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Alternatives to Traditional Transportation Fuels 1995

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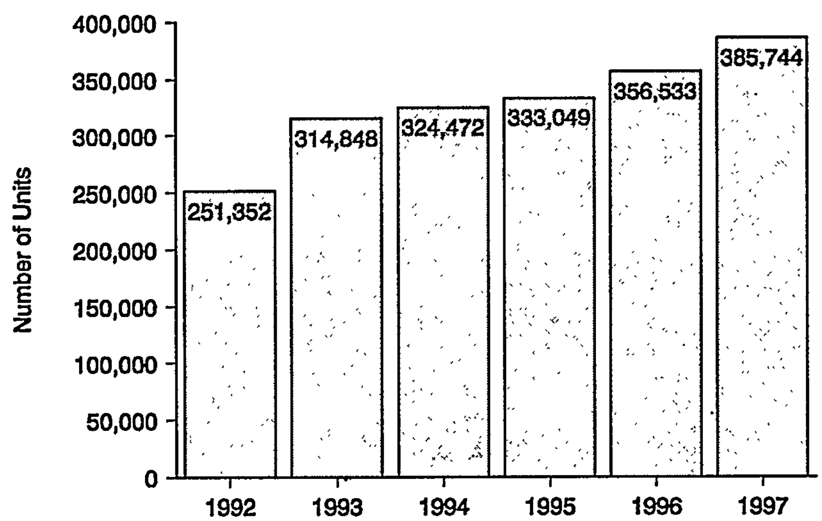
Overview

Concerns about the environmental impact of fossil fuel use and the Nation's continuing dependence on foreign oil are stimulating the use of alternative-fueled vehicles (AFV's) and alternative fuels. Generally, alternative fuels are those other than gasoline and diesel.

ALTERNATIVE-FUELED VEHICLES IN USE

Figure 1. Estimated Number of Alternative-Fueled Vehicles in Use in the United States, 1992–1997



Source: Table 1, p. 11.

Overview

- More than 333,000 AFV's were in use in 1995, a 6 percent increase since 1993.
- The number of AFV's in use in the United States is expected to increase at an average annual rate of 7.6 percent between 1995 and 1997.

Growth in AFV's and alternative transportation fuels is primarily the result of—

1. *The Energy Policy Act of 1992 (EPACT) and Presidential Executive Order 12844 requiring minimum AFV purchases for Federal government vehicle fleets beginning in 1993.*

2. *EPACT mandates for the acquisition of AFV's by State and local government fleets and some private fleets scheduled to take effect over the next few years.*

ALTERNATIVE-FUELED VEHICLES IN USE

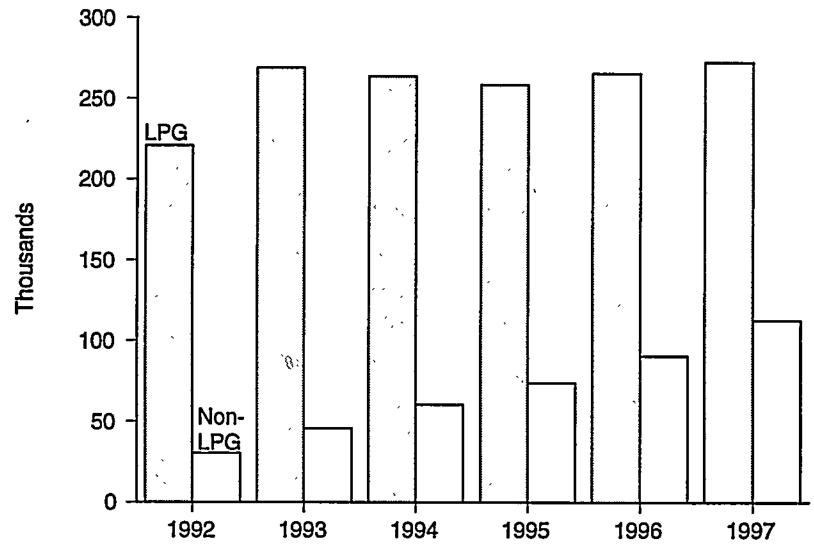
■

More than three-fourths of the AFV's in use in 1995 were vehicles designed to operate on liquefied petroleum gas (LPG), primarily propane.

■

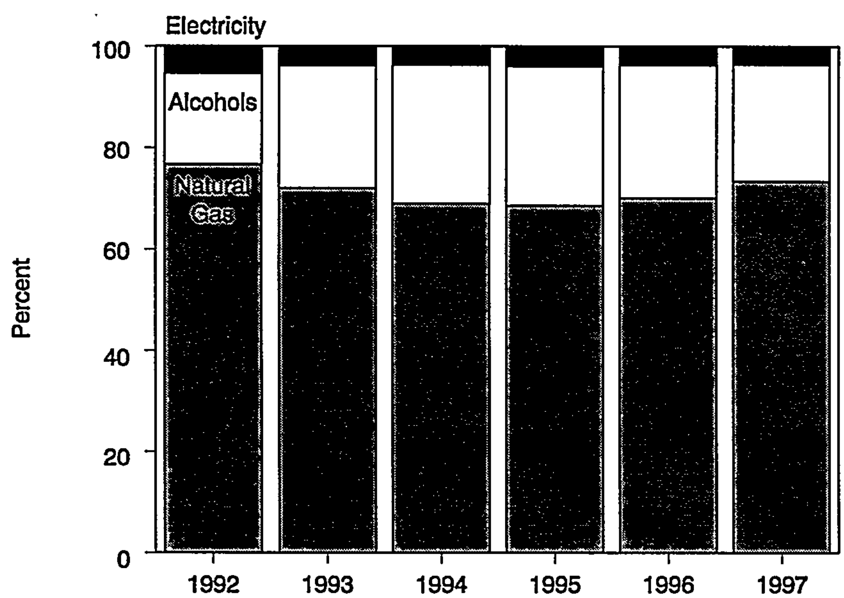
LPG fueled vehicles will continue to dominate AFV's for some time, even though their share of the total is expected to decline from 88 percent in 1992 to 71 percent in 1997.

Figure 2. Estimated Number of LPG-Fueled and Non LPG Fueled Vehicles in Use in the United States, 1992–1997



Note: Declines during 1994 and 1995 in LPG vehicles may be the result of differences in data sources used to develop estimates for those years.
Source: Table 1, p. 11.

Figure 3. Share of Estimated Number of Alternative-Fueled Vehicles in Use in the United States, by Non LPG Fuel, 1992–1997



Source: Table 1, p. 11.

■

Among all AFV's not fueled with LPG, alcohol vehicles (methanol and ethanol) increased from 18 percent in 1992 to more than 27 percent in 1995. Growth through 1997 will largely come from ethanol.

■

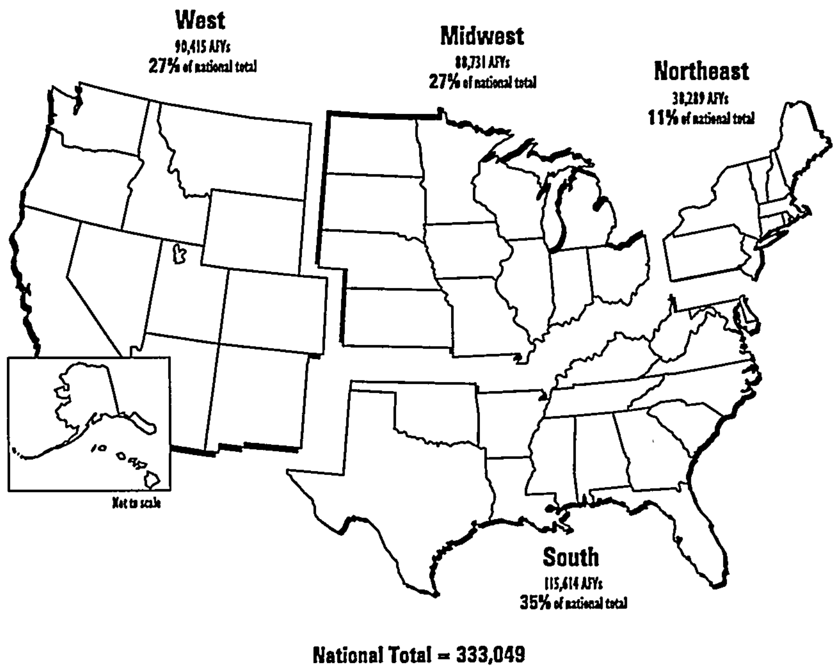
Natural gas fueled vehicles continue to represent more than two-thirds of the non-LPG AFV's in use.

■

The share of electric vehicles continues to decline, representing less than 4 percent of non-LPG vehicles in use in 1995.

Overview

Figure 4. Estimated Number of Alternative-Fueled Vehicles in Use,by Census Region, 1995

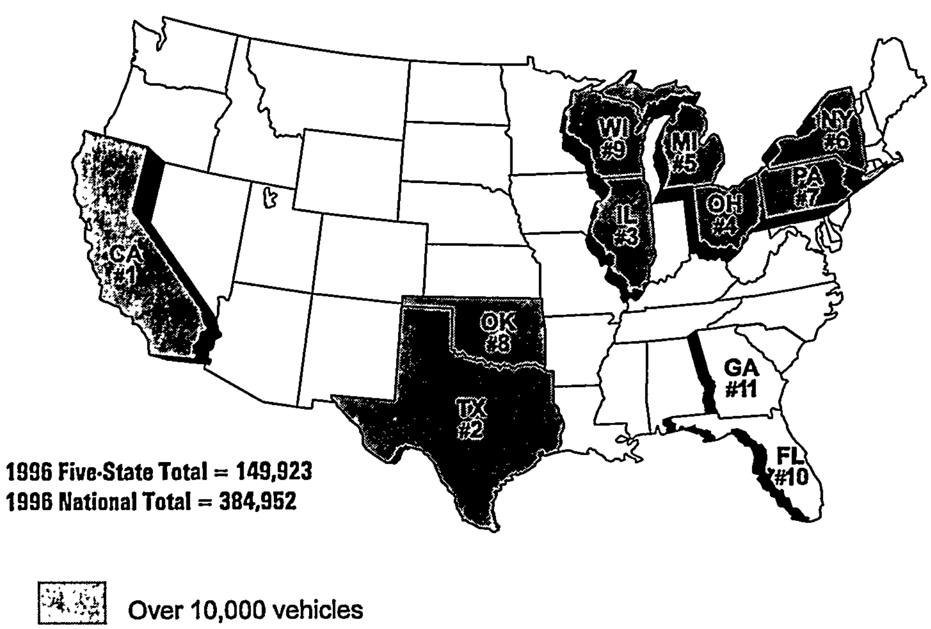


Source Table 2, p. 14.

■ The South, with 35 percent of all AFV's in 1995, continues to lead the other regions.

■ Between 1995 and 1997, the number of AFV's is expected to grow most rapidly in the West, where AFV's are anticipated to increase by 20 percent, compared to nationwide growth of 16 percent. The South is expected to experience the slowest growth (13 percent).

Figure 5. States Having the Largest Number of AFV's in Use, 1995



Source: Table 3, p. 16.

■ In 1995, 9 States had more than 10,000 AFV's in use.

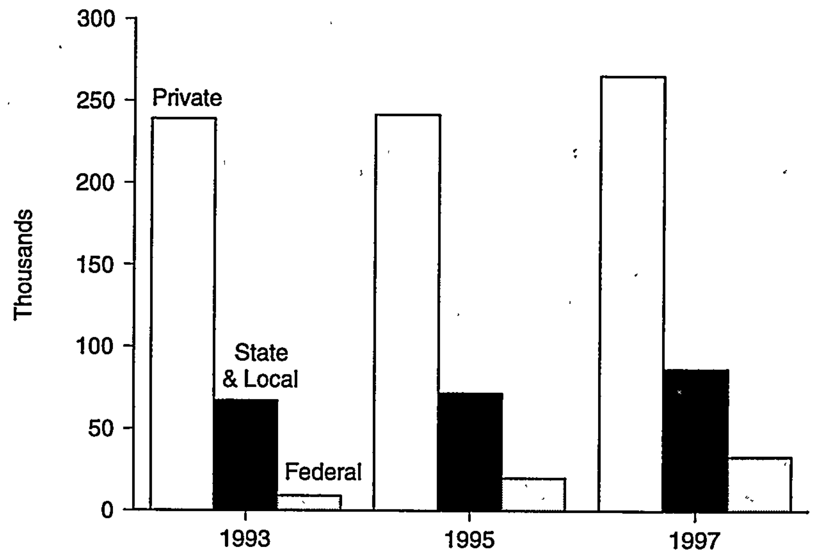
■ One fourth of the AFV's in use are located in California (51,745) and Texas (32,307). They continue to lead all other States by a wide margin in the number of AFV's in use.

■ By 1997, Georgia and Florida are also expected to exceed 10,000 AFV's.

ALTERNATIVE-FUELED VEHICLES IN USE

- The majority of AFV's in use are privately owned.
- Ownership of AFV's by the Federal government has increased more rapidly than State and local government ownership, which has increased more rapidly than private ownership.

Figure 6. Estimated Number of Alternative-Fueled Vehicles in Use by Ownership Classification, 1993, 1995, and 1997



Source: Tables 4-6, pp. 17-18.

