pollution control measure is eligible for credits toward reducing the states' air pollution. States have the option of including alternative fuel programs in their plans as one pollution control measure, provided the AFVs included in such programs produce lower emissions than the vehicles they replace. However, without adequate guidance on the amount of credits AFVs will receive in states' plans, it has been difficult for states to assess the effect of an alternative fuels program as part of a pollution reduction strategy.

EPA responded to the need for more information in this area by issuing guidance on credits for low-emission vehicles in October 1993. The guidance does not differentiate between alternative fuels and conventional fuels. In line with the Clean Air Act Amendments, the guidance focuses on emissions levels, regardless of the fuel used to power the vehicle. While the guidance explained the general methodology that could be used to calculate credits, it did not provide enough information on the application of this methodology to specific cases. Recognizing that states may wish to have more specific information, EPA officials said they plan to issue more detailed guidance on this subject in the near future.

Technical Assistance

With regard to technical assistance, several state and local government officials mentioned the need for more objective comparative information on (1) the different types of alternative fuels and vehicles, (2) the costs associated with the fuels and vehicles (including the vehicles' life-cycle costs), and (3) the fuels that may best suit certain fleets. The alternative fuel industry sometimes holds workshops on these issues, but in the view of at least one state official, the information tends to be biased towards the fuel of the provider hosting the workshop. Other technical issues that some state and local officials identified were the lack of standards for alternative fueling equipment, fuel quality, and moisture content in fuel. Information on ongoing efforts to develop standards addressing these issues appears in appendix IV of this report. In addition, state and local officials expressed a need for information that explains the differences between EPACT and the Clean Air Act.

Section 405 of EPACT addresses the need for more assistance to state and local officials by requiring DOE to develop a public information package to assist consumers in choosing among alternative fuels and AFVs. EPACT requires that the information DOE distributes contain material on the characteristic of vehicles and fuels as compared with their gasoline-fueled counterparts on a life-cycle basis. These comparisons are to include information on environmental performance, energy efficiency, cost, maintenance requirements, reliability, safety, and whether the fuels are domestically produced. DOE officials expect to issue the first information package at the end of June 1994.

Related to the need for technical assistance is the need for DOE to establish guidelines in a timely manner for state and local incentives programs. Under these programs, authorized by section 409 of EPACT, states may qualify for federal financial assistance if they submit an acceptable plan to DOE designed to accelerate the introduction and use of alternative fuels and AFVs. Section 409 requires that the Secretary of Energy issue regulations establishing guidelines by October 1993. However, DOE is not expected to propose these regulations until the summer of 1994. One state energy official expressed the need for timely guidance in order to develop a program plan that will allow the state to qualify for available program funding.

Comprehensive Source of Funding Information

State and local officials said that development of comprehensive information on the different sources of financial assistance for alternative fuels programs would be helpful in planning their programs. Many officials said that they were aware that funding was available from various levels of government, but the actual sources are sometimes difficult to find. DOE's alternative fuels hotline has information on all of the federal financial assistance available for alternative fuels programs. The hotline also has some information on state and local incentives. For example, DOE tracks alternative fuels legislation and has information on any tax incentives at the state or local level. A DOE official said the agency would like to provide even more information on state and local financial assistance, but it is difficult to keep this information up to date.

Efforts Are Under Way to Coordinate State and Local Programs, but Burden on Fleets Is a Concern

Fleet administrators and automobile manufacturers are concerned that states, in trying to meet clean air and alternative fuel requirements, may develop and in some instances have developed legislation that differs from that of other states, including adjacent states. These differences are a particular concern in those states that share a nonattainment area. Since most alternative fuels legislation is targeted at public and private fleets, these representatives believe that a multitude of alternative fuels requirements could become onerous for fleets, especially those that operate in more than one state. However, in our discussions with officials from each level of government and from coordinating organizations, it was apparent that most recognized the need for consistent legislation and regulations, especially in multistate jurisdictions.

Fleets Are Concerned That Emerging State and Local Alternative Fuels Programs May Be Burdensome

Fleet administrators and automobile manufacturers voiced a concern about the multitude of alternative fuels legislation being passed at the state and local levels. They said that legislation of the different states is not always consistent on the vehicles covered, reporting requirements, or types of fuels allowed. For example, a national fleet association official expressed the concern that vehicles garaged at operators' homes could be covered under fleet requirements in one jurisdiction and exempted in another. Fleet operators also told us that state programs require different record-keeping and reporting requirements. Also, the federal Clean Fuel Fleet Program permits the use of reformulated gasoline, while some states' alternative fuels programs prohibit its use. As a result, fleets operating in more than one state may be faced with burdensome record-keeping and vehicle procurement decisions, resulting in increased economic and administrative costs for fleets. We approached several federal, state, and local officials with these concerns. They acknowledged that alternative fuels legislation that differed from state to state would create an administrative burden on fleets. However, they did not think that differences in legislation would preclude a fleet from meeting the requirements.

Efforts to Coordinate Between States

Many federal, state, and local officials we spoke with on this topic recognize the need for the states (as well as the District of Columbia) to have consistent legislation or regulations, especially in cases where a nonattainment area overlaps two or more jurisdictions. At the federal level, EPA has established rules that require neighboring jurisdictions in such cases to work together to resolve clean air problems. In addition, EPA has developed a rule for the Clean Fuel Fleet Program that strives for

consistency between state programs by defining key legal terms such as "covered fleet operator," "centrally fueled," and "capable of being centrally fueled." Moreover, the rule states that multistate nonattainment areas—that is, nonattainment areas that span state borders—should develop consistent programs to ease the burden on fleets. Programs must also be consistent to facilitate the credit trading program under the Clean Fuel Fleet Program.

In developing its definitions for the Clean Fuel Fleet Program, EPA consulted with DOE in an effort to make them consistent with similar definitions contained in EPACT's fleet provisions. Meanwhile, DOE is also establishing its own definitions as it develops rules to implement those EPACT provisions. Officials of both agencies believe that their coordination efforts will help minimize confusion resulting from the two fleet programs. However, basic differences in the way terms are defined in EPACT and the Clean Air Act Amendments make it impossible to eliminate all inconsistencies. One state official said that these inconsistencies could lead to coordination problems between clean air and energy programs.

With respect to state implementation plans, EPA reviews the plans during the development phase and flags any inconsistencies that may pose a problem. An EPA official told us that the agency discusses these inconsistencies with states and attempts to work through the differences in the plans before they are submitted for approval.

At the state and local level, many officials we spoke with were aware of the need to coordinate legislation and regulations with federal and other state programs. Some state and local officials had initiated regular meetings to discuss their alternative fuel programs, and others meet through coordinating organizations such as the Northeast States for Coordinated Air Use Management, the Ozone Transport Commission, and the Mid-Atlantic Region Air Management Association. These organizations were created to facilitate coordinated legislation and regulations between member states. Once laws are passed, a state official told us about efforts to promote coordination by reviewing implementing regulations for consistency.

Conclusions

Reasonable progress has been made to coordinate the AFV activities of federal agencies, such as the efforts of DOE and GSA to coordinate federal AFV purchases and the work of the INTERFUEL organization in bringing federal agencies together to discuss common concerns about alternative

fuels. On the other hand, there are several coordination issues whose significance has only recently been recognized and for which coordination efforts have been initiated.

With respect to coordinating alternative fuel programs among various levels of government, state and local officials cited several additional federal coordination activities that would be helpful to them. Federal officials have attempted to respond to these needs, or plan to do so, through the implementation of EPACT and the Clean Air Act requirements, but it is unclear at this time whether state and local officials will find this response satisfactory.

Coordination among state and local governments, particularly those that share Clean Air Act nonattainment areas, is under way but remains challenging because of the possibility that inconsistent state and local laws could become burdensome for fleets. Clearly, efficient implementation of alternative fuels programs will be enhanced if officials at all levels of government continue to recognize the need for ongoing coordination.

Federal Legislation and Programs for Alternative Fuels

Major Laws and Executive Orders

Executive Order 12261

Executive Order 12261 (Jan. 5, 1981) requires federal agencies, whenever feasible, to specify that gasohol is an acceptable substitute for unleaded gasoline. In procuring unleaded gasoline, agencies should purchase gasohol by preference. Gasohol is a blend of 10 percent ethanol and 90 percent gasoline. Because the ethanol used for such blending receives a tax subsidy, and because blends containing methanol can result in corrosion damage to conventional vehicles, most gasohol is blended from ethanol. Since gasohol is 90-percent gasoline, the mixture is not an alternative fuel. However, to the extent that a portion of gasoline is replaced with ethanol, the use of gasohol can reduce the level of petroleum imports and also promotes the development of facilities to produce ethanol.

Alternative Motor Fuels Act of 1988

The purpose of the Alternative Motor Fuels Act (Oct. 14, 1988) is to encourage (1) the development and widespread use by consumers of methanol, ethanol, and natural gas as alternative transportation fuels, and (2) the production of alternative-fueled vehicles (AFV) using these fuels. The Department of Energy (DOE) is the lead federal agency responsible for implementing this act, in conjunction with other federal agencies, states and local governments, and industry. Under the act, DOE was assigned responsibility for working with other federal agencies to ensure that the maximum practical number of vehicles acquired annually are AFVs and for establishing a program to collect data on the operation of AFVs.

Clean Air Act Amendments of 1990

Under the Clean Air Act, as amended (Nov. 15, 1990), the Environmental Protection Agency (EPA) oversees efforts by the states to meet national ambient air quality standards. The act requires EPA to, among other strategies, regulate the emissions of certain pollutants from motor vehicles. A geographic area that meets or exceeds the national standards for these pollutants is called an attainment area; areas that do not meet the standards are called nonattainment areas. States containing nonattainment areas are required to develop state implementation plans identifying the strategies they will use to reduce air pollution and reach attainment status. As one of their strategies, states may find it effective to develop initiatives employing AFVs, provided the emissions levels of the AFVs are low enough to help demonstrate progress toward attainment. If these states include an alternative fuels initiative as part of their planned strategies, they may earn credits toward their emissions reduction goals.

A major theme of the 1990 amendments to the Clean Air Act is the use of cleaner fuels to help achieve lower vehicle emissions. Accordingly, nine severe nonattainment areas are required to use new, cleaner-burning gasoline—known as reformulated gasoline—beginning in 1995. The use of alternative fuels, which may produce lower emissions than conventional fuels, is not mandated but is another strategy available to states to meet the air quality standards. Furthermore, in approximately 22 serious nonattainment areas, the act requires certain fleets to acquire clean-fuel vehicles with emissions lower than those of the basic standards. Clean fuels eligible for this Clean Fuel Fleet Program include both reformulated gasoline and alternative fuels. EPA officials expect that reformulated gasoline will meet nearly all the emissions standards established for the program in the Clean Air Act Amendments. Consequently, they believe that no significant increase in the use of alternative fuel will result from this program. On the other hand, EPA officials believe that some fleets may acquire vehicles, such as flexible-fueled vehicles (FFV), capable of using alternative fuels in an effort to simultaneously satisfy the requirements of both the Clean Air Act Amendments and EPACT. However, these vehicles would not be required to actually use alternative fuels.

Executive Order 12759

Executive Order 12759 (Apr. 17, 1991) requires each agency operating 300 or more commercially designed motor vehicles domestically to develop a plan to reduce gasoline and diesel consumption by at least 10 percent by 1995 compared with fiscal year 1991. To this end, the order encouraged both increased energy efficiency and also greater use of alternative fuels. To achieve the latter, the order called for a more aggressive introduction of AFVs into vehicle fleets owned and/or operated by federal agencies. The order reinforced the requirement in the Alternative Motor Fuels Act that the government acquire as many AFVs as practical by the end of model year 1995.

Intermodal Surface Transportation Efficiency Act of 1991

The Intermodal Surface Transportation Efficiency Act (Dec. 18, 1991) authorizes $6 billion to fund the Department of Transportation's Congestion Mitigation and Air Quality Improvement program over a 6-year period. This program apportions these funds to states with the stipulation that the money generally be spent on transportation projects or programs that contribute to attainment of national ambient air quality standards. Eligible projects or programs include those in the transportation portion of an approved state implementation plan. Therefore, if an alternative fuels program affecting a publicly owned fleet is included in an approved state plan and the program will have air quality benefits, funding could be available for the program.

Energy Policy Act of 1992

The Energy Policy Act of 1992 (EPACT, Oct. 24, 1992) requires the Secretary of Energy to establish a program to promote the replacement of petroleum motor fuels with replacement fuels to the maximum extent possible. In addition, the Secretary is to determine the technical and economic feasibility of achieving the goals of producing sufficient replacement fuels to replace at least 10 percent of petroleum, on an energy equivalent basis, by the year 2000 and at least 30 percent by the year 2010. The act defines replacement fuels as the portion of any motor fuel that is methanol, ethanol, or other alcohols; natural gas; liquified petroleum gas (propane); hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); ethers; and any other fuel that the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security and environmental benefits. This definition of replacement fuels is similar to the act's definition of alternative fuels, except that the latter definition includes blends of at least 70 percent alcohol with gasoline but does not include blends of gasoline and ether,[1] which typically contain much lower percentages of ether.

To facilitate the use of alternative/replacement fuels, EPACT set forth requirements for the acquisition of AFVs by public and private fleets (as discussed in ch. 1). The act also provides tax deductions for qualified clean-fuel vehicles and certain refueling properties and tax credits for qualified electric vehicles. EPACT also contains provisions for conducting an electric vehicle demonstration project and for research, development, and demonstration or commercial application of infrastructure and support systems for electric vehicles.

Executive Order 12844

Executive Order 12844 (Apr. 21, 1993) calls for accelerating the federal government's scheduled acquisition of AFVs to exceed by 50 percent the targets mandated for 1993-95 in the Energy Policy Act of 1992. Thus, the federal acquisition targets for those years increased to 7,500, 11,250, and 15,000 AFVs, respectively.

This executive order also established a Federal Fleet Conversion Task Force, comprising key federal and state officials, executives from the automotive and fuel provider industries, and representatives of commercial fleet operators. The Task Force was charged with giving advice on implementing the order, including recommending ways in which federal actions could provide an impetus for the development and

[1]An ether is typically produced by combining ethanol or methanol with certain by-products of petroleum refining. Since ethers contain oxygen, they are called oxygenates. In certain areas, they are blended with gasoline as a means of reducing carbon monoxide emissions.

production of AFVs and for the expansion of refueling facilities necessary to support large numbers of privately owned AFVs in the future.

Major Federal Agencies' Alternative Fuel Programs and Activities

Department of Energy

DOE is responsible for ensuring that the maximum practical number of vehicles acquired annually are AFVs. In doing so, the agency is to provide federal leadership on the acquisition and use of AFVs. This responsibility includes helping agencies develop 5-year acquisition plans for AFVs, monitoring AFV performance through the agency's Alternative Fuels Data Center, providing guidance and funding for the conversion of vehicles to AFVs, and funding the incremental costs of AFV purchases.