Growth in AFV's and replacement fuels is also the result of—

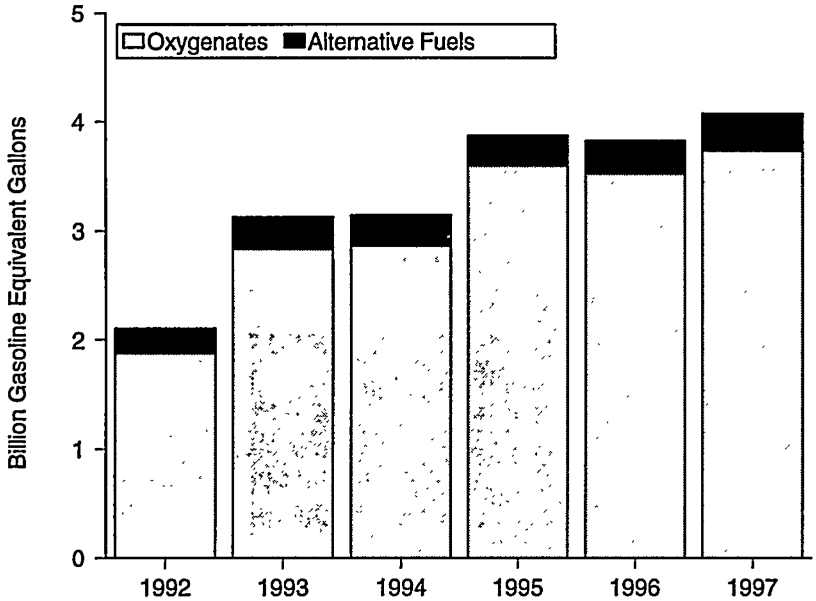
3. *Voluntary AFV programs encouraged by EPACT, such as the DOE Clean Cities program.*

4. *Clean Air Act Amendments of 1990 (CAAA90), requiring the addition of oxygenates (e.g., ethanol) to gasoline during winter months in specified metropolitan areas, beginning in 1992, to reduce carbon monoxide emissions.*

5. *CAAA90 requirements for using reformulated gasoline in designated areas, beginning in 1995, to reduce smog.*

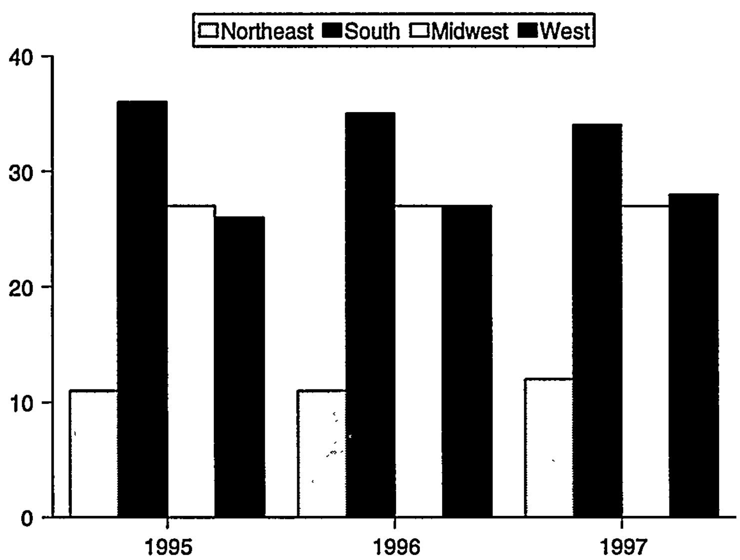
6. *The 1988 Alternative Motor Fuels Act, directing Federal agencies to administer programs that encourage the development of alternative fuels and the production of alternative-fueled vehicles.*

Figure 7. Estimated Consumption of Alternative Fuels and Oxygenates in the United States, 1992-1997



Source: Table 7, p. 20.

Figure 8. Share of Estimated Consumption of Alternative Fuels in the United States, by Census Region, 1995, 1996, and 1997



Source: Table 8, p. 21.

Overview

■ Whereas traditional fuels are expected to increase 19 percent from 1992 to 1997, alternative fuels and oxygenates will rise far faster—84 percent over the period.

■ Increasing use of oxygenates represents the largest part of this increase, with a growth of 91.5 percent from 1992 to 1995.

■ Alternative fuel use increased more than 21 percent during the same period while representing little more than 10 percent of the total gasoline-equivalent gallons used.

■ Alternative fuel consumption patterns by region vary slightly from the number of vehicles in use, with the South leading in fuel consumed, followed by the Midwest and West.

■ The estimated share of alternative fuel consumed is expected to change slightly by 1997, with the South representing slightly less consumption and the West slightly more than current proportions.

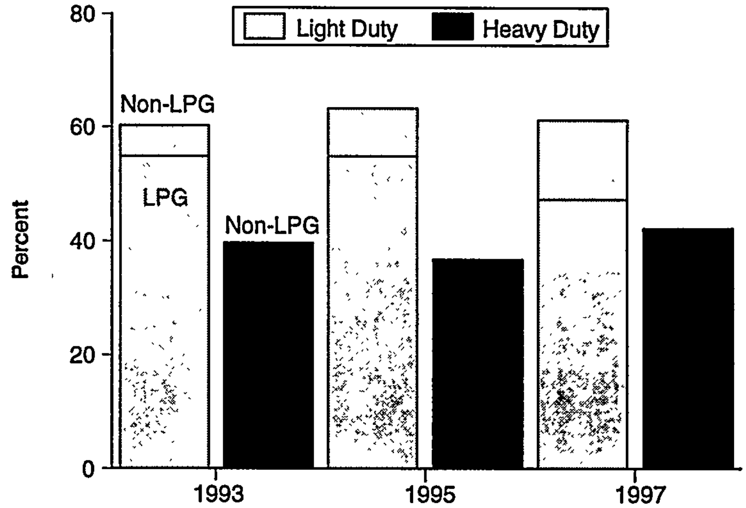
Overview	ALTERNATIVE-FUELED VEHICLE CONSUMPTION

■ The percentage of alternative fuel consumed by light duty vehicles increased from 60 to 63 percent from 1993 to 1995 but is expected to decline to an estimated 61 percent by 1997.

■ Light duty vehicles are those weighing less than 8,500 pounds, usually passenger cars, vans, and small pick up trucks.

■ The increase in non-LPG alternate transportation fuel composition is led by a 300 percent increase in compressed natural gas use anticipated between 1993 and 1997.

Figure 9. Share of Estimated Consumption of Alternative Fuels in the United States, by Weight Class, 1993, 1995, and 1997



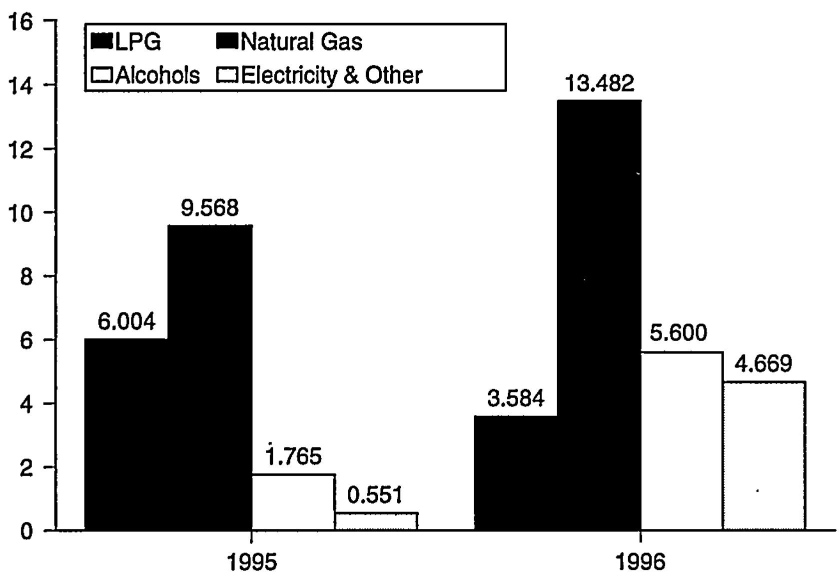
Source: Table 10, p. 23.

Chapter Four presents the number and type of alternative-fueled vehicles made available in the United States in 1995 and planned to be made available in 1996.

In 1995, EIA initiated a survey of AFV suppliers. Data show that for 1995 and 1996 combined, these suppliers made available (and expect to make available) some—

- *45,000 onroad AFV's*
- *126,000 nonroad AFV's, such as agricultural and construction vehicles and forklifts.*

Figure 10. Number of Onroad Alternative-Fueled Vehicles Made Available in 1995 and Planned to Made Available in 1996, by Fuel Type



Notes: Some data withheld to avoid disclosure of individual company data. Natural gas includes compressed natural gas and liquefied natural gas.
Source: Tables 11 and 13, p. 26 and 28, respectively.

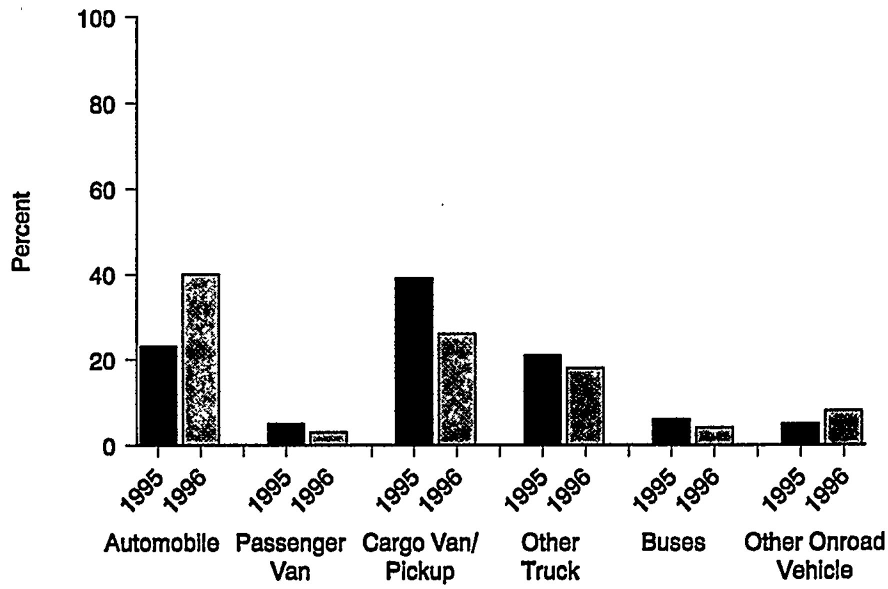
- The number of onroad AFV's made available is expected to increase by nearly 53 percent from 1995 to 1996.
- The largest number of onroad AFV's expected to be made available will be fueled by natural gas, rising more than 40 percent.
- Electric onroad AFV's are expected to show both the largest absolute and percentage increase in vehicles made available, growing 767 percent from 1995 to 1996.

■ The relative percentage of Onroad AFV's, by vehicle type, is expected to change only slightly from 1995 to 1996.

■ Automobiles and Other Onroad Vehicles are expected to have the largest increase in vehicles made available, increasing 160 and 155 percent, respectively, from 1995 to 1996.

■ All other categories of Onroad AFV's are expected to show small increases in vehicles made available from 1995 to 1996 except Passenger Vans, which are expected to decline slightly.

Figure 11. Percentage Share of Onroad Alternative-Fueled Vehicles Made Available in 1995 and Planned to be Made Available in 1996, by Vehicle Category

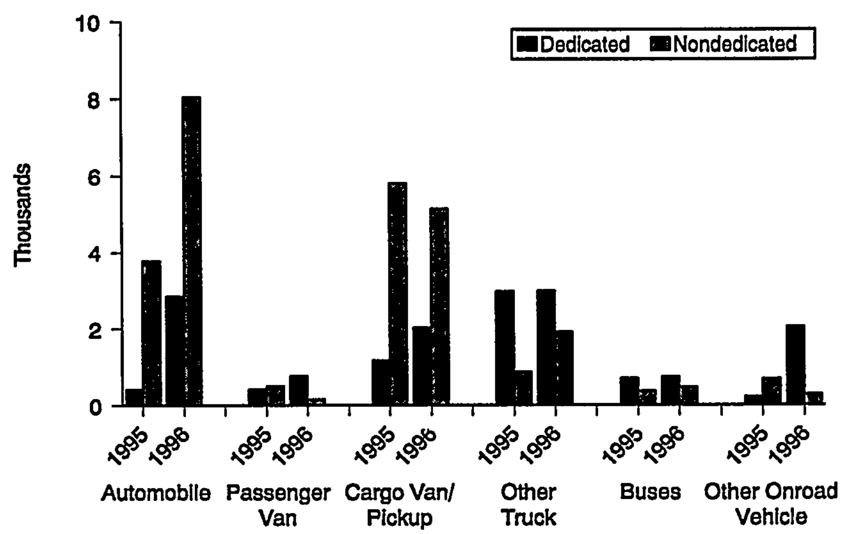


Source: Tables 11 and 13, p. 26 and 28, respectively.

■ The percentage of dedicated (single fueled) AFV's is expected to increase by about 9 percent from 1995 to 1996.

■ The share of dedicated Automobile, Passenger Van, Cargo Van/Pickup, and Other Onroad AFV's is expected to increase markedly from 1995 to 1996. A slight decline in the number of dedicated AFV's is expected in the Other Truck and Buses categories.

Figure 12. Number of Onroad Alternative-Fueled Vehicles Made Available in 1995 and Planned to be Made Available in 1996, by Vehicle Category



Source: Tables 11 and 13, p. 26 and 28, respectively.