In addition, in an effort to leverage the effect of federal AFV purchases, DOE developed its Clean Cities Program. By working with local participants in selected cities with a strong interest in alternative fuels, the agency hopes to combine federal, state, local, and commercial efforts to encourage the development of an adequate number of refueling facilities for alternative fuels.

General Services Administration

GSA is responsible for the management of the second largest fleet in the federal government, the Interagency Fleet Management System, which includes about 145,000 vehicles. Most of these vehicles are leased to other agencies or their contractors. In addition, GSA is responsible for purchasing from automobile manufacturers the vehicles that GSA leases, as well as negotiating vehicle purchase contracts for most of the other vehicles that federal agencies acquire for their fleets. As a result, GSA plays a major role in developing AFV specifications and requirements and negotiating with automobile companies for the purchase of AFVs. It also helps determine where federal AFVs will operate. In addition, GSA has engaged in efforts to encourage fuel providers to build refueling facilities to service the AFVs in the federal fleet.

United States Postal Service

The Postal Service, which operates the largest single federal fleet—about 180,000 vehicles—has been experimenting with the use of alternative fuels since the 1970s. The agency's current alternative fuels program focuses on

converting vehicles to use compressed natural gas (CNG). In addition, the Postal Service is leasing or converting a limited number of electric vehicles to demonstrate their use in California. The AFVs are primarily mail-delivery vehicles that are converted to CNG use by a private conversion company. The Postal Service plans to convert over 7,000 AFVs by 1996; additional conversions could potentially take place by the year 2000, depending on their costs, technology development, and the availability of refueling facilities.

Department of Defense

Together, the combined Department of Defense (DOD) military services operate the third largest federal fleet, with about 127,000 vehicles. Over the past several years, DOD has cooperated with DOE and GSA to acquire AFVs in order to help meet the goals established by EPACT and the two executive orders. In addition to its normal fleet operations, DOD has also been given an increasingly significant role in AFV research, development, and demonstrations. DOD's Advanced Research Project Agency has received fiscal year 1993 and 1994 funding to develop electric and hybrid vehicle technologies and alternative refueling facilities and for demonstrations of natural gas vehicles and refueling facilities.

Environmental Protection Agency

EPA is responsible for implementing Clean Air Act programs designed to reduce air pollution. The Clean Air Act, as amended, is fuel neutral—any fuel that can burn cleanly may be used to satisfy vehicle emissions standards. However, one program established under the act, the Clean Fuel Fleet Program, has the potential to encourage more widespread use of AFVs. This program requires certain fleets in nonattainment areas to acquire vehicles that do better than the basic requirements on emissions. If AFVs can accomplish this more readily than conventional vehicles, as some evidence suggests, then these fleets may be encouraged to acquire AFVs. On the other hand, as discussed earlier, EPA expects that vehicles operating on reformulated gasoline may be able to qualify as clean-fuel vehicles. The Clean Fuel Fleet Program also enables fleets to earn air pollution credits and other benefits by acquiring vehicles that run even cleaner than required, and this approach may also encourage the acquisition of certain very-clean-running AFVs.

State and Local Alternative Fuels Programs

The descriptions that follow are intended to provide examples of the types of significant alternative fuels programs that states and local governments are developing. This sampling is not all-inclusive. Other states and localities are also implementing alternative fuel programs.

State Programs

The California Energy Commission's methanol program was created in response to the oil shortages of the 1970s as part of an effort to diversify the mix of fuels the state depends on for its energy. Using oil overcharge funds,[1] the commission helped pay for the installation of methanol fuel facilities at approximately 50 public service stations throughout the state. The commission has also tried to convince government and private fleets to acquire methanol vehicles for their fleets, has helped pay the higher cost of these vehicles, and was instrumental in encouraging automobile manufacturers to begin producing methanol vehicles. More recently, the commission also began paying the incremental costs of CNG vehicles acquired by public fleets.

California's efforts to address the state's severe air quality problems, directed by the California Air Resources Board, have helped to promote the expanded use of alternative fuels. By developing its Low-Emission Vehicle and Clean Fuels Program, with emissions standards that are generally more stringent than the national standards, the state has encouraged the development of cleaner-burning vehicles, some of which have been AFVs.[2] In calculating the contributions of various vehicles towards the formation of ozone, the key component of smog, the Air Resources Board found that the contributions of vehicles operating on several alternative fuels were lower than those of vehicles using petroleum-based fuels. This finding tends to encourage the development and use of AFVs. The Low-Emission Vehicle and Clean Fuels Program also requires that, beginning in 1998, a minimum of 2 percent of the new cars sold in California by major automobile manufacturers be zero-emission vehicles. Currently, electric vehicles are the only AFVs that emit no pollutants.

[1]As a result of court decrees, legislation, and DOE administrative actions, funds were collected from oil companies that overcharged customers during the period of oil price controls between 1973 and 1981. DOE collected the funds and distributed them to the states to be used for energy-related projects intended to compensate the victims of the overcharges.

[2]Under the Clean Air Act, as amended, the states are prohibited from adopting or attempting to enforce their own vehicle emission standards for new motor vehicles. However, California is exempt from this prohibition if it receives a waiver of federal preemption from EPA for any standard or accompanying enforcement procedure the state adopts. The standards adopted must be, in the aggregate, at least as protective of public health and welfare as the applicable federal standards. Under certain conditions, other qualified states may adopt California's standards in lieu of the federal standards.

The California Public Utilities Commission has adopted broad policy guidelines to assist privately owned utility companies in approving new and continuing programs for low-emission vehicles. Under these guidelines, utility companies may, under certain conditions, use revenues from ratepayers to support AFV research programs and efforts to develop alternative fuel refueling facilities and services. In 1992, four utility companies in California spent approximately $50 million from ratepayer revenues to support AFV research and related activities. The commission's action supports previous efforts by the utilities to develop alternative sources of vehicle propulsion as well as state legislative mandates aimed at resolving California's severe air pollution problems.

Texas law mandates that a certain percentage of the fleets operated by state agencies with more than 15 vehicles and by city, metropolitan, and regional transit authorities be able to operate on alternative fuels. The law requires that at least 30 percent of the vehicles in these fleets be AFVs by September 1, 1994, and that at least 50 percent be AFVs by September 1, 1996. If a determination is made that the program (1) is reducing emissions, (2) is projected to be effective in improving overall air quality, and (3) is necessary for the attainment of federal ambient air quality standards in the nonattainment areas, then the AFV requirement for these fleets would increase to 90 percent by September 1, 1998. In addition, if such a determination is made, local governments operating more than 15 vehicles primarily in nonattainment areas (excluding law enforcement and emergency vehicles) and private persons operating more than 25 vehicles primarily in nonattainment areas (excluding emergency vehicles) would also be subject to phased-in AFV mandates. The affected local government and private fleets would be required to include at least 30 percent AFVs by September 1, 1998, at least 50 percent AFVs by September 1, 2000, and at least 90 percent AFVs by September 1, 2002. Texas law also includes AFV mandates that will affect certain public school transportation systems beginning in 1997.

Several other states have approved legislation that requires replacing the vehicles of certain state agencies with AFVs. Among these states are Arizona, Colorado, and Louisiana. The timetables for replacement and the percentages of vehicles required vary from state to state. In addition, Pennsylvania, in cooperation with fuel providers and other interested parties, is planning to establish a network of alternative fuel refueling facilities along the Pennsylvania Turnpike.

A number of states, particularly northeastern states with serious air quality problems, such as New York and Massachusetts, are attempting to take advantage of a provision in the Clean Air Act that allows them to adopt California's Low-Emission Vehicle Program.

Local Programs

The city of Denver passed a local ordinance in 1990 designed to increase the number of AFVs in city and privately owned vehicle fleets. The ordinance required all fleet operators with 30 or more vehicles registered in the city to convert at least 10 percent of their gasoline-powered vehicles to vehicles using clean-burning fuels by the end of 1992. The only exceptions were emergency medical vehicles, fleet vehicles that refuel at least once a week outside the city's boundaries, heavy-duty trucks, some utility company service vehicles, and vehicle fleets used primarily for leasing or renting.

Denver's Mayor also signed an executive order in 1993 declaring the city and county's municipal fleets as "green fleets." Under this policy, all agencies were directed to decrease annual fuel expenses by an average of 1 percent and reduce carbon monoxide emissions by an average of 1.5 percent. The executive order suggested several actions that agency officials could take to achieve this, including the use of AFVs.

A 1991 New York City law has authorized the development of an Alternative Fuels Fleet Program. The program began with a plan to purchase several hundred AFVs to be operated by various city fleets during an evaluation period. Contingent on the results of that evaluation, a second part of the plan called for a mandatory purchase program that would include almost all light-duty vehicles purchased by the city. Beginning in 1994, at least 30 percent of new purchases were to be AFVs; this amount would increase to 60 percent of new purchases in 1995 and 80 percent in 1996 and succeeding years. According to a New York City official, the mandatory program is now in effect, and the city expects to purchase enough AFVs in fiscal year 1994 to meet the target of 30 percent.

In greater Los Angeles, the South Coast Air Quality Management District has undertaken about 100 projects aimed at developing low-emission technologies using clean fuels. Many of the projects involved using alternative fuels, including procuring FFVs for use in the district's fleet, loaning district-owned vehicles to private and public organizations interested in learning about AFVs, and participating in demonstration projects that monitor AFVs' fuel usage, emissions, and performance. The

district developed a regulation designed to reduce emissions from motor vehicles by encouraging carpooling and AFV use.

Initial Start-Up Problems Experienced With AFVs, but Solutions Are Being Developed

For the AFVs introduced into the federal fleet, problems have been experienced with, among other things, the development of vehicle component technology, maintenance support, refueling equipment, fuel composition, and driver acceptance. GSA fleet managers said that many of the problems are related to the introduction of new technologies. Some problems have already been resolved, while solutions for others are being addressed. Other federal agencies and nonfederal AFV users described similar experiences with the operation of their AFVs.

Technological Problems Experienced With AFVs

GSA fleet managers cited problems associated with the development of AFV technology for both methanol- and CNG-powered AFVs. For example, components had to be redesigned and replaced, the rate of oil consumption was high in some methanol FFVs, and the driving range of some AFVs was insufficient for certain vehicle applications. Solutions have been developed for many of the problems associated with AFV component technology. AFV manufacturers have also recognized that a lack of sufficient driving range continues to be a problem, and they are taking actions to address this issue.

Some Components Required Replacement

Various mechanical problems have been experienced with AFVs, including stalling, starting difficulties, lack of engine power, and poor acceleration. For example, in methanol FFVs, there was a problem with the fuel sensor that measures the relative proportions of methanol and gasoline. A replacement sensor seems to have corrected the problem. Operators of CNG pickup trucks experienced problems with driveability, such as failure to start, stalling, and surging. The driveability problems seem to have been solved by installing a redesigned fuel injector. Auto manufacturers redesigned, tested, and installed these and other new components at their own expense.

Rate of Oil Consumption in FFVs Was High

GSA fleet managers have reported high rates of oil consumption with the 1993-model methanol FFVs. The oil used in the FFVs is approved by the vehicle manufacturer and contains a special additive designed specifically for vehicles operating on methanol. Testing by the manufacturer found that the average oil consumption for vehicles with low mileage ranged from 900 to 2,000 miles per quart. The rate of oil consumption for most vehicles with higher mileage improved to 2,500-3,000 miles per quart, but some vehicles remained in the 900-2,000 mile-per-quart range. The manufacturer attributed the high oil consumption to the chrome-faced

engine rings and the solvent action of the methanol fuel. According to the manufacturer, these engine rings require a long break-in period and result in higher oil consumption on vehicles with low mileage. The manufacturer expects that the oil consumption may improve as the engines accumulate additional mileage and does not believe the high oil consumption levels indicate the FFVs lack mechanical integrity. Some GSA fleet managers said that given the high rate of oil consumption and the fact that the special oil used in FFVs is two to three times more expensive than oil used in conventional gasoline-powered vehicles, it may be difficult to resell FFVs at future GSA vehicle auctions.

Driving Range Was Inadequate for Certain Applications

GSA fleet managers believe that the limited driving range of AFVs is an obstacle to wider acceptance of the vehicles. The low range of dedicated CNG vehicles makes them impractical for some applications, while the reduced range of FFVs operating on methanol sometimes makes it impractical to drive the extra distance necessary to obtain the fuel. The limited driving range can be attributed in part to the lower energy density of alternative fuels in comparison with gasoline.

Because of CNG's lower energy density, the size and weight of the cylinders needed to store fuel make it difficult to store enough fuel on the vehicle to achieve satisfactory driving range. A CNG vehicle with cylinders filled to 3,000 pounds per square inch and occupying the same amount of space as a conventional vehicle's gasoline tank can travel about one-fourth as far as the gasoline-powered vehicle. Although CNG is available in several locations in some metropolitan areas, limited driving range—from 80 to 140 miles with full tanks—and a lack of refueling facilities prevents CNG vehicles from traveling outside of most metropolitan areas. Because CNG vehicles in use by the federal fleet have been dedicated vehicles—that is, use only CNG—they have operated only in close proximity to the refueling sites.[1] In some instances, an additional fuel tank has been added to CNG vehicles to help alleviate this problem. Also, some fleet managers are interested in obtaining bi-fueled CNG-gasoline models to help alleviate the range limitations of AFVs operating on CNG. One manufacturer has indicated that it intends to offer this type of vehicle in the future.

Methanol's energy density is about half that of gasoline, so a methanol vehicle can travel half as far as a gasoline vehicle given fuel tanks of equal volume. However, manufacturers have produced FFVs with a larger fuel

[1]The Postal Service's converted vehicles are bi-fueled vehicles. Despite the bi-fuel capability of its AFVs, the Postal Service requires the vehicles to operate on CNG at all times.

tank to help increase the driving range when the vehicles are operating on methanol. Nonetheless, FFVs get fewer miles on a tankful of methanol than a tankful of gasoline, so drivers must refuel more often.

AFV Maintenance Support Infrastructure Is Developing Slowly

The limited availability of trained mechanics and the lack of repair parts were problems that GSA fleet managers noted for both FFV and CNG vehicles alike. GSA fleet managers believed that the problems associated with AFV repair and maintenance were more acute when the vehicles were initially introduced into an area. Overall, these types of problems seem to dissipate once sufficient numbers of AFVs are placed in a service area and the dealers and mechanics become familiar with the vehicles.