1. Introduction

This report provides information on transportation fuels other than gasoline and diesel, and the vehicles that use these fuels. The Energy Information Administration (EIA) provides this information to support the U.S. Department of Energy's reporting obligations under Section 503 of the Energy Policy Act of 1992 (EPACT). The principal information contained in this report includes historical and year-ahead estimates of the following:

- The number and type of alternative-fueled vehicles (AFV's)[1] in use (Chapter 2)
- The consumption of alternative transportation fuels and "replacement fuels"[2] (Chapter 3)
- The number and type of alternative-fueled vehicles made available in the current and following years (Chapter 4).

In addition, the report contains some material on special topics (Chapter 5). The appendices include a discussion of the methodology used to develop the estimates (Appendix A), a map defining geographic regions used (Appendix B), and a list of AFV suppliers (Appendix C).

The alternative transportation fuels (ATF's) considered in this report are compressed natural gas (CNG), liquefied natural gas (LNG), liquefied petroleum gas (LPG, i.e. propane), methanol, ethanol, electricity, and biodiesel.[3] Vehicles consuming these fuels may either be "new" AFV's or existing vehicles with converted fueling systems.

Congress enacted EPACT with the objectives of lessening U.S. dependence on foreign petroleum and promoting energy efficiency. At the same time, EPACT requires that efforts to attain these objectives incorporate assessments of their consequences in regard to greenhouse gas production. Many have regarded the use of ATF's as a way to lessen dependency on foreign oil while simultaneously reducing greenhouse gas emissions. EIA recently released a report comparing greenhouse gas emissions from gasoline and ATF's.[4]

EIA produced its first report on AFV's and ATF's in 1994.[5] It contains extensive background material on ATF and AFV characteristics, legislation, and industry-related information, and provides some early estimates of AFV inventories and ATF consumption. Subsequently in 1995, EIA produced its first annual data report,[6] with data for 1992-1995. A similar report followed in 1996.[7] Thus, this report is EIA's third annual report on alternative transportation fuels.

EIA derives its information from a wide variety of sources. EIA conducts a survey[8] to determine the number and type of AFV's made available in the current year and expected to be made available in the following year. Industry information and EIA data are used to estimate the AFV population and ATF consumption. Finally, the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, provides EIA with information, both to develop estimates and to report on AFV/ATF progress.

[1] Alternative-fueled vehicle is defined as a vehicle either designed and manufactured by an original equipment manufacturer or a converted vehicle designed to operate in either dual-fuel, flexible-fuel, bi-fuel, or dedicated modes on fuels other than gasoline or diesel. This does not include a conventional vehicle that is limited to operation on blended or reformulated gasoline.

[2] Section 301 of EPACT defines alternative fuels as: methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary of Energy, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits. EPACT defines replacement fuels as the portion of any motor fuel that is methanol, ethanol, or other alcohols, natural gas, liquefied petroleum gas, hydrogen, coal-derived liquid fuels, fuels (other than alcohol) derived from biological materials, electricity (including electricity from solar energy), ethers, or any other fuel the Secretary of Energy determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits.

[3] Data for biodiesel are not included in this report. However, a discussion is presented in Chapter 5.

[4] Energy Information Administration, *Alternatives to Traditional Transportation Fuels 1994, Volume 2, Greenhouse Gas Emissions*, DOE/EIA-0585/2(94)/2 (Washington, DC, August 1996).

[5] Energy Information Administration, *Alternatives to Traditional Transportation Fuels: An Overview*, DOE/EIA-0585(0) (Washington, DC, June 1994).

[6] Energy Information Administration, *Alternatives to Traditional Transportation Fuels 1993*, DOE/EIA-0585(93) (Washington, DC, January 1995).

[7] Energy Information Administration, *Alternatives to Traditional Transportation Fuels 1994, Volume 1*, DOE/EIA-0585/1(94) (Washington, DC, February 1996).

[8] Energy Information Administration, Form EIA-886, "Alternative Fuel Vehicle Suppliers' Annual Report."

2. Alternative-Fueled Vehicles In Use

Alternative-Fueled Vehicle Inventory

The number of alternative-fueled vehicles (AFV's) in use is expected to increase at an average annual rate of 7.6 percent between 1995 and 1997, compared to an average annual rate of 9.8 percent from 1992 to 1995. Revised estimates of the number of AFV's in use at the end of 1995 are lower than reported a year ago (Table 1). Slower than expected growth in liquefied petroleum gas (LPG) and compressed natural gas (CNG) vehicles is the major reason for the lower estimates.

Liquefied Petroleum Gas (LPG) Vehicles

LPG vehicles continue to dominate AFV's, but they are growing at a slower rate than most other types of AFV's. As a result, the share of AFV's attributable to LPG vehicles is declining (from 88 percent in 1992 to an expected level of 71 percent in 1997). Although the number of LPG vehicles in use is expected to increase at about the same rate as that of conventional vehicles from 1995 to 1997, the actual number of LPG vehicles cannot be determined precisely. The estimates in this report are considered minimum estimates. Some evidence suggests the actual count could be as high as 300,000 to 350,000.

LPG vehicle estimates were derived from State-level data. Reasonably accurate government or private sources of data on the number of onroad LPG vehicles exist for only about one-third of the States. Estimates for the remaining States were imputed based on LPG usage data from the Energy Information Administration's *State Energy Data Report* (see Appendix A). The estimates in this report are subject to known data limitations, such as inconsistencies

Table 1. Estimated Number of Alternative-Fueled Vehicles in Use in the United States, by Fuel, 1992-1997

Fuel	1992	1993	1994	1995	1996	1997	Average Annual Growth Rate (percent)
Liquefied Petroleum Gases (LPG)[a]	221,000	269,000	264,000	R259,000	R266,000	*273,000*	4.3
Compressed Natural Gas (CNG)	23,191	32,714	41,227	R50,218	R62,805	*81,747*	28.7
Liquefied Natural Gas (LNG)	90	299	R484	R603	R715	*955*	60.4
Methanol, 85 Percent[b] (M85)	4,850	10,263	15,484	R18,319	R19,636	*19,787*	32.5
Methanol, Neat (M100)	404	414	415	R386	R155	*130*	-20.3
Ethanol, 85 Percent[b] (E85)	172	441	605	R1,527	R3,575	*5,859*	102.5
Ethanol, 95 Percent[b] (E95)	38	27	33	R136	R341	*341*	55.1
Electricity	R1,607	R1,690	R2,224	R2,860	R3,306	*3,925*	19.6
Non-LPG Subtotal	R30,352	R45,848	R60,472	R74,049	R90,533	*112,744*	30.0
Total	**R251,352**	**R314,848**	**R324,472**	**R333,049**	**R356,533**	***385,744***	**8.9**

[a]Values represent lower bound estimates and are rounded to thousands. Accordingly, these estimates are not equal to the sum of Federal fleet data (for which exact counts are available) and non-Federal fleet estimates (rounded to thousands).
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
R = Revised.
Note: Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Sources: **Federal:** U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. **Non-Federal:** Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

between LPG tank sales and decal sales[9] and the widespread acknowledgment of underreporting or misreporting of vehicles and fuel. These limitations imply that the values in this report should be considered estimated minimum values.

Revised estimates of LPG vehicles in use at the end of 1995 are lower than previously reported (259,000 compared to 272,000 reported a year ago). Revised 1995 estimates are also lower than those for 1994. These changes, however, do not necessarily indicate a decline in the LPG vehicle population but could indicate an improvement in the accuracy of the estimation (1994 estimates of total LPG vehicles have not been revised for this report).

Compressed Natural Gas (CNG) Vehicles

While the share of LPG vehicles is expected to decline, the share of vehicles designed to operate on CNG is expected to grow, from 9 percent of all AFV's in 1992 to 21 percent in 1997. The number of CNG-fueled vehicles in use is expected to increase by more than 60 percent from 1995 to 1997. The estimated number of CNG vehicles in use at the end of 1995, however, has been revised downward from about 66,000 in last year's report to about 50,000 in this report. A smaller number of light-duty, private vehicles, which comprise almost half of CNG vehicles, accounted for most of the revision.

Growth in the use of CNG vehicles does not appear to be uniform across the natural gas industry. Most of the growth appears to be occurring at utilities that service the largest fleets (both utility and nonutility). This variability within the industry has increased dramatically over the past year due to a number of factors, including changes in regulatory policy in California, the lack of scale economies in some CNG vehicle programs, and EPACT compliance issues.

In November 1995, the California Public Utilities Commission ordered the State's utilities to stop using ratepayer funds for engine development work, vehicle or station incentives, marketing, and similar programs. Funding is allowed only for safety, education, information, and related functions. The response was varied. At least one major California utility drastically curtailed its CNG vehicle program. Another refocused its program toward large, high-fuel-usage vehicles.

Independent of the California ruling, numerous utilities with small or mid-sized CNG vehicle operations have indicated dissatisfaction with the absence of scale economies in their CNG vehicle programs. Many of these utilities are trimming their programs. Considerable enthusiasm still exists for CNG at many of the utilities with the largest fleets; the previously widespread and rapid growth appears to be narrowing to them.

Another important and continuing trend is a shift toward vehicles in heavier weight classes. The proportion of CNG vehicles in use that are heavy-duty vehicles increased from 10 percent in 1992 to 14 percent in 1995. This level is expected to remain stable through 1997. This change is significant for both vehicles and fuel use.

Liquefied Natural Gas (LNG) Vehicles

The number of vehicles designed to operate on LNG, although relatively small, continues to grow steadily as more fleet managers conduct trials of the fuel. From 1995 to 1997, growth is expected to be particularly strong in the western United States. Transit buses and heavy-duty trucks remain the primary users of LNG, but the number of light-duty LNG vehicles is higher than previously estimated. Further investigation identified several light-duty LNG vehicles that were not included in last year's report. Because some of the newly identified vehicles were actually operating in 1994, estimates of the number of LNG vehicles in 1994 have been revised.

Estimates for 1997 are based largely on orders already placed and expressed intentions to adopt LNG; however, some uncertainty remains about the accuracy of these estimates. The number of vehicles expected to be deployed depends significantly on the success of a few large transit organizations in operating and adopting LNG buses, and on the success of trucking organizations in utilizing LNG in their fuel mix. Future growth also depends on several other factors, including increased fuel system reliability, resolution of outstanding safety and maintenance issues, development of an LNG infrastructure, and the availability of government subsidies for bus purchases and test programs.

Methanol (M85 and M100) Vehicles

By 1997, methanol vehicles are expected to comprise 5 percent of all AFV's, an increase from 2 percent in 1992. The number of M85 vehicles, which almost quadrupled from 1992 to 1995, is expected to increase at a much slower pace from 1995 to 1997. Growth is expected to

[9] In some States, the purchase of fuel use decals for LPG or other alternative-fueled vehicles is an alternative to paying fuel taxes at the pump. In States with decal programs, some require decals while others make it optional.

occur primarily in California, where most of the United States' methanol vehicles are operated. The use of M85-fueled vehicles in California may peak in the next few years because methanol costs, emissions savings, and bus reliability have become major concerns. Competition for methanol by methyl tertiary butyl ether (MTBE) suppliers has been a particular problem in California. Growth in M85-fueled vehicles has resulted almost exclusively from Federal, State, and local government expansion or from incentives to the private sector in California. Some uncertainty surrounds the estimates for 1997, which are largely based on California Energy Commission plans that are contingent upon original equipment manufacturers' (OEM) vehicle production and customer purchases.

Although M85 vehicles are expected to continue increasing, the number of vehicles designed to operate on M100 (neat methanol) is expected to decline substantially. No new M100-fueled buses have been ordered since 1993, and the Los Angeles County Metropolitan Transit Authority (LACMTA), the largest operator of M100-fueled buses, has decided to end its M100 program. LACMTA reported numerous problems with the bus engines and significantly high failure rates. Other concerns were fuel economy and fuel price. LACMTA is reconfiguring its M100 buses into E95 buses and has reoriented its purchases toward CNG buses (for 1997 and beyond). On the other hand, in 1995, a number of school buses in California were reconfigured from M85 to M100 buses. After 1996, most of the M100 vehicles in the United States will be school buses.

Ethanol (E85 and E95) Vehicles

Rapid increases in the number of E85 and E95 vehicles are expected to occur between 1995 and 1997, raising the share of ethanol vehicles from about .5 percent in 1995 to 1.6 percent of all AFV's in 1997. The increases are largely due to State government programs in the Midwest and the South, Federal vehicle orders, and the interest of corn growers.

In May 1995, General Motors (GM) announced that, starting in model year 1997, all of its Chevrolet S-10 and GMC Sonoma pickup trucks would be flexible-fueled vehicles capable of operating on E85 and/or gasoline. According to recent information from GM, the introduction of these vehicles has been delayed until model year 1999. Therefore, no estimates for these pickup trucks are included in this report.

The estimated number of E95 vehicles in use increased substantially in 1995 and 1996. The increases, however, are virtually all due to the M100 buses that were reconfigured for E95 by LACTMA. The private market for E95-fueled vehicles is almost nonexistent. The market for dedicated ethanol-fueled vehicles suffers from the same limitations as those of M100-fueled vehicles, and unlike E85-fueled vehicles, no OEM is planning to manufacture them in large numbers.