GSA acquires AFVs with 3-year warranties and is committed to obtaining service at factory-authorized dealerships. Initially, the manufacturers have designated a limited number of dealers to service AFVs and provide warranty coverage. However, when the AFVs were first introduced, personnel at the designated dealers may not have received the necessary training to properly service these vehicles. Also, GSA managers found that some of the designated dealers did not know how to order AFV parts properly. As a result, operators sometimes had to take the vehicles farther away to obtain service from another designated dealer or had to wait weeks for their local dealer to obtain parts to repair the vehicle. Moreover, adding dealers to the authorized network has been slow, because they are reluctant to spend money to train mechanics, especially if they did not sell the AFV and there is no guarantee that more AFVs will be brought into the area for future service.

Refueling Equipment and Fuel Composition Have Created Problems

For CNG vehicles, the fuel dispenser and vehicle receptacle fittings are not always compatible, making it difficult or impossible to refuel in some instances. For methanol vehicles, the fuel dispenser is the same shape as the dispenser used for gasoline, raising the possibility that the operator will put methanol in a conventional gasoline vehicle. Additionally, there have been instances in which both CNG and methanol fuel have been contaminated, resulting in poor vehicle performance. Actions are being taken to address these problems. Appendix IV describes the efforts of industry groups to adopt standards for fuel composition and dispensing, among other things.

Compressed Natural Gas

Historically, CNG vehicles have been produced with several different types of fuel receptacle fittings, which does not always match the fitting of the available fuel dispenser. As a result, adapters are sometimes needed to refuel CNG vehicles. If the fuel dispenser and vehicle receptacle fittings are not compatible and no adaptor is available, the vehicle cannot be refueled. CNG vehicles at one federal fleet location had to be refitted with a different fuel receptacle that was compatible with the type of dispenser fitting used by the local CNG fuel provider. Also, one CNG fuel provider equipped fuel pumps with two different types of dispenser fittings to allow refueling of vehicles with both types of matching receptacle. A recently developed standard design profile for CNG dispenser and vehicle receptacle fittings may help to alleviate the incompatibility.

Debris—including metal chips and pieces of pipe thread sealant—have contaminated CNG fuel, clogged fuel lines, and resulted in vehicle performance problems, such as surging and stalling. These contaminants have been traced to the gas lines and fuel compressors. The metal chips and thread sealant are apparently introduced when the high-pressure gas fittings are assembled. Fuel filters have been added to help alleviate these problems.

Methanol

Because the methanol fuel dispenser is the same shape as a gasoline dispenser, a driver may mistakenly refuel a conventional vehicle with methanol. The use of the large nozzle formerly used for leaded gasoline has been discussed within the methanol industry as a possible solution to the problem of potential incorrect refueling. However, it now appears that the standard unleaded nozzle, in conjunction with an interlocking safety device, will be used instead.

The corrosive effects of methanol fuel on certain materials used in the storage and dispensing of the fuel have led to impurities such as aluminum compounds and sludge being found in the fuel. These impurities have plugged fuel filters and have caused interference with the sensor that reads the mixture of methanol and gasoline in the fuel, resulting in poor vehicle performance and emissions. Replacing aluminum dispensers with methanol-compatible nickel-plated fuel dispensers has helped solve this problem.

Some Drivers Were Initially Reluctant to Use AFVs

GSA fleet managers said that some drivers perceive AFVs as being unsafe, although there were no reported problems with AFVs at the time of our discussions.[2] In addition, some drivers have been reluctant to use AFVs because they are not familiar with how to operate or refuel them. Coupled with poor driving range and a lack of available refueling sites, these factors can make AFV operation inconvenient. As a result, some drivers have purposely avoided using AFVs and used conventional gasoline-powered vehicles instead.

GSA fleet managers indicated that drivers who are initially reluctant to operate AFVs become more comfortable with the vehicles once they have used them. These managers also noted that agencies operating AFVs need to promote the use of AFVs and the benefits of using them. To help alleviate the problems of drivers' perceptions about AFV use, drivers are provided with a video on the operation and refueling of AFVs.

Other AFV Users Report Similar Problems

According to reports and anecdotal information obtained from federal and nonfederal AFV users, their experiences with operating AFVs are similar to the experiences described by GSA fleet managers. These AFV operators believe solutions are being developed for many of the problems associated with AFV components. However, in their view the lack of adequate refueling facilities is a major obstacle that must be overcome before AFVs gain wider acceptance.

Postal Service AFV Program

According to U.S. Postal Service officials, the lack of sufficient CNG refueling facilities prohibits them from operating more of their fleet on CNG. By the end of 1994, the Postal Service will operate or have contracted to convert about 4,500 bi-fueled CNG-gasoline vehicles. Although its AFVs are capable of using two fuels, the Postal Service requires the vehicles to operate on CNG at all times. Postal Service officials noted that they are planning to convert vehicles to CNG in locations where commercial refueling facilities are available.

Postal Service mail-carrying vehicles are converted to CNG operation by a private company after the agency purchases the vehicles from an automobile manufacturer. Postal Service officials said it is less expensive to procure the converted vehicles competitively than to purchase CNG

[2]Subsequent to our discussions with GSA fleet managers, two accidents occurred involving the rupture of CNG cylinders on nonfederal 1992 CNG pickup trucks. As a result, GSA has removed from service all 1992 CNG pickup trucks in its fleet, and General Motors is recalling the vehicles. This matter is discussed in ch. 4.

vehicles from the automaker or have the automaker convert the vehicles. Postal Service officials said that they have not had problems with converted vehicles and therefore, they do not have any experience in attempting to obtain warranty coverage for the fuel system. Furthermore, in no case has a conversion resulted in voiding the manufacturer's warranty on the basic vehicle.

Federal Data Collection Program for Light-Duty AFVs

A July 1993 DOE report detailing findings from its AFV data collection program corroborated many of our findings on the problems of AFVs.[3] The report describes initial start-up problems with AFVs that are gradually being resolved as experience is gained with the vehicles. According to the report, the data collection program acts as a stimulus to vehicle manufacturers and fuel suppliers to help solve these problems. Also, while the problems cause inconvenience for AFV operators, experience is being gained and solutions to the problems are being developed.

National Association of Fleet Administrators Survey

A 1993 survey by the National Association of Fleet Administrators of 79 fleet managers and 167 drivers in California who operate 1,702 FFVs found that they generally gave these vehicles good grades—although they considered refueling facilities unsatisfactory. Most fleet managers surveyed felt that the FFVs are as good as their gasoline counterparts; however, they realize that the vehicles are still in the developmental stage and that design problems exist.

The survey identified problems similar to those experienced in the federal FFV fleet, including failed fuel system components, such as injectors and sensors. Often repairs took several days or even weeks and were complicated by the limited availability of parts and service technicians trained to make repairs. The survey also showed that the two most common dislikes of FFV drivers were the reduced driving range on methanol and the shortage of refueling facilities. Despite the fact that California has the nation's most highly developed methanol refueling network, most of the 79 respondents to the survey felt that the shortage of methanol refueling facilities might hamper wider acceptance of AFVs.

[3]Federal Alternative Fuel Program Light Duty Vehicle Operations, Second Annual Report to Congress for Fiscal Year 1992, Department of Energy, July 1993.

Efforts to Develop Uniform Standards

Uniform regulations and standards covering alternative fuels, refueling facilities, and AFVs are essential to the success of AFV programs. Areas in which sufficient standardization has thus far been lacking include emissions and safety; methods of paying for, measuring, and dispensing fuel; and fuel composition. Lack of uniform standards in these areas can cause inconvenience and dissatisfaction on the part of AFV users and indecision on the part of potential AFV producers and purchasers. Federal agencies and private industry groups are making some progress on regulations and voluntary standards in each of these areas. However, the development of the information and expertise needed to issue regulations covering AFVs has proven to be a time-consuming effort for regulatory agencies, and the development of voluntary standards has been slowed by a lack of consensus among the affected parties.

Standards for Gaseous-Fueled Vehicles Are Expected This Year

EPA issued emissions standards in 1989 for vehicles that operate on methanol or methanol-gasoline mixtures. Such vehicles make up most of the alcohol-fueled vehicles currently in service. Standards for ethanol-fueled vehicles have not been issued, but this is not viewed as critical because of the small number of these vehicles being produced. However, EPA has encountered delays in issuing standards for OEM vehicles and converted vehicles that operate on the gaseous fuels—natural gas and propane. These delays have added to market uncertainty during a period when interest has been high in increasing the use of gaseous-fueled vehicles.

Standards for Alcohol-Fueled Vehicles

The large majority of alcohol-fueled vehicles in operation are methanol FFVs that are designed to run on varying mixtures of methanol and gasoline. EPA issued standards covering all methanol vehicles, including FFVs, in April 1989. EPA officials believe there are too few ethanol vehicles and insufficient market demand for them to necessitate the development of ethanol emission standards at this time. Ethanol industry representatives say the lack of emphasis on ethanol as a primary fuel stems from the industry's current focus on promoting ethanol as an additive to reformulated and oxygenated gasolines.[1] However, if standards for ethanol vehicles do become necessary, an EPA official said they are likely to be quite similar to the methanol standards.

[1]The Clear Air Act Amendments of 1990 require the use of oxygenated and reformulated gasolines in certain areas. The use of these fuels in place of conventional gasoline is intended to reduce vehicle emissions. Both new types of gasoline require extra oxygen content, and ethanol is one additive that can provide oxygen. In addition, ethanol is an important ingredient of ethyl tertiary butyl ether, another additive that increases the oxygen content of gasoline.

Standards for Natural Gas and Propane Vehicles

EPA officials said in May 1994 that they expected to issue standards covering emissions from natural gas and propane vehicles by the end of June. EPA issued a notice of proposed rulemaking on this subject in November 1992. According to an EPA official, completion of the standards—in contrast to the early action on methanol—has been delayed by extensive administrative review within EPA and by the Office of Management and Budget. When issued, the regulations will include standards for dedicated natural gas and propane vehicles, as well as dual-fueled vehicles that can run on either gasoline or a gaseous fuel. The regulations will eliminate some of the uncertainty that has posed a significant barrier to market acceptance of gaseous-fueled vehicle. Industry officials feel the regulations should have been issued much earlier.

Standards for Converted Vehicles

According to EPA officials, pending EPA regulations on the Clean Fuel Fleet Program and on emissions standards for gaseous-fueled vehicles will include procedures intended to ensure that vehicles that undergo aftermarket conversions meet appropriate emissions standards. Both regulations are expected to be issued in June 1994.

Clean-fuel vehicles are those that meet emissions standards that are more stringent than the standards for conventional vehicles. The Clean Fuel Fleet Program (described in app. I) requires certain fleets in nonattainment areas to acquire such vehicles. The Clean Air Act Amendments of 1990 require EPA to establish regulations for the conversion of conventional vehicles to clean-fuel vehicles. The regulations must include criteria that ensure that a converted vehicle complies with the standards for clean-fuel vehicles. The act also provides that the conversion of a vehicle will not be a considered a violation of the act's provisions on tampering if the conversion complies with EPA's regulations. According to EPA officials, the pending regulations will require conversion companies to go through the same test procedures to certify compliance with emissions standards and durability requirements as those that apply when automakers certify new vehicles. Agency officials state that under the pending regulations, to avoid certification of conversion kits without regard to the particular vehicles in which they are installed, the converter must establish a specific combination of conversion technology and an existing vehicle type. After demonstrating through testing that this configuration meets the standards, the converter must perform all vehicle conversions exactly like those on the last vehicle and must take responsibility for the converted vehicles' emissions. According to EPA

officials, the agency is authorized to demand recall and repair of these vehicles if they do not continue to meet the emissions standards for a specified number of miles driven. In addition, EPA officials state that every newly converted vehicle in this program will be subjected to an appropriate individual emissions test to ensure that it meets the necessary standards to quality for the program. A converted vehicle that does not meet all these requirements cannot quality as a clean-fuel vehicle.

The Clean Air Act Amendments of 1990 also provided an exception to the act's provisions on tampering in certain circumstances in which a conventional vehicle has been converted to use a clean alternative fuel. According to EPA officials, the pending regulation for gaseous-fueled vehicles will cover those converted vehicles not covered by the program for clean-fuel vehicles. Under these pending regulations, conversion companies may voluntarily agree to follow the same procedures as those that apply to the Clean Fuel Fleet Program in exchange for an exemption from the provisions on tampering. EPA officials state that companies using AFVs to earn emissions reductions credits for trading purposes must comply with these procedures. EPA officials state that (1) if credits are not an issue, a vehicle may be exempted from the tampering provisions by meeting the emissions standards that would have applied to the vehicle when new and (2) the vehicles are not required to take an individual emissions test.

Entities that manufacture, sell, or install conversion equipment without going through the requirements described above will be required to comply with the provisions on tampering in section 203 of the Clean Air Act. These provisions prohibit any person from knowingly removing or rendering inoperative any emissions control device installed on or in a motor vehicle. Under these procedures, manufacturers and dealers can be liable for a maximum penalty of $25,000 for each violation, while the maximum penalty for other parties is $2,500. However, applying anti-tampering authority to converted vehicles will be complex because there are many possible combinations of engine classes, conversion component manufacturers, and installers. Unlike the procedures under the pending regulations for the Clean Fuel Fleet Program, liability under the anti-tampering procedures is not limited to a single entity, so determining which entity, or entities, is liable may be problematic.

According to an EPA official, vehicles converted to meet EPACT mandates but not covered by the Clean Fuel Fleet Program could fall under any of the three procedures outlined above. That is, fleet owners could

voluntarily choose to acquire vehicles certified as clean-fuel vehicles under the first procedure, or they could choose the second procedure to avoid the possibility of a tampering violation. Thirdly, they could take their chances with noncertified vehicles, which, according to the EPA official, would still have to meet the applicable emissions standards. In this case, the anti-tampering rules would still serve as the mechanism for ensuring that the standards were met.

Safety Requirements Are in Place for Alcohol-Fueled Vehicles but Still in Progress for Gaseous-Fueled Vehicles

Except for fuel system integrity standards, all other safety standards issued by the National Highway Traffic Safety Administration (NHTSA) apply to all vehicles, whether powered by conventional fuels or alternative fuels. In addition, the fuel system integrity of methanol and ethanol vehicles is covered by a standard for liquid-fueled vehicles previously issued by NHTSA. However, since the existing standard did not apply to the fuel system integrity of gaseous-fueled vehicles, the agency began in 1990 to consider the need for a standard for vehicles that use propane and CNG.[2] Early in the process, NHTSA decided to postpone consideration of propane vehicles and focus on those powered by CNG.

As of May 1994, the agency had issued one set of requirements covering the overall integrity of CNG vehicle fuel systems, but was still working to complete additional requirements for CNG storage containers. The agency expected to complete these additional requirements for containers by September 1994. In addition, NHTSA soon plans to clarify and strengthen its regulation of aftermarket conversions, using its existing authority to prevent converters from rendering a vehicle's safety equipment inoperative and to ensure that a vehicle converted from one regulated system (e.g., gasoline) to a second regulated system (e.g., CNG) complies with the standard for the second fuel system. Meanwhile, NHTSA is reevaluating and prioritizing the need for fuel system integrity standards covering vehicles that operate on other alternative fuels, including not only propane but also liquified natural gas, electricity, and hydrogen.