Electric Vehicles

From 1995 to 1997, the number of electric vehicles is expected to increase modestly in all weight classes, in all regions, and in all ownership categories. Growth is primarily driven by State government mandates and regulations; private owner purchases; and conversions in California, Arizona, and Colorado. Electric vehicle counts are subject to some degree of uncertainty, which is caused by differences in the definition of an onroad electric vehicle, by the relatively large percentage of electric vehicles that do not operate like conventional vehicles, and, for light-duty vehicles only, by possible incentives for vehicle associations to inflate estimates. Some of this uncertainty has been reduced by slightly restricting the definition of electric vehicles (e.g., large golf carts have been excluded). These definitional changes resulted in small revisions to previously reported data for 1992 to 1994.

Much research and development still occurs in anticipation of State government mandates for zero-emission vehicles (ZEV's). However, these mandates were eased somewhat in 1996, when the California Air Resources Board decided to delay the start of its ZEV mandates from model year 1998 to model year 2003.

Regional Distribution of AFV's

The largest number of AFV's are located in the South, followed by the West, the Midwest, and the Northeast (Table 2). (Census regions are defined in Appendix B.) The predominance of AFV's in the South and the West is primarily due to the large number of States in those regions and to high concentrations of AFV's in California and Texas.

Between 1995 and 1997, the number of AFV's is expected to grow most rapidly in the West, where AFV's are anticipated to increase by 20 percent, compared to nationwide growth of 16 percent. The South is expected to experience the slowest growth (13 percent). Ethanol vehicles continue to be located mainly in the Midwest, where ethanol production is concentrated and infrastructure development efforts are under way. Methanol and electric vehicles are found predominantly in the West,

Table 2. Estimated Number of Alternative-Fueled Vehicles in Use in the United States, by Fuel and Census Region, 1995-1997

Fuel	1995					1996					1997				
	Northeast	South	Midwest	West	Total	Northeast	South	Midwest	West	Total	Northeast	South	Midwest	West	Total
Liquefied Petroleum Gases (LPG)[a]	29,000	98,000	76,000	56,000	**259,000**	29,000	101,000	78,000	58,000	**266,000**	*30,000*	*104,000*	*80,000*	*59,000*	***273,000***
Compressed Natural Gas (CNG)	7,468	14,673	9,390	18,687	**50,218**	9,562	18,413	11,167	23,663	**62,805**	*12,121*	*23,561*	*15,607*	*30,458*	***81,747***
Liquefied Natural Gas (LNG)	0	447	12	144	**603**	7	496	14	198	**715**	*7*	*546*	*14*	*388*	***955***
Methanol, 85 Percent[b] (M85)	1,382	2,039	1,521	13,377	**18,319**	1,253	1,829	1,381	15,173	**19,636**	*991*	*1,557*	*1,086*	*16,153*	***19,787***
Methanol, Neat (M100)	18	8	0	360	**386**	18	9	0	128	**155**	*18*	*9*	*0*	*103*	***130***
Ethanol, 85 Percent[b] (E85)	4	71	1,413	39	**1,527**	4	212	3,229	130	**3,575**	*4*	*316*	*5,283*	*256*	***5,859***
Ethanol, 95 Percent[b] (E95)	0	1	6	129	**136**	0	1	6	334	**341**	*0*	*1*	*6*	*334*	***341***
Electricity	417	375	389	1,679	**2,860**	486	532	434	1,854	**3,306**	*503*	*760*	*467*	*2,195*	***3,925***
Total	**38,289**	**115,614**	**88,731**	**90,415**	**333,049**	**40,330**	**122,492**	**94,231**	**99,480**	**356,533**	***43,644***	***130,750***	***102,463***	***108,887***	***385,744***

[a]Values represent lower bound estimates and are rounded to thousands.
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
Note: Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Source: Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels.

particularly in California. CNG and LPG vehicles are more evenly distributed across the regions.

Estimates of AFV's in use in each of the 50 States are presented in the 1995 report for the first time (Table 3). California, Texas, Illinois, Ohio, and Michigan continue to be the five states with the largest numbers of AFV's. In 1995, these States account for about 40 percent of the AFV's in the United States. In addition to the top five States, four others are estimated to have more than 10,000 AFV's in use in 1995: New York, Oklahoma, Pennsylvania, and Wisconsin. By 1997, Georgia and Florida are also expected to exceed the 10,000 figure.

Alternative-Fueled Vehicles Ownership

As in previous years, the majority of AFV's in use (roughly 70 percent in 1995 and 1997) are privately owned. The predominance of privately owned vehicles is primarily due to the large number of privately owned LPG vehicles (Table 4). The proportion of CNG and methanol vehicles that were privately owned in 1995 was 54 percent and 28 percent, respectively. Eighty percent of the LPG vehicles in use in 1995 were privately owned.

Revised 1995 and 1996 estimates for LPG vehicles indicate a lower percentage of private ownership and a higher percentage of State and local ownership than was reported last year. The differing percentages are believed to result from improved data sources that better identify ownership, rather than from any switching of vehicles between categories. Therefore, the ownership classifications of LPG vehicles estimated to be in use prior to 1995 have been changed to reflect the new information.

Private ownership of non-LPG AFV's has increased since 1992, but not as rapidly as public ownership. Thus, the proportion of non-LPG AFV's owned by the private sector has declined from 66 percent in 1992 to an expected 43 percent in 1997.

Ownership of AFV's by State and local governments has increased more rapidly than private ownership, but more slowly than Federal ownership (Table 5). State governments become subject to AFV mandates in model year 1997, as specified in the Federal rulemaking for State and fuel provider fleets. (See Chapter 5 for an explanation of the final rulemaking.)

Despite cutbacks in funding, the Federal fleet of AFV's continues to grow, and the fuel mix is diversifying. In 1993, CNG and methanol vehicles comprised 98 percent of the Federal AFV fleet. In 1997, vehicles designed for these two fuels are expected to account for 87 percent of the fleet, with ethanol and electric vehicles accounting for most of the remainder (Table 6). The majority of Federal AFV's are in the fleets of the General Services Administration (GSA) (which leases vehicles to other agencies through the Interagency Fleet Management System), the U.S. Postal Service, and the U.S. Department of Defense. In 1996, GSA began retiring a number of its older alcohol vehicles. Many of these vehicles were sold to the non-Federal sector. Estimates for 1997 are based on the number of vehicle acquisitions needed to meet Energy Policy Act of 1992 (EPACT) mandates. However, much uncertainty exists about actual vehicle acquisitions. While U.S. Department of Energy (DOE) funding of the incremental cost of purchasing AFV's is almost certain to be unavailable, a proposed executive order, if enacted, would require agencies to continue to meet EPACT goals.

Alternative-Fueled Vehicles by Weight Class

From 1995 to 1997, the number of light-duty AFV's in use is expected to increase at about the same rate as the number of heavy-duty AFV's; therefore, light-duty AFV's will remain at 82 percent of total AFV's during the period. This percentage increased slightly from 1992 to 1995 (light-duty vehicles averaged about 80 percent of all AFV's in 1992). Within certain fuel types, particularly CNG and electric vehicles, significant shifts have occurred. In 1992, 90 percent of CNG vehicles and 99 percent of electric vehicles were light-duty vehicles. By 1997, 86 percent of CNG vehicles and 95 percent of electric vehicles are expected to be light-duty vehicles. Shifts toward heavier duty vehicles can have a significant impact on alternative fuel usage because those vehicles tend to consume much higher quantities of fuel.

Table 3. Estimated Number of Alternative-Fueled Vehicles In Use, by State, 1995-1997

	1995	1996	1997
Alabama	3,355	3,604	*3,985*
Alaska	170	197	*462*
Arizona	4,963	5,917	*7,000*
Arkansas	1,663	1,754	*1,852*
California	51,745	57,396	*63,413*
Colorado	5,783	6,376	*6,768*
Connecticut	2,044	2,254	*2,787*
Delaware	327	352	*432*
District of Columbia	1,027	1,096	*1,243*
Florida	9,716	10,380	*10,630*
Georgia	9,260	10,036	*11,047*
Hawaii	469	514	*518*
Idaho	1,686	1,775	*1,812*
Illinois	17,125	18,050	*19,113*
Indiana	8,214	8,775	*9,421*
Iowa	5,145	5,535	*5,842*
Kansas	4,455	4,611	*4,780*
Kentucky	3,739	3,990	*4,125*
Louisiana	4,411	4,629	*5,692*
Maine	648	666	*680*
Maryland	3,973	4,228	*4,442*
Massachusetts	3,625	3,785	*3,964*
Michigan	15,192	15,828	*17,049*
Minnesota	2,274	2,580	*2,926*
Mississippi	6,303	6,465	*6,622*
Missouri	3,842	4,375	*4,950*
Montana	1,461	1,539	*1,777*
Nebraska	2,675	2,851	*3,201*
Nevada	2,220	2,546	*2,814*
New Hampshire	353	365	*385*
New Jersey	5,117	5,842	*6,424*
New Mexico	3,966	4,268	*4,549*
New York	12,982	13,684	*14,682*
North Carolina	8,268	8,498	*8,824*
North Dakota	1,168	1,268	*1,216*
Ohio	16,825	17,847	*20,514*
Oklahoma	12,063	12,615	*13,272*
Oregon	6,711	6,958	*7,148*
Pennsylvania	12,585	12,756	*13,420*
Rhode Island	632	668	*977*
South Carolina	4,152	4,260	*4,431*
South Dakota	1,194	1,256	*1,393*
Tennessee	7,328	7,558	*7,845*
Texas	32,307	34,465	*36,009*
Utah	3,383	3,815	*4,463*
Vermont	303	310	*325*
Virginia	6,390	6,987	*8,483*
Washington	6,712	7,000	*6,906*
West Virginia	1,332	1,575	*1,816*
Wisconsin	10,622	11,255	*12,058*
Wyoming	1,146	1,179	*1,257*
U.S. Total	**333,049**	**356,533**	***385,744***

Note: Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Source: Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels.

Table 4. Estimated Number of Alternative-Fueled Vehicles in Use by U.S. Private Entities, by Fuel and Weight Category, 1993, 1995, and 1997

Fuel	1993			1995			1997		
	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total
Liquefied Petroleum Gases (LPG)[a]	R173,000	R43,000	**R216,000**	R166,000	R41,000	**R207,000**	*174,000*	*44,000*	***218,000***
Compressed Natural Gas (CNG)	16,932	1,719	**18,651**	R22,950	R3,981	**R26,931**	*30,950*	*6,001*	***36,951***
Liquefied Natural Gas (LNG) ...	2	3	**5**	R49	R34	**R83**	*48*	*61*	***109***
Methanol, 85 Percent[b] (M85) ...	2,737	0	**2,737**	R5,198	0	**R5,198**	*7,766*	*0*	***7,766***
Methanol, Neat (M100)	0	2	**2**	0	R0	**R0**	*0*	*0*	***0***
Ethanol, 85 Percent[b] (E85)	52	0	**52**	54	0	**54**	*109*	*0*	***109***
Ethanol, 95 Percent[b] (E95)	4	4	**8**	R1	R1	**R2**	*1*	*1*	***2***
Electricity	1,657	0	**1,657**	R2,400	R26	**R2,426**	*2,966*	*28*	***2,994***
Non-LPG Subtotal	21,384	1,728	**23,112**	R30,652	R4,042	**R34,694**	*41,840*	*6,091*	***47,931***
Total	**R194,384•**	**R44,728**	**R239,112**	**R196,652**	**R45,042**	**R241,694**	***215,840***	***50,091***	***265,931***

[a]Values represent lower bound estimates and are rounded to thousands.
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
R = Revised.
Note: • Weight classes are based on Environmental Protection Agency definitions: light duty is less than or equal to 8,500 pounds gross vehicle weight; heavy duty is greater than 8,500 pounds gross vehicle weight. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Sources: Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

Table 5. Estimated Number of Alternative-Fueled Vehicles in Use by State and Local Governments, by Fuel and Weight Category, 1993, 1995, and 1997

Fuel	1993			1995			1997		
	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total
Liquefied Petroleum Gases (LPG)[a] ..	R43,000	R10,000	**R53,000**	R42,000	R10,000	**R52,000**	*44,000*	*11,000*	***55,000***
Compressed Natural Gas (CNG)	8,692	2,281	**10,973**	R10,670	R3,185	**R13,855**	*17,134*	*5,384*	***22,518***
Liquefied Natural Gas (LNG)	29	265	**294**	R47	R426	**R473**	*49*	*727*	***776***
Methanol, 85 Percent[b] (M85)	1,900	108	**2,008**	R3,569	R0	**R3,569**	*5,427*	*0*	***5,427***
Methanol, Neat (M100)	0	412	**412**	0	R386	**R386**	*1*	*129*	***130***
Ethanol, 85 Percent[b] (E85)	273	2	**275**	R1,084	R0	**R1,084**	*2,164*	*0*	***2,164***
Ethanol, 95 Percent[b] (E95)	1	18	**19**	R0	R134	**R134**	*0*	*339*	***339***
Electricity	R14	19	**R33**	R160	R83	**R243**	*257*	*155*	***412***
Non-LPG Subtotal	R10,909	3,105	**R14,014**	R15,530	R4,214	**R19,744**	*25,032*	*6,734*	***31,766***
Total	**R53,909**	**R13,105**	**R67,014**	**R57,530**	**R14,214**	**R71,744**	***69,032***	***17,734***	***86,766***

[a]Values represent lower bound estimates and are rounded to thousands.
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
R = Revised.
Notes: • Weight classes are based on Environmental Protection Agency definitions: light duty is less than or equal to 8,500 pounds gross vehicle weight; heavy duty is greater than 8,500 pounds gross vehicle weight. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Sources: Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

Table 6. Estimated Number of Alternative-Fueled Vehicles in Use by the U.S. Federal Government, by Fuel and Weight Category, 1993, 1995, and 1997

Fuel	1993			1995			1997[a]		
	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total
Liquefied Petroleum Gases (LPG)	32	0	32	R139	R2	R141	*256*	*2*	*258*
Compressed Natural Gas (CNG)	3,090	0	3,090	R9,432	R0	R9,432	*22,278*	*0*	*22,278*
Liquefied Natural Gas (LNG)	0	0	0	R47	0	R47	*64*	*6*	*70*
Methanol, 85 Percent[b] (M85)	5,518	0	5,518	R9,552	R0	R9,552	*6,594*	*0*	*6,594*
Methanol, Neat (M100)	0	0	0	0	0	0	*0*	*0*	*0*
Ethanol, 85 Percent[b] (E85)	114	0	114	R389	0	R389	*3,586*	*0*	*3,586*
Ethanol, 95 Percent[b] (E95)	0	0	0	0	0	0	*0*	*0*	*0*
Electricity	R0	0	R0	R191	R0	R191	*519*	*0*	*519*
Non-LPG Subtotal	R8,722	0	R8,722	R19,611	0	R19,611	*33,041*	*6*	*33,047*
Total	R8,754	0	R8,754	R19,750	R2	R19,752	*33,297*	*8*	*33,305*

[a]Based on Federal alternative-fueled vehicle acquisition requirements.
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
R = Revised.
Notes: • Weight classes are based on Environmental Protection Agency definitions: light duty is less than or equal to 8,500 pounds gross vehicle weight; heavy duty is greater than 8,500 pounds gross vehicle weight. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Sources: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Supplemented with data from individual Federal agencies.

Part of the fleet of 250 natural gas vehicles loaned to Atlanta Committee for the Olympic Games by the A.G.A. Clean Air Team for use during the 1996 Olympics.

3. Alternative and Replacement Fuel Consumption

In this report, the term "alternative and replacement fuels" refers to all alternative fuels, as defined in Section 301 of the Energy Policy Act of 1992 (EPACT), plus alcohols, ethers, or other qualified fuels (as defined by EPACT) that are blended with traditional fuels in smaller amounts than is required to meet the criteria for an alternative fuel.[10] From 1992 to 1995, consumption of alternative and replacement fuels grew at a much faster pace than traditional vehicular fuels. During that period, consumption of alternative and replacement fuels increased 84 percent (on a gasoline-equivalent-gallon basis) while consumption of traditional highway fuels increased 6.5 percent (Table 7). From 1995 to 1997, however, the growth of alternative and replacement fuel consumption is expected to slow to only 5.2 percent, which is just slightly faster than the estimated consumption of traditional fuels. The slowdown in alternative and replacement fuel growth is attributable to a slowdown in oxygenate consumption, which is expected to increase 4 percent between 1995 and 1997. Consumption of alternative transportation fuels (ATF's), on the other hand, is expected to increase 22 percent during the period, but alternative fuels account for less than 10 percent of total alternative and replacement fuel consumption.

As a result of slower growth in alternative and replacement fuel consumption, the share of total highway fuel provided by alternative and replacement fuels is not expected to increase significantly from 1995 to 1997. In 1992, alternative and replacement fuels accounted for 1.6 percent, on a gasoline-equivalent-gallon basis, of onroad transportation fuel use. By 1995, that share had increased to 2.7 percent, but it is expected to remain at that level through 1997. Alternative fuels alone accounted for .17 percent of onroad fuel consumption in 1992 and .19 percent in 1995; ATF's are expected to account for .23 percent in 1997.

Alternative Fuels

While the most important factor in overall ATF consumption growth is the number of alternative-fueled vehicles (AFV's) in use, other factors also affect the rate of growth. The mix of AFV's by fuel type and by weight and usage classification—as well as the proportion of alternative fuels used in bifuel, dual-fuel, or flexible-fuel vehicles—can cause growth rates of vehicles and growth rates of fuel consumption to differ. Dedicated and heavy-duty vehicles, for instance, consume more ATF on average than nondedicated and light-duty vehicles. From 1992 to 1995, the number of AFV's in use grew at an average annual rate of 9.8 percent, while ATF consumption grew at 6.6 percent. During that time period, the percentage of AFV's that were light-duty vehicles increased slightly, which may partially explain why ATF consumption did not increase as quickly as AFV's in use. From 1995 to 1997, the percentage of light-duty vehicles is expected to remain fairly constant. The number of AFV's is expected to grow 7.6 percent annually, but ATF consumption is expected to grow 10.4 percent. In those years, a large part of the growth rate difference is due to compressed natural gas (CNG) consumption.

The shift toward heavier duty CNG vehicles (explained in Chapter 2) is also apparent in CNG consumption. However, data collected in 1996 for CNG consumption clearly show a large and broad-based increase in expected fuel usage per vehicle from 1995 to 1997. For a CNG AFV fleet expected to increase about 60 percent in 2 years, fuel use is expected to increase by about 130 percent. The slight shift toward heavy-duty vehicles over the 2-year period is not sufficient to explain this trend. Although the estimated increase is broadly based (many companies, regions, fleet types, etc.), it implies changes that are not captured in the vehicle data or reported in the literature. Thus, some uncertainty exists about the estimated events the data represent.

Deviation is significant between AFV growth rates and ATF consumption growth rates for M100 vehicles. From 1995 to 1997, the number of M100 vehicles in use is expected to decline by 66 percent, while consumption is expected to decline 84 percent. As explained earlier, the use of M100 for transit buses is expected to decline and, after 1996, most of the M100 vehicles in the United States will be school buses. Because of the large difference in annual vehicle-miles-traveled between transit and school buses, M100 consumption is expected to decline in 1996 and 1997 at a much higher rate than the vehicle counts themselves would suggest. This apparent discrepancy is particularly evident in regional fuel consumption data (Table 8).

In total, the regional distribution of ATF consumption is similar to the distribution of AFV's. Consumption is lowest in the Northeast, which accounted for 11 percent of ATF consumption in 1995, and highest in the South, which accounted for 36 percent (Table 8). For some fuels, however, the regional distribution reflects differences in the mix of vehicle types by region. For example, while 24 percent of the liquefied natural gas (LNG) vehicles in 1995 were located in the West, only 8 percent of total LNG consumption occurred there. Overall, no major regional shifts took place from year to year. However, the conversion of a large number of California buses from methanol to ethanol (see Chapter 2) is noticeable in the regional estimates. In 1994, 99 percent of E95 consumption in the United States occurred in the Midwest. By 1997, 99 percent of E95 consumption is expected to occur in the West. The consumption of M100 exhibits a regional shift away from the West as the number of M100 vehicles in that region declines. LNG consumption shows a significant shift toward the West between 1995 and 1997,

Table 7. Estimated Consumption of Vehicle Fuels in the United States, 1992-1997
(Thousand Gasoline-Equivalent Gallons)

Fuel	1992	1993	1994	1995	1996	1997
Alternative Fuels						
Liquefied Petroleum Gases (LPG) ...	208,142	264,655	R248,467	R232,701	R238,681	*244,659*
Compressed Natural Gas (CNG)	16,823	21,603	24,160	R35,162	R50,884	*81,736*
Liquefied Natural Gas (LNG)	585	1,901	R2,345	R2,759	R3,233	*4,702*
Methanol, 85 Percent[a] (M85)	1,069	1,593	2,340	R3,575	R3,832	*3,850*
Methanol, Neat (M100)	2,547	3,166	3,190	R2,150	R360	*338*
Ethanol, 85 Percent[a] (E85)	21	48	80	R190	R436	*728*
Ethanol, 95 Percent[a] (E95)	85	80	140	R709	R1,803	*1,803*
Electricity	R359	R288	430	R663	R815	*1,001*
Subtotal	**R229,631**	**R293,334**	**R281,152**	**R277,909**	**R300,044**	***338,817***
Oxygenates						
Methyl Tertiary Butyl Ether (MTBE)[b] ..	1,175,000	2,069,200	2,018,800	R2,682,200	R2,709,100	*2,820,400*
Ethanol in Gasohol	701,000	760,000	845,900	R910,700	812,900	*912,000*
Total Alternative and Replacement Fuels	**2,105,631**	**3,122,534**	**3,145,852**	**R3,870,809**	**R3,822,044**	***4,071,217***
Traditional Fuels						
Gasoline[c]	110,135,000	111,323,000	113,144,000	R115,943,000	R117,768,000	*120,125,000*
Diesel	23,866,000	24,296,630	26,422,490	R26,798,750	R27,566,920	*27,825,950*
Total Fuel Consumption[d]	**R134,230,631**	**R135,912,964**	**R139,847,642**	**R143,019,659**	**R145,634,964**	***148,289,767***

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline. Consumption data include the gasoline portion of the fuel.
[b]Includes a very small amount of other ethers, primarily Tertiary Amyl Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).
[c]Gasoline consumption includes ethanol in gasohol and MTBE.
[d]Total fuel consumption is the sum of alternative fuel, gasoline, and diesel consumption. Oxygenate consumption is included in gasoline consumption.
R = Revised.

Notes: • Fuel quantities are expressed in a common base unit of gasoline-equivalent gallons to allow comparisons of different fuel types. Gasoline-equivalent gallons do not represent gasoline displacement. Gasoline equivalent is computed by dividing the lower heating value of the alternative fuel by the lower heating value of gasoline and multiplying this result by the alternative fuel consumption value. Lower heating value refers to the Btu content per unit of fuel excluding the heat produced by condensation of water vapor in the fuel. • Totals may not equal sum of components due to independent rounding. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.

Sources: **1992-1995 Oxygenate Consumption:** Energy Information Administration, *Petroleum Supply Monthly.* **1992-1995 Traditional Fuel Consumption:** Energy Information Administration, *Petroleum Supply Annual, Volume 1* (June 1996). Highway use of gasoline was estimated as 97.1 percent of consumption, based on data in the *Transportation Energy Data Book: Edition 15*, prepared by Oak Ridge National Laboratory for the U.S. Department of Energy (July 1995). Diesel consumption was adjusted for highway use by multiplying by .488, derived from Energy Information Administration, *Fuel Oil and Kerosene Sales 1993*, Table HL1. **1996-1997 Oxygenate and Traditional Fuel Consumption:** Energy Information Administration, *Short Term Energy Outlook, Third Quarter 1996.* **Alternative Fuel Consumption:** Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels and Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

Table 8. Share of Alternate Transportation Fuel Consumption, by Region, 1995-1997
(Percent)

Fuel	1995				1996				1997			
	North-east	South	Mid-west	West	North-east	South	Mid-west	West	North-east	South	Mid-west	West
Liquefied Petroleum Gases (LPG)	11	38	29	22	11	38	29	22	11	38	29	22
Compressed Natural Gas (CNG)	14	24	19	42	15	24	19	43	16	23	21	41
Liquefied Natural Gas (LNG)	0	90	2	8	*	87	2	11	*	67	1	32
Methanol, 85 Percent[a] (M85)	7	11	8	74	6	9	7	78	5	8	5	82
Methanol, Neat (M100)	7	3	0	90	42	19	0	39	45	20	0	34
Ethanol, 85 Percent[a] (E85)	1	5	91	4	*	5	92	3	*	5	90	5
Ethanol, 95 Percent[a] (E95)	0	*	3	97	0	*	1	99	0	*	1	99
Electricity	13	22	10	56	12	27	10	51	10	32	8	50
Total	11	36	27	26	11	35	27	27	12	34	27	28

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline. Consumption data include the gasoline portion of the fuel.
* Less than 0.5 percent rounded to 0.
Notes: • Totals may not equal sum of components due to independent rounding. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Source: **Federal:** Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels. **Non-Federal:** Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

while consumption of electricity in vehicles shifts toward the South.

The relative distribution of ATF consumption by type of owner is similar to the distribution of AFV's. In 1995, the Federal Government accounted for 2.3 percent of ATF consumption, State and local governments accounted for 18.7 percent, and private entities accounted for 79.0 percent (Table 9). The public sector is expected to increase its share of AFV's and ATF consumption by 1997. In 1997, the Federal Government, State and local governments, and the private sector are expected to consume 4.6, 21.8, and 73.6 percent of alternative fuels, respectively.

The role of heavy-duty AFV's is much more significant in terms of fuel consumption than their numbers suggest. In 1997, heavy-duty vehicles are expected to comprise 17.6 percent of total AFV's, yet consumption by heavy-duty vehicles is expected to account for 38.7 percent of total ATF consumption. ATF consumption by heavy-duty vehicles is expected to increase 28.8 percent between 1995 and 1997 (Table 10). During the same time period, ATF consumption by light-duty vehicles is expected to increase 17.9 percent.

Oxygenates

The increasing use of alternative and replacement fuels is led by the increased use of oxygenates in gasoline. Oxygenate consumption (on a gasoline-equivalent-gallon basis) increased 92 percent from 1992 to 1995 and is expected to increase 4 percent from 1995 to 1997. The largest year-to-year increases occurred between 1992 and 1993, when oxygenated gasoline requirements were instituted, and from 1994 to 1995, when reformulated gasoline requirements went into effect.