Standards for Alcohol-Fueled Vehicles

The federal motor vehicle safety standard covering liquid-fueled vehicles is applicable to the fuel systems of methanol and ethanol vehicles. In January 1993, NHTSA issued an additional requirement designed to prevent

[2]In general, NHTSA uses the term "standard" in the singular to refer to a collection of "requirements" covering a specific topic. For example, in the discussion that follows, NHTSA is said to be developing a standard covering CNG vehicle fuel systems; this standard in turn includes a number of different requirements for various aspects of those fuel systems.

the siphoning of methanol and ethanol from vehicle fuel tanks, a potentially dangerous practice.

Standards for Gaseous-Fueled Vehicles

NHTSA first indicated its interest in developing a new fuel system integrity standard for CNG and propane vehicles in an October 1990 notice in the Federal Register. In this notice, NHTSA acknowledged that the lack of such a standard could act as a barrier to the development of the gaseous-fueled vehicle market. In response to early comments, the agency decided to delay action on new requirements for propane vehicles and focus first on CNG-fueled vehicles.

Meanwhile, the natural gas vehicle industry worked independently to develop a voluntary industry standard for CNG cylinders. The industry standard, known as NGV2, was adopted in 1992. NGV2 specifies several sets of detailed material and design requirements for vehicular CNG cylinders. In light of recent accidents involving cylinders, discussed in chapters 3 and 4, industry officials are considering the possibility of strengthening some provisions of NGV2.

NHTSA, in developing its safety standard for CNG cylinders, has taken into consideration the provisions of NGV2. In a supplemental notice of proposed rulemaking in December 1993, NHTSA indicated that it was considering patterning its burst requirement more closely on NGV2. This requirement is intended to ensure cylinder safety by evaluating a container's initial strength and its degradation over time. In addition, like the industry, NHTSA is considering the need for still further requirements in light of both the recent cylinder failures and other issues that came to NHTSA's attention during the development of the new CNG standard.

The first CNG requirements resulting from NHTSA's efforts, covering the overall fuel system integrity of CNG vehicles, were issued in April 1994. They require that new CNG vehicles be subjected to crash testing, with a limit placed on the allowable pressure drop in the fuel system after the crash. Other requirements addressing the strength, durability, and venting of CNG fuel containers are expected to be issued by mid-1994. Moreover, during the development of these initial CNG container requirements, NHTSA identified a possible need for several additional requirements dealing with a CNG container's internal corrosion, brittle fracture under low temperatures, external damage, and fragmentation. The agency anticipates proposing rules covering these new items in the near future. Agency officials acknowledged that recent accidents involving CNG containers

influenced their decision to expand the types of additional requirements that will be proposed.

Recognizing the negative impact of a lack of safety standards, the Federal Fleet Conversion Task Force recommended in August 1993 that NHTSA establish AFV safety standards promptly, because "the unsettled regulatory environment . . . hinders the widespread use and commercialization of AFVs." As of May 1994, although progress had been made, much remained to be done, and NHTSA officials told us they recognize the urgency of issuing new standards as soon as possible. Still, they felt the time required to develop the new standards was justified, citing the challenge of learning how to deal for the first time with vehicles operated on new types of automotive fuels. They also said they had encountered opposition from industry groups to the agency's regulatory approach on several key issues, especially the method of testing CNG cylinder integrity. NHTSA officials said that the process of developing new safety regulations is by its nature a time-consuming process, and they do not consider the time it took to develop the regulations for CNG vehicles to have been outside the normal range.

Standards for Converted Vehicles

Federal Motor Vehicle Safety Standards, such as the one being developed for CNG vehicle fuel system integrity, apply only to newly manufactured vehicles and vehicle components. While new CNG cylinders installed during an aftermarket conversion would have to meet the standards, other components of a converted fuel system would not be covered. However, NHTSA does have authority to ensure that commercial vehicle converters do not "render inoperative" existing vehicle safety equipment. According to NHTSA officials, this authority can be applied to vehicles that undergo aftermarket conversions to operate on alternative fuels, whether the conversion results in a dedicated or bi-fueled configuration. In the near future, NHTSA plans to strengthen its regulation of aftermarket conversions by clarifying how its authority on rendering safety equipment inoperative applies to such conversions.

Reevaluating the Need for Standards for Propane, Liquified Natural Gas, and Electric Vehicles

Since our initial discussions with NHTSA officials in mid-1993, the agency has been reevaluating the need for fuel system integrity safety standards covering vehicles powered by each of the other alternative fuels not yet subject to a standard. In doing so, the agency has attempted to prioritize the various fuels according to the urgency of the need for standards. As a result, priorities have shifted somewhat. For example, last year NHTSA

officials said they did not believe there were enough electric vehicles in operation to justify an effort to develop a new safety standard. However, in part because of keen interest from DOD and DOE, agency officials now view a standard for electric vehicles as their next major priority. Accordingly, NHTSA officials anticipate issuing a request for comment regarding the need for a standard for electric vehicles by the end of 1994.

After electricity, NHTSA's next priorities are to renew consideration of the need for a standard for propane vehicles and to begin considering the need for a standard for liquified natural gas vehicles. According to NHTSA officials, virtually every state has already adopted propane vehicle safety standards developed by the National Fire Protection Association. Thus, the urgency of the need for NHTSA to develop a standard for propane vehicles may be somewhat diminished. And since NHTSA expects that most liquified natural gas vehicles will be heavy-duty vehicles, the smaller number of vehicles involved likewise lessens the relative urgency of developing a standard for vehicles that use this fuel. Finally, the development of a standard for hydrogen vehicles, which are in the very early stages of development, is an even lower priority. Nonetheless, NHTSA officials stressed that their goal is to identify all the standards that are needed for AFVs, regardless of fuel type, and to develop them as rapidly as resources permit.

Standardizing Fuel Credit Cards Poses Significant Challenge

The wide variety of companies selling alternative fuels, many of them new to marketing automotive fuels, has resulted in a proliferation of the credit cards and/or access cards used to obtain alternative fuels.[3] This can cause confusion and inconvenience for AFV operators. Standardization of the method of obtaining alternative fuels will help to minimize these problems, but achieving standardization will be difficult. This is especially true for users of AFVs in the federal fleet.

Current Methods of Purchasing Fuel Have Drawbacks

The current system for purchasing alternative fuels is inconvenient for drivers and makes it difficult to track the usage rates of the different types of fuel. AFV users obtain fuel from a variety of different companies, including major oil companies, independent gasoline marketers, local utilities, and various joint-venture companies established specifically to sell alternative fuels. Many companies require that vehicle operators carry credit cards and/or access cards in order to use refueling facilities. Often,

[3]In some cases, a separate access card is required to gain access to a private, enclosed area containing refueling facilities for alternative fuels.

these cards are not interchangeable, and operators may need to carry several cards if they purchase fuel from several different companies or if they are driving flexible-fueled or dual-fueled vehicles for which they buy different fuels at different times. The problem is especially prevalent among federal fleet operators because they must generally use the federal credit card to buy conventional fuels but must use other specialized cards to purchase alternative fuels. When the cards get misplaced, drivers can be delayed, especially if they operate dedicated AFVs.

Perhaps more significant is the fact that multiple payment systems make it difficult to track alternative fuel usage rates in comparison to conventional fuels. Again, this is particularly problematic for the federal government, for which the replacement of petroleum fuels with alternative fuels is a key objective of the AFV program.