Since the introduction of oxygenate mandates, the share of oxygenates in the gasoline supply has increased greatly. In 1992, oxygenates comprised 1.7 percent, on a gasoline-equivalent-gallon basis, of the gasoline consumed. By 1995, oxygenates accounted for 3.1 percent of gasoline supplied. Between 1995 and 1997, oxygenated gasoline as a proportion of total gasoline consumption is not expected to increase as quickly as it had been. Also, the demand for gasoline is expected to grow at a slower pace than in earlier years. As a result, the proportion of oxygenates in the gasoline supply is expected to remain constant between 1995 and 1997.

Table 9. Estimated Consumption of Alternate Transportation Fuels in the United States, by Vehicle Ownership, 1993, 1995, and 1997
(Thousand Gasoline-Equivalent Gallons)

Fuel	1993				1995				1997			
	Federal	State and Local	Private	Total	Federal	State and Local	Private	Total	Federal	State and Local	Private	Total
Liquefied Petroleum Gases (LPG)	14	R51,637	R213,003	**3e+05**	R105	R33,424	R199,172	**R232,701**	*191*	*35,364*	*209,104*	***244,659***
Compressed Natural Gas (CNG)	842	6,930	13,831	**21,603**	R4,250	R12,340	R18,572	**R35,162**	*13,386*	*30,572*	*37,778*	***81,736***
Liquefied Natural Gas (LNG)	0	1,894	6	**1,901**	R17	R2,658	R84	**R2,759**	*58*	*4,521*	*123*	***4,702***
Methanol, 85 Percent[a] (M85)	644	270	680	**1,593**	R1,864	R416	R1,295	**R3,575**	*1,283*	*633*	*1,934*	***3,850***
Methanol, Neat (M100)	0	3,165	*	**3,166**	0	R2,150	R0	**R2,150**	*0*	*338*	*0*	***338***
Ethanol, 85 Percent[a] (E85)	11	27	11	**48**	R49	R128	R13	**R190**	*446*	*253*	*29*	***728***
Ethanol, 95 Percent[a] (E95)	0	74	6	**80**	0	R707	R2	**R709**	*0*	*1,801*	*2*	***1,803***
Electricity	R0	R58	231	**R288**	R25	R281	R357	**R663**	*70*	*481*	*450*	***1,001***
Total	**R1,511•**	**R64,055•**	**R227,768•**	**R293,334•**	**R6,310•**	**R52,104•**	**R219,495•**	**R277,909•**	***15,434***	***73,963***	***249,420***	***338,817***

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline. Consumption data include the gasoline portion of the fuel.

* Less than 0.5 thousand gasoline-equivalent gallons.

R = Revised.

Notes: • Fuel quantities are expressed in a common base unit of gasoline-equivalent gallons to allow comparison of different fuel types. Gasoline-equivalent gallons do not represent gasoline displacement. Gasoline equivalent is computed by dividing the lower heating value of the alternative fuel by the lower heating value of gasoline and multiplying this result by the alternative fuel consumption value. Lower heating value refers to the Btu content per unit of fuel excluding the heat produced by condensation of water vapor in the fuel. • Totals may not equal sum of components due to independent rounding.

• Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.

Source: **Federal:** Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels. **Non-Federal:** Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

Table 10. Estimated Consumption of Alternate Transportation Fuels in the United States, by Fuel and Vehicle Weight, 1993, 1995, and 1997
(Thousand Gasoline-Equivalent Gallons)

Fuel	1993			1995			1997		
	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total	Light Duty	Heavy Duty	Total
Liquefied Petroleum Gases (LPG) ...	160,717	103,938	**264,655**	R152,452	R80,249	**R232,701**	*160,161*	*84,498*	***244,659***
Compressed Natural Gas (CNG)	14,388	7,214	**21,603**	R19,400	R15,761	**R35,162**	*42,277*	*39,458*	***81,736***
Liquefied Natural Gas (LNG)	10	1,891	**1,901**	R52	R2,708	**R2,759**	*58*	*4,644*	***4,702***
Methanol, 85 Percent[a] (M85)	1,545	48	**1,593**	R3,576	R0	**R3,575**	*3,851*	*0*	***3,850***
Methanol, Neat (M100)	0	3,166	**3,166**	0	R2,150	**R2,150**	*	*338*	***338***
Ethanol, 85 Percent[a] (E85)	47	2	**48**	R190	R0	**R190**	*729*	*0*	***728***
Ethanol, 95 Percent[a] (E95)	1	79	**80**	R*	R709	**R709**	*	*1,803*	***1,803***
Electricity	R226	62	**R288**	R365	R298	**R663**	*505*	*496*	***1,001***
Total	**R176,934**	**116,400**	**R293,334**	**R176,035**	**R101,875**	**R277,909**	***207,581***	***131,237***	***338,817***

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline. Consumption data include the gasoline portion of the fuel.
* Less than 0.5 thousand gasoline-equivalent gallons.
R = Revised.
Notes: • Fuel quantities are expressed in a common base unit of gasoline-equivalent gallons to allow comparisons of different fuel types. Gasoline-equivalent gallons do not represent gasoline displacement. Gasoline equivalent is computed by dividing the lower heating value of the alternative fuel by the lower heating value of gasoline and multiplying this result by the alternative fuel consumption value. Lower heating value refers to the Btu content per unit of fuel excluding the heat produced by condensation of water vapor in the fuel. • Weight classes are based on Environmental Protection Agency definitions: light duty is less than or equal to 8,500 pounds gross vehicle weight; heavy duty is greater than 8,500 pounds gross vehicle weight. • Totals may not equal sum of components due to independent rounding. • Estimates for historical years are in roman type; estimates for 1997, based on plans or projections, are in italic.
Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, and Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

4. Alternative-Fueled Vehicles Made Available

Over the long term, the population of alternative fueled vehicles (AFV's) will be determined by those added to the inventory each successive year (net of retirements). Accordingly, the Energy Information Administration (EIA) developed a survey ("Alternative Fuels Vehicle Suppliers' Annual Report," Form EIA-886), first conducted in 1995, that reports the number of vehicles "made available" in the previous calendar year.[11] In addition, the survey requests respondents to estimate the number of vehicles they expect to make available in the next calendar year. EIA fielded the EIA-886 survey for the second time in 1996, obtaining information on AFV's made available in 1995 and planned to be made available through the end of 1996 (Tables 11 through 13).

AFV's Made Available, 1995

Preliminary data[12] indicate that 17,888 onroad AFV's were made available in 1995. More than one-half were designed for CNG, while about one-third were fueled by LPG. About 40 percent were cargo vans or pickup trucks, 23 percent were automobiles, and 21 percent were trucks other than pickup trucks. One-third of the onroad vehicles made available had dedicated fuel systems. LPG fueled 65 percent of the dedicated vehicles. Two-thirds of the nondedicated vehicles were CNG vehicles. The single largest category of AFV's in 1995 was CNG cargo vans and pickup trucks, which accounted for 27 percent of total AFV's made available.

The number of nonroad AFV's made available in 1995 was 81,020, with LPG forklifts accounting for more than one-third (Table 12). Electric vehicles accounted for more than half of the nonroad AFV's made available in 1995.[13]

AFV's Made Available, 1995 Versus 1994

An important distinction must be made in comparing the results of the 1996 survey with those obtained in 1995. A major challenge in obtaining accurate AFV survey information is determining the universe of respondents. Between 1995 and 1996, about 400 new potential respondents were added and a number of previous respondents were determined not to be in the AFV conversion business. In total, there were 1,350 respondents to the 1996 survey. Thus, in comparing results obtained in 1996 with those obtained in 1995 (1994 calendar year data), it is important to understand whether the major changes appear to be the result of adding new respondents, changes in behavior of respondents in both years, or changes in nonresponse patterns.

To analyze and compare vehicles made available in 1994 and 1995, survey respondents were divided into four categories: (1) those that supplied responses to both the 1995 and 1996 surveys; (2) new respondents—those that participated in the 1996 survey only; (3) nonrespondents—those identified in either survey but who did not respond; and (4) out-of-scope respondents—those that were identified in 1995 or 1996 as not supplying AFV's. Below is a summary of 1995 versus 1994 results for CNG and LPG vehicles.[14]

Compressed Natural Gas (CNG)

The EIA-886 survey reported approximately 2,300 more onroad CNG vehicles made available in 1995 than in 1994. AFV's made available by original equipment manufacturers (OEM's) declined by 100, while CNG vehicles

[10] For more information about Section 301 of the EPACT, refer to footnote number 2 in Chapter 1. Consumption of biodiesel fuel (see Chapter 5) is not included in this report, primarily because of data limitations, but it will be considered in future reports.

[11] An AFV is considered made available in the year it is completed and made ready for delivery to dealers or users. While a vehicle may be "made available" and "placed in service" in different years, the two activities closely track one another.

[12] As of August 31, 1996.

[13] The precise number of electric nonroad vehicles cannot be published due to confidentiality rules. See Table 12.

[14] Other fuel types are not included in this summary because of confidentiality of the data.

Table 11. Number of Onroad Alternative-Fueled Vehicles Made Available, by Fuel Type and Vehicle Configuration, 1995

Fuel Type	Automobiles	Passenger Vans	Cargo Vans/ Pickups	Other Trucks	Buses	Other Onroad Vehicles	Total
Liquefied Petroleum Gases (LPG)	516	193	1,966	W	153	W	6,004
Dedicated	207	50	549	W	53	W	3,832
Nondedicated	309	143	1,417	W	100	W	2,172
Compressed Natural Gas (CNG)	1,827	W	4,875	703	W	W	9,483
Dedicated	136	W	W	27	398	W	1,495
Nondedicated	1,691	367	W	676	W	W	7,988
Liquefied Natural Gas (LNG)	0	0	W	W	W	0	85
Dedicated	0	0	W	W	W	0	14
Nondedicated	0	0	W	W	W	0	71
Methanol, 85 percent[a] (M85)	1,335	0	0	0	0	0	1,335
Dedicated	0	0	0	0	0	0	0
Nondedicated	1,335	0	0	0	0	0	1,335
Methanol, Neat (M100)	0	0	0	0	0	0	0
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	0	0	0
Ethanol, 85 percent[a] (E85)	430	0	0	0	0	0	430
Dedicated	0	0	0	0	0	0	0
Nondedicated	430	0	0	0	0	0	430
Ethanol, 95 percent[a] (E95)	0	0	0	0	0	0	0
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	0	0	0
Electricity	74	W	65	0	W	W	538
Nonhybrid	74	W	65	0	W	W	538
Hybrid	0	0	0	0	0	0	0
Other[b]	0	0	W	0	10	W	13
Dedicated	0	0	0	0	8	0	8
Nondedicated	0	0	W	0	2	W	5
Total	**4,182**	**935**	**6,956**	**3,838**	**1,071**	**906**	**17,888**
Dedicated and Nonhybrid	**417**	**425**	**1,164**	**2,959**	**706**	**216**	**5,887**
Nondedicated and Hybrid	**3,765**	**510**	**5,792**	**879**	**365**	**690**	**12,001**

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
[b]Includes hydrogen, biodiesel, and other alternative fuels.
W = Withheld to avoid disclosure of individual company data.
Notes: •Vehicles made available are vehicles that are completed and made available for delivery to dealers or users in a given year. •Dedicated vehicles and nonhybrid electric vehicles are designed to operate exclusively on one alternative fuel. Nondedicated vehicles and hybrid electric vehicles are configured to operate on more than one fuel, usually an alternative fuel and gasoline or diesel fuel. •Data are based on survey responses as of August 31, 1996.
Source: Energy Information Administration, Form EIA-886, "Alternative Fuel Vehicle Suppliers' Annual Report."

Table 12. Number of Nonroad Alternative-Fueled Vehicles Made Available in 1995 and Planned to be Made Available in 1996, by Fuel Type

Fuel Type	1995	1996
Liquefied Petroleum Gases (LPG)	W	W
Compressed Natural Gas (CNG)	323	574
Liquefied Natural Gas (LNG)	W	W
Methanol, 85 percent[a] (M85)	0	0
Methanol, Neat (M100)	0	0
Ethanol, 85 percent[a] (E85)	0	0
Ethanol, 95 percent[a] (E95)	0	0
Electricity	W	24,264
Other[b]	0	0
Total	81,020	44,634

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
[b]Includes hydrogen, biodiesel, and other alternative fuels.
W = Withheld to avoid disclosure of individual company data.
Notes: • Nonroad vehicles are vehicles designed for offroad operation and used for industrial or commercial purposes. They include forklifts, agricultural and construction vehicles, and others. • Vehicles made available are vehicles that are completed and made available for delivery to dealers or users in a given year. • Data are based on survey responses as of August 31, 1996.
Source: Energy Information Administration, Form EIA-886, "Alternative Fuel Vehicle Suppliers' Annual Report."

made available through conversions increased by 2,400. The decrease in the number of OEM vehicles was predominately reported by respondents identified in last year's survey who showed a decrease in the number of vehicles manufactured. This decrease was overshadowed by the large increase in the number of vehicles converted to CNG. Thirty-six percent of the increase in converted vehicles made available were from after-market vehicle converters who reported increases (ranging from 80 to more than 600 vehicles) in the number of AFV's converted between 1994 and 1995, while thirty-four percent of the converted AFV's reported in 1996 were nonrespondents to the 1995 survey.