Finally, the existence of several payment systems may result in additional work hours and expense on the part of fleet operators to process credit card invoices and manually prepare reports.

Standardization Would Require Interagency Coordination

From a technical point of view, it appears possible to develop a system by which all conventional and alternative fuels could be purchased using a single credit card. However, such a system would require the cooperation of many affected parties, including oil companies, utilities, and fleet operators. For the federal government, adapting the federal credit card to purchase all the fuels will require considerable coordination and effort on the part of GSA and the Defense Fuel Supply Center.[4] Currently, these two agencies are in the early stages of developing a system that will permit, for the first time, the purchase of fuels from the major oil companies using an electronic point-of-sale system.[5] Once that system is implemented, it may be feasible to begin the challenging task of adding the many other alternative fuel providers to the system.

[4]The Defense Fuel Supply Center negotiates contracts with fuel providers to accept the federal credit card and supply fuel to all federal agencies.

[5]In an electronic point-of-sale system, information about the cardbearer's account is encoded on a magnetic strip on the card. A computerized cardreader at the point of sale reads this information; contacts a data base to get approval of the transaction; and enters into the data base information about the transaction, such as the type of fuel and number of gallons purchased and the purchase price.

Industry Is Struggling to Reach Consensus on Fuel Composition, Dispensing, and Storage

Industry groups have been working to develop voluntary standards in a number of areas not addressed by federal regulations, with varying degrees of progress. Topics that are receiving attention and on which additional work is needed include the compatibility of pump dispenser and vehicle fueling receptacles, optimum pressure for onboard storage of CNG, method of measuring CNG for sale to the public, and composition of the fuels.

Compatibility of Fuel Nozzles and Vehicle Receptacles

For both methanol and CNG, several issues remain to be resolved regarding the design of standardized fuel nozzles and receptacles. For methanol, the need is simply to agree upon a nozzle design that prevents misfueling—the accidental fueling of gasoline vehicles with methanol. In California, the state with the largest methanol refueling network, industry and government officials have agreed to continue to use the standard unleaded gasoline nozzle, but in conjunction with an interlocking device that has not yet been determined. For CNG, the problem is that several different types of fuel receptacles have been in use for some time, so that a vehicle cannot be refueled unless the fitting on its receptacle is compatible with the one on the fuel dispenser, or the operator carries a suitable adapter. Industry groups have developed a standardized design profile for the fittings, known as NGV1, which may eventually gain widespread acceptance. However, in the meantime, many existing vehicle and fuel dispenser fittings remain unchanged.

Onboard Storage of CNG

The natural gas vehicle industry as a whole has had difficulty agreeing on a standardized maximum pressure for the cylinders used to store CNG on vehicles. Currently, cylinders rated at 3,000 and 3,600 pounds per square inch are in use. Industry officials agree that it is desirable to adopt a common standard, since the lack of standards inhibits the marketing of CNG vehicles. Also, adoption of a common standard would permit economies of scale in the manufacture of cylinders and refueling equipment. Nonetheless, various groups within the industry cannot agree upon the optimum pressure. For example, automakers prefer 3,600 pounds per square inch as a means of achieving longer driving range, but operators of existing lower-rated compressors want to avoid the expense of replacing them with larger ones. In addition, some oppose the higher-rated cylinders because they have a greater tendency to heat up during refueling, making them difficult to fill completely. Research and debate on these issues is continuing, and it appears that market forces may eventually decide the question.

Method of Measuring CNG for Sale to the Public

The National Conference on Weights and Measures,[6] with the assistance of the Department of Commerce, has been debating the issue of how best to measure CNG for sale to the public. Conference representatives initially favored a traditional standard based on either weight or volume. However, at the urging of the natural gas vehicle industry, they have agreed to consider adopting the gasoline gallon equivalent as a standard. The industry favors this measurement because it would allow consumers to more easily compare CNG prices with gasoline prices. However, it is problematic because the energy content of natural gas varies from region to region.

It appears this issue will be resolved in 1994. Once the National Conference on Weights and Measures selects a measurement standard, all of the states are likely to adopt it, so that a uniform standard will exist, regardless of whether it is the gasoline gallon equivalent preferred by industry or some other standard.

Fuel Composition

Industry groups have been working to resolve fuel composition problems for methanol and CNG. For methanol, the most serious problem is that materials that deteriorate when in contact with methanol continue to be used in methanol pumps. As discussed in appendix III, when highly corrosive methanol breaks down these materials, contaminants enter the vehicle's fuel system and clog components. Materials that do not break down are available, but thus far industry and government officials have been unable to decide on a system for imposing uniform standards on fuel providers or pump manufacturers. For CNG, a variety of contamination and composition problems remain to be resolved, including excessive water and compressor oil in some CNG and variations in the amount of methane and other hydrocarbons found in CNG in different regions. Industry groups are working on voluntary standards to address these issues, but AFV producers believe that federally mandated CNG specifications may be necessary, if voluntary standards do not go far enough.

[6]The National Conference on Weights and Measures represents state agencies that regulate the measurement of commodities for sale to the public.

Organizations and Companies Contacted by GAO

Federal Government

Department of Commerce—National Institute of Standards and Technology
Department of Defense
Department of Energy
Department of Transportation
Environmental Protection Agency
General Services Administration
Interagency Committee on Alternative Fuels and Low-Emission Vehicles
National Highway Traffic Safety Administration
U.S. Department of Agriculture
U.S. Postal Service

State and Local Governments

Atlanta, Georgia (participants in Clean Air Transportation-Atlanta)

Atlanta Chamber of Commerce*[1]
Atlanta Gas Light Company*
Atlanta Motor Services*
Amoco Oil Company*
Augustine Environmental Associates*
Cox Enterprises*
DOE Atlanta Support Office[2]
Georgia Environmental Protection Division
Georgia Power Company*
Georgia State Office of Energy Resources

California

California Energy Commission
California Air Resources Board
Sacramento Air Quality Management District
South Coast Air Quality Management District

Colorado

State Office of Energy
Vehicle Emissions Control Office
Denver Environmental Protection Division

[1]An asterisk indicates a nongovernmental organization participating in Atlanta's Clean Cities Program.

[2]A federal government participant in the program.

District of Columbia

D.C. Energy Office
Metropolitan Washington Council of Governments

Illinois

Illinois Environmental Protection Agency

Michigan

Michigan Department of Natural Resources
Michigan Public Service Commission

New York

New York State Energy Office
New York Metropolitan Transportation Council
New York City Department of Environmental Protection

Pennsylvania

Pennsylvania Energy Office

Texas

Texas General Land Office
Texas Air Control Board

Others

Associations

American Automobile Manufacturers Association
American Methanol Institute
Mid-Atlantic Regional Air Management Association
National Association of Fleet Administrators
National Association of Regional Councils
Natural Gas Vehicle Coalition
Northeast States Coordinated Air Use Management
Renewable Fuels Association

Automobile Companies

Chrysler Corporation
Ford Motor Company
General Motors Corporation

Automobile Converter

Stewart & Stevenson Power, Inc.

Federal Government Contractor

National Renewable Energy Laboratory Alternative Fuels Data Center

Fuel Providers

Conoco
EnFuels
Equitable Gas Company
Exxon Corporation
MG Marketing and Refining
Mobile Oil Company
Natural Fuels Corporation
Pacific Gas and Electric
Shell Oil Company
Sun Oil Company

Government/Private Sector

Federal Fleet Conversion Task Force

Research Organization

Gas Research Institute

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