Liquefied Petroleum Gas (LPG)

The number of LPG (propane) vehicles made available in 1995 was approximately 1,200 fewer than in 1994. Both OEM's and after-market converters reported decreases. Fifty-five percent of the decrease was reported by respondents that were identified in the 1995 survey (reporting vehicles for 1994) but reported converting no vehicles in this year's survey. Forty-four percent of the reduction in OEM AFV's originated from respondents that were identified in the 1995 survey but were out of scope this year. After-market converters reported making available 1,100 fewer LPG vehicles in 1995 than in 1994. Of this decrease, 69 percent were from respondents that reported in both years. Twenty-two percent of the decrease in AFV's resulted from entities who reported converting vehicles in 1994 but converted none in 1995.

Nonroad AFV's

The EIA-886 survey results showed that 81,020 nonroad AFV's were made available in 1995 (Table 12). This number represents an increase of more than 40,000 nonroad AFV's from 1994. Forklifts, industrial vehicles, and nonagricultural nonroad vehicles accounted for more than ninety-five percent of nonroad AFV's.

Outlook—1996 AFV's to be Made Available

The number of onroad AFV's planned to be made available in 1996 is 27,335 (Table 12). This number represents an increase of more than 9,400 AFV's from 1995 to 1996. CNG vehicles are expected to account for more than 40 percent of the increase. LPG vehicles are projected to decline by 40 percent. Electric vehicles are expected to increase nearly tenfold. Eighty-three percent of the planned AFV's are expected to be automobiles, pickup trucks, and other trucks.

Table 13. Number of Onroad Alternative-Fueled Vehicles Planned to be Made Available, by Fuel Type and Vehicle Configuration, 1996

Fuel Type	Automobiles	Passenger Vans	Cargo Vans/ Pickups	Other Trucks	Buses	Other Onroad Vehicles	Total
Liquefied Petroleum Gas (LPG)	436	24	966	W	184	W	3,584
Dedicated	223	W	196	W	W	W	2,382
Nondedicated	213	W	770	47	W	W	1,202
Compressed Natural Gas (CNG)	2,748	W	5,629	W	850	W	13,283
Dedicated	W	W	W	W	555	W	4,203
Nondedicated	W	W	W	W	295	W	9,080
Liquefied Natural Gas (LNG)	0	0	W	W	W	0	199
Dedicated	0	0	0	W	W	0	138
Nondedicated	0	0	W	W	W	0	61
Methanol, 85 percent (M85)[a]	W	0	0	0	0	0	W
Dedicated	0	0	0	0	0	0	0
Nondedicated	W	0	0	0	0	0	W
Methanol, Neat (M100)	0	0	0	0	0	0	0
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	0	0	0
Ethanol, 85 percent (E85)[a]	W	0	0	0	0	0	W
Dedicated	0	0	0	0	0	0	0
Nondedicated	W	0	0	0	0	0	W
Ethanol, 95 percent (E95)[a]	0	0	0	0	0	0	0
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	0	0	0
Electricity	W	W	W	W	W	W	4,663
Nonhybrid	W	W	W	W	W	W	4,663
Hybrid	0	0	0	0	0	0	0
Other[b]	W	0	0	0	W	0	6
Dedicated	0	0	0	0	0	0	0
Nondedicated	W	0	0	0	W	0	6
Total	**10,871**	**924**	**7,150**	**4,878**	**1,199**	**2,313**	**27,335**
Dedicated and Nonhybrid	**2,846**	**778**	**2,023**	**2,972**	**733**	**2,034**	**11,386**
Nondedicated and Hybrid	**8,025**	**146**	**5,127**	**1,906**	**466**	**279**	**15,949**

[a]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
[b]Includes hydrogen, biodiesel, and other alternative fuels.
W = Withheld to avoid disclosure of individual company data.
Notes: • Vehicles made available are vehicles that are completed and made available for delivery to dealers or users in a given year. • Dedicated vehicles and nonhybrid electric vehicles are designed to operate exclusively on one alternative fuel. Nondedicated vehicles and hybrid electric vehicles are configured to operate on more than one fuel, usually an alternative fuel and gasoline or diesel fuel. •Data are based on survey responses as of August 31, 1996.
Source: Energy Information Administration, Form EIA-886, "Alternative Fuel Vehicle Suppliers' Annual Report."

5. Special Topics

This chapter presents information on a variety of alternative-fuel subjects. The objective is to provide brief discussions of selected topics that are of special interest to readers. The first section of this chapter summarizes the recent Federal rulemaking for acquisition of alternative-fueled vehicles by alternative fuel providers and State fleets. The next section lists, by State, (1) incentives offered by governments and industry to expand the use of alternative-fueled vehicles (AFV's) and (2) State taxes on the different transportation fuels. The third section is a background discussion of biodiesel fuel. This section is a prelude to the inclusion of biodiesel fuel data in future EIA reports. The next section provides some explanation of the emerging technology of fuel cells and their potential for vehicle use. Finally, information is presented on the location of alternative fuel refueling sites. When applicable, the reader is referred to non-EIA sources for further information.

Federal Rule for Alternative-Fueled Vehicle Acquisitions by State Government and Fuel Provider Fleets

On March 14, 1996, the U.S. Department of Energy (DOE) published a final rule to implement alternative-fuel vehicle (AFV) acquisition requirements for State government and fuel provider fleets, as directed in the Energy Policy Act of 1992 (EPACT). The rule contains interpretations necessary for affected entities to determine whether and to what extent the requirements apply. It also explains procedures for exemption and administrative remedies, specifies a program of marketable credits to reward those who voluntarily acquire vehicles in excess of mandated requirements or before the requirements take effect, and allows use of such credits to demonstrate compliance with those requirements.

In general, a State government or State agency must comply with the AFV acquisition requirements if it owns, operates, leases, or otherwise controls a specified number of light-duty vehicles meeting certain criteria (e.g., capable of being centrally fueled). States have the option to comply as a whole State or to allow State agency fleet operators to comply individually. For States or State agencies, the rulemaking specifies that of the new light-duty vehicles acquired annually, the following percentages must be AFV's:

- Ten percent for model year 1997
- Fifteen percent for model year 1998
- Twenty-five percent for model year 1999
- Fifty percent for model year 2000
- Seventy-five percent thereafter.

An alternative-fuel provider is defined as an entity whose principal business is producing, storing, refining, processing, transporting, distributing, importing, or selling any alternative fuel (other than electricity), or generating, transmitting, importing, or selling electricity. Alternative fuel providers include entities that produce and/or import an average of 50,000 barrels per day or more of petroleum if 30 percent or more of the entities' gross annual revenues are derived from producing alternative fuels. Entities that are defined as alternative fuel providers must comply with the rulemaking if they own, operate, lease, or otherwise control a specified number of light-duty vehicles meeting certain criteria. The percentage acquisition requirements for alternative-fuel providers are the following:

- Thirty percent for model year 1997
- Fifty percent for model year 1998
- Seventy percent for model year 1999
- Ninety percent thereafter.

Under certain conditions, electric utilities may follow a different schedule.

The U.S. Department of Energy provides a "reader-friendly" guide covering the main requirements of the rule. To obtain a copy of the guide, a full copy of the rule, or other information about the rule, contact the Energy Efficiency and Renewable Energy Clearinghouse (EREC), 1-800-DOE-EREC (or P.O. Box 3048, Merrifield, VA 22116). World Wide Web users can access EREC information at http://www.eren.doe.gov. Information may also be obtained from the National Alternative Fuels Hotline, 1-800-423-1DOE (http://www.afdc.doe.gov).

State and Industry Incentives for Alternative-Fueled Vehicles and State Taxes on Alternative and Traditional Transportation Fuels

This section provides an overview of efforts taken by the States and industries to promote alternative transportation fuels and alternative-fueled vehicles in compliance with EPACT, and the Clean Air Act Amendments of 1990 (CAAA90). Table 14 presents a summary of incentives offered by States and industries to promote alternative fueled vehicles. Table 15 gives an update of State taxes on gasoline, diesel, gasohol, compressed natural gas, liquefied petroleum gas, methanol, and ethanol.

Biodiesel

On March 14, 1996, the Secretary of Energy designated neat[15] biodiesel as an alternative transportation fuel, in accordance with the provisions of EPACT.[16] This action heightened the importance of biodiesel as a component of the plan to meet the EPACT goal to increase the Nation's energy security. EPACT requires that 30 percent of the Nation's fuel come from non-petroleum sources by 2010, with at least half of this amount being of domestic origin.

In addition, biodiesel is viewed as an agent to reduce noxious emissions. Currently, engine pollution accounts for nearly 90 percent of carbon monoxide, 50 percent of nitrogen oxides (which, in turn, combine to form about 50 percent of photochemical oxidants, including harmful ozone) and 50 percent of the volatile organic compounds, 16 percent of particulate matter in metropolitan areas (diesel only), and 30 percent of airborne lead emissions.

Biodiesel is now registered as a fuel and as a fuel additive with the U.S. Environmental Protection Agency under CAAA90. Both EPACT and CAAA90 have provisions mandating the acquisition of "clean" vehicles, although definitions vary slightly between the two laws.

Background

Biodiesel is made from vegetable oils or animal tallow. Most biodiesel produced in the United States today is derived from either soybeans or rapeseed (mustard). Currently, only one company in the United States makes biodiesel in commercial quantities—Proctor and Gamble. Consumption of biodiesel in 1995 amounted to about 1 million gallons.

Biodiesel is made through a process known as trans-esterification. Essentially, a vegetable oil is combined with an alcohol in the presence of a catalyst[17] to form biodiesel. Glycerol, used in making soap, is a valuable by-product of this chemical reaction. Ironically, the alcohols normally used to make biodiesel, methanol, and ethanol are also alternative transportation fuels.

Performance Characteristics

Although neat biodiesel is now officially an alternate transportation fuel, the principal motivation for using biodiesel seems to be to reduce harmful emissions. A variety of diesel engine tests[18] have shown that a 20-percent biodiesel blend (B20)[19] used in unmodified diesel engines reduces particulate matter and carbon monoxide emissions considerably, total hydrocarbon emissions somewhat; however, nitrogen oxide emissions increase without other engine modifications.[20] Specifications for two typical samples of neat biodiesel are presented in Table 16.

Power output using biodiesel B20 appears to be close to that obtained from conventional No. 2 low-sulfur diesel (LSD).[21] Biodiesel fuel economy is slightly less than for

[15] "Neat" fuel is 100-percent pure, as opposed to a blend (e.g., E85).

[16] 61 FR, p. 10653 officially made neat biodiesel an "alternative transportation fuel."

[17] One catalyst used is sodium hydroxide (NaOH).

[18] "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," by L.G. Schumacher, D. Fossen, W. Goetz, S. C. Borgelt, and W. G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 65211. C.L. Peterson and D.L. Reece, "Emission Testing with Blends of Esters of Rapeseed Oil Fuel With and Without a Catalytic Convertor," Society of Automotive Engineers Technical Paper Series (January 4, 1996, Warrendale, PA).

[19] Usually 20-percent biodiesel, 80-percent No. 2 low-sulfur diesel.

[20] Nitrogen emissions can be reduced by changing the ignition timing and using a platinum catalytic converter; see "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," by L. G. Schumacher, D. Fossen, W. Goetz, S. C. Borgelt, and W. G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 65211.

[21] "Cummins 5.9L Biodiesel Fueled Engines," by L. G. Schumacher, W. G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 6521), and J. G. Hrahl (Institute of Biosystems Engineering, Federal Agricultural Research Centre, Braunschweig, Germany D-38116).

Table 14. State and Industry Incentives for Alternative-Fueled Vehicles

State	State Incentives	Industry Incentives
Alabama	The State provides assistance of up to $250,000 per project for conversion of public fleet vehicles.	Natural gas utilities support natural gas vehicles program.
Alaska	The State provides no incentives.	Enstar Natural Gas Company provides assistance for the conversion of natural gas vehicles.
Arizona	The State provides income tax reductions, vehicle license tax reductions, and fuel tax reductions for the purchase and use of AFV's.	Two electric utilities offer rebates for the purchase of electric buses.
Arkansas	The State provides a 50-percent rebate for the conversion costs for AFV's.	Utilities offer incentives.
California	The California Energy Commission offers incentives of $1,000 for certified low-emission vehicles and $1,500 for certified ultra–low-emission vehicles. The State offers an income tax credit equal to 55 percent of incremental or conversion cost of certified low-emission vehicles.	Many utilities offer incentives for the purchase or conversion of AFV's. For example, San Diego Gas & Electric provides 50 percent of the incremental conversion cost or the purchase price of original equipment manufacturers (OEM) natural gas vehicles.
Colorado	The State provides rebates of $1,500- $6,000 per AFV's. The State offers 5- percent tax credit to the owners for the conversion to or the purchase of AFV's.	Most utilities support alternative fuel projects by participating in the State programs.
Connecticut	Corporations are eligible for tax credits for 50 percent of conversion costs to CNG Vehicles, LPG Vehicles, LNG Vehicles, Electric Vehicles, or AFV filling stations. A 10-percent tax credit is available for the incremental cost of natural gas or electric vehicles.	Utilities are actively supporting the use of AFV's. Natural gas utilities offer cash or other incentives for vehicle purchase or conversions on a project-specific basis.
Delaware	The State provides financing for the, conversion or the purchase of AFV's for public fleets.	No incentives are offered.
District of Columbia	The State provides no incentives.	Several utilities offer incentives for AFV's.
Florida	The State provides tax exemption for privately owned electric vehicles. The state offers financing for the conversion to or the purchase of AFV's for public fleets.	Several utilities offer incentives for the conversion to CNG Vehicles.
Georgia	The State offers grants to fund the conversions to or the purchases of AFV's for public fleets.	Atlanta Gas Light Company offers cash rebates for the part of conversion to or the purchase cost of natural gas vehicles.
Hawaii	The State offers income tax deductions for the conversion to or the purchase cost of AFV's and for the installation of AFV refueling stations.	Several utilities offer incentives for AFV's.
Idaho	The State provides no incentives.	Mountain Fuel offer incentives for the conversion to CNG Vehicles.
Illinois	The State offers a rebate of 80 percent of conversion or incremental cost of AFV's, up to $4,000 per vehicle.	Several utilities promote the use of AFV's. People Gas Light & Coke offers $1,500 per vehicle rebate for natural gas vehicle conversions or purchases.
Indiana	The State provides no incentives.	Several utilities offer rebates of up to $1,000 for natural gas vehicle conversions.
Iowa	The State provides financing for AFV conversions for public fleets.	Midwest Gas offers incentives for the conversion to natural gas vehicles.
Kansas	The State offers tax credits to fleets of 10 or more vehicles and grants of up to $1,500 per vehicle for AFV conversions or purchases.	No incentives are offered.
Kentucky	The State provides no incentives.	Several utilities provide incentives for AFV's. Western Kentucky Gas offers its customers a $1,000 rebate for CNGV conversion costs.

Table 14. State and Industry Incentives for Alternative-Fueled Vehicles (Continued)

State	State Incentives	Industry Incentives
Louisiana	The State offers tax credit for 20 percent of the incremental or conversion costs for AFV's or refueling stations. It also offers zero-interest loans for the conversion of public fleets and school buses to AFV's.	Trans Louisiana Gas offers incentives for the conversion to natural gas vehicles on a case-by-case basis.
Maine	The State provides no incentives.	Bay State Gas Company offer incentives for the conversion to natural gas vehicles.
Maryland	The State offers income tax credits for the cost of converting or purchasing AFV's. Refueling or recharging equipment for AFV's are exempt from property tax. Electric vehicles are exempt from motor fuel tax and the conversion costs for clean fuel vehicles are exempt from sales tax.	Several utilities are active in promoting AFV's, and Potomac Electric Power Company has a special rate for off-peak charging of electric vehicles.
Massachusetts	The State provides no incentives.	Several utilities support the use of AFV's and offer various incentives.
Michigan	The State provides no incentives.	Several utilities are providing incentives for AFV's, including $300 and $500 rebates from Consumers Power Company for biofuels and dedicated AFV's.
Minnesota	The State provides no incentives.	Several natural gas utilities offer incentives for the conversion to or purchase of CNG Vehicles, including a $500-$2,000 rebate from Minnegasco, Northern Minnesota Utilities, and Northern States Power.
Mississippi	The State provides no incentives.	Mississippi Valley Gas offers incentives for natural gas vehicles.
Missouri	The State provides no incentives.	Philips 66 offer incentives for the conversion to LPG Vehicles.
Montana	The State provides a 50-percent income tax credit for the conversion costs of AFV's.	Several utilities offer incentives for natural gas vehicles.
Nebraska	The State offers no-cost and low-cost loans for the conversion costs of public fleets, incremental cost factory-equipped AFV's, and installation costs for refueling stations.	Metropolitan Utilities Distribution offers a $500 rebate for the conversions and purchases of original equipment manufacturer CNG Vehicles.
Nevada	The State pays for all but $1,500 per vehicle for the conversion to natural gas of up to two vehicles per private fleet.	No incentives are offered.
New Hampshire	The State has mandates requiring public and private entities to purchase a percentage of inherently low emission vehicles.	Bay State Gas Company offers incentives for the conversion to natural gas vehicles.
New Jersey	The State provides no incentives.	Several utilities are active in supporting AFV programs and offer rebates for purchases and conversion of vehicles.
New Mexico	The State provides grants on a competitive basis for projects, including AFV conversion projects.	Gas Company of New Mexico offer rebates for the purchase of natural gas vehicles.
New York	The State provides several sales tax exemptions for AFV's and funds AFV projects on a case-by-case basis.	Many utilities offer assistance on a case-by-case basis.
North Carolina	The State provides no incentives.	Several utilities support AFV projects on a case-by-case basis.
North Dakota	The State provides a tax credit of $200-$500 per vehicle on conversions to alternate fuels.	Montana-Dakota Utilities Company provides a 10-percent credit on the purchase of natural gas vehicles and incentives on the conversion to natural gas vehicles or LPG Vehicles.

Table 14. State and Industry Incentives for Alternative-Fueled Vehicles (Continued)

State	State Incentives	Industry Incentives
Ohio	The State provides no incentives.	Several utilities support AFV programs. Cincinnati Gas and Electric offers a $600 conversion rebate for CNG Vehicles.
Oklahoma	The State provides income tax credit of up to 50 percent of the cost of AFV conversions and 10 percent of the total OEM AFV cost, up to $1,500. It has a loan fund for conversion of public fleets to AFV's.	No incentives are provided.
Oregon	The State provides a 35-percent tax credit for AFV's and AFV refueling stations.	Natural gas utilities will work with customers to facilitate a tax credit program for natural gas vehicles.
Pennsylvania	The State provides tax and registration fee exemptions for electric vehicles. The alternative fuels incentives grants offer to pay 50 percent of the costs for conversions and purchases of AFV's, and installations of refueling stations for AFV's.	Consolidated Natural Gas Company offers $1,000 for the purchase of OEM AFV's.
Rhode Island	The State provides no incentives.	Providence Gas provides a $1,000 rebate per vehicle for up to two conversions of vehicles to natural gas vehicles.
South Carolina	Legislation is pending for tax incentives for AFV's.	Utilities offer incentives for natural gas vehicles on a case-by-case basis.
South Dakota	The State provides no incentives.	Montana-Dakota Utilities Company offers a 10-percent credit, up to $500 for the purchase of AFV's.
Tennessee	The State provides no incentives.	Utilities provide incentives for natural gas vehicles on a case-by-case basis.
Texas	The State provides low-interest loans for the conversion of public fleets to AFV's.	The City of Austin and Southern Union Gas offer a $2,000 rebate for the purchase or conversion of a natural gas vehicle, and Atmos Energy offers a $500 rebate for the purchase of or conversion to a natural gas vehicle. Entex offers a $2,000 rebate for the conversion to or purchase of a natural gas vehicle.
Utah	The State provides a 20-percent tax credit, up to $500 for each new dedicated AFV registered in Utah, and a 20-percent tax credit, up to $400 for the conversion costs for CNG Vehicles, LPG Vehicles and Electric Vehicles. It offers low-interest loan programs for the purchase of or conversion to AFV's or for the construction of refueling facilities for AFV's.	The Salt Lake City Airport Authority provides incentives to ground transportation providers for the conversion to or purchase of AFV's.
Vermont	Legislation is pending for tax incentives for AFV's.	Vermont Gas Systems provide assistance for the conversion to natural gas vehicles on a case-by-case basis.
Virginia	The State provides a licensing fee exemption and exemption from the high occupancy vehicle lane use restrictions for AFV's. It also provides a 10-percent tax deduction to Federal clean fuel tax, 1.5-percent sales tax reduction for AFV's, and an AFV fuel tax reduction. It offers loans for the conversion of public fleets to AFV's.	Several utilities support AFV programs and offer incentives on a case-by-case basis.
Washington	The State provides no incentives.	Washington Natural Gas offers support for the conversion to natural gas vehicles.
West Virginia	The State provides grants, up to $1,000, for the conversion of public fleets to AFV's.	Several utilities provide assistance with natural gas vehicle conversions. Virginia Power offers a special rate for recharging Electric Vehicles.

Table 14. State and Industry Incentives for Alternative-Fueled Vehicles (Continued)

State	State Incentives	Industry Incentives
Wisconsin	The State offers municipalities the competitive cost-sharing grants for the added costs of AFV's. The maximum grant is $2,500 per auto and $10,000 per truck. Each municipality is limited to $50,000.	Several utilities are active in promoting natural gas vehicles. Wisconsin Gas, Wisconsin Natural Gas, and Madison Gas & Electric offer cash rebates for the purchase of or conversion to natural gas vehicles.
Wyoming	The State provides no incentives.	Montana-Dakota Utilities Company provides a 10-percent credit, up to $500, on the incremental cost of purchasing the natural gas option on an OEM vehicle.

Sources: *Clean Cities: Guide to Alternative Fuel Vehicle Incentives and Laws*, U.S. Department of Energy, November 1995; *The Clean Fuels and Electric Vehicles Report*, J.E. Sinor Consultants, Inc., Vol. 8, No. 2, April 1996.

LSD.[22] Engine maintenance appears to be about the same for the two fuels.[23] Vehicle range is likely to be slightly less, owing both to biodiesel's slightly lower fuel economy and lower heating value (approximately 17,500 Btu/lb[24] versus 19,600 Btu/lb for conventional diesel).

In terms of safety, biodiesel has superior safety characteristics compared to conventional diesel (already a safe fuel compared to gasoline). Biodiesel's flash point is about 350 degrees Fahrenheit, versus 176 degrees for conventional diesel.[25] In addition, biodiesel is less toxic to mammals than conventional diesel.

Biodiesel requires some special handling in cold weather. Whereas the pour point for conventional diesel is about -18 degrees Fahrenheit, biodiesel's pour point ranges between roughly -5 and 20 degrees, depending upon the oil and alcohol used.[26] This problem can be overcome by using a combination of recycled (and hotter) fuel and fuel preheaters.

Feasibility

While biodiesel's performance appears to be highly desirable, economics is another matter. Biodiesel costs between four and six times the price of LSD, depending upon crop prices. Thus, even a 20-percent blend of biodiesel is considerably more expensive than LSD. Recently, a life-cycle cost study of transit buses concluded that if neat biodiesel cost $3.00 per gallon, the total operating cost of transit buses fueled with B20 would be 32-percent higher than if LSD were used.[27] This price difference reinforces the view that its primary application will be in niche markets.

Availability is another reason most efforts to introduce biodiesel are targeted to niche markets. Current bio-oil (soybean, corn, cottonseed, peanut, sunflower, canola, and rendered tallow) production, even if dedicated to fuel production entirely, would fall far short of satisfying total diesel fuel demand. With U.S. diesel fuel consumption in

[22] "Cummins 5.9L Biodiesel Fueled Engines," by L. G. Schumacher, W. G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 6521), and J. G. Hrahl (Institute of Biosystems Engineering, Federal Agricultural Research Centre, Braunschweig, Germany D-38116). C. L. Peterson and D. Reece, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83844-2040, Internet address: //http.www.uidaho.edu.bae.biodiesel/biodie.html, as of July 1, 1996.

[23] "Maintenance, Repair, Engine Exhaust Emissions Associated with Biodiesel Fueling of Urban Buses," by L. G. Schumacher and M. G. Russell, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 65211.

[24] C. L. Peterson and D. Reece, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83844-2040, Internet address: //http.www.uidaho.edu.bae.biodiesel/biodie.html, as of July 1, 1996.

[25] C. L. Peterson and D. Reece, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83844-2040, Internet address: //http.www.uidaho.edu.bae.biodiesel/biodie.html, as of July 1, 1996.

[26] Ibid, and "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," by L.G. Schumacher, D. Fossen, W. Goetz, S. C. Borgelt, and W. G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 65211.

[27] "The Economics of Engine Replacement/Repair for Biodiesel Fuels," prepared for the U.S. Department of Agriculture, Office of Technology, by N.B.C. Ahouissoussi and M.E. Wetzstein, University of Georgia, Department of Agricultural and Applied Economics, March 1995.

Table 15. State Taxes on Alternative and Traditional Transportation Fuels
(Dollars per Gas-Equivalent Gallon)

State	Gasoline	Diesel	Gasohol	CNG	LPG	Methanol	Ethanol
Alabama[a,b]	0.18	0.19	0.18	0.18	0.18	0.18	0.18
Alaska	0.08	0.08	0	0.08	0.08	0.08	0.08
Arizona	0.185	0.185	0.185	0.01	0.185	0.185	0.185
Arkansas	0.185	0.185	0.185	0.01	0.165	0.185	0.185
California[a]	0.18	0.18	0.18	0.07	0.06	0.09	0.09
Colorado	0.22	0.22	0.22	0.205	0.205	0.22	0.22
Connecticut[c]	0.37	0.18	0.36	0.37	0.37	0.37	0.37
Delaware	0.23	0.22	0.19	0.19	0.19	0.19	0.19
District of Columbia	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Florida[d,a,e]	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Georgia[e]	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Hawaii[f]	0.248	0.248	0.248	0.248	0.17	0.248	0.248
Idaho	0.21	0.21	0.21	0.165	0.152	0.21	0.21
Illinois[d,g,h]	0.19	0.215	0.19	0.19	0.19	0.19	0.19
Indiana	0.15	0.16	0.16	0.16	0.16	0.15	0.16
Iowa	0.2	0.225	0.19	0.16	0.2	0.19	0.19
Kansas	0.18	0.2	0.18	0.17	0.17	0.2	0.2
Kentucky[d,i]	0.15	0.15	0.15	0.12	0.15	0.15	0.15
Louisiana[b]	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Maine	0.19	0.2	0.18	0.18	0.18	0.18	0.18
Maryland	0.235	0.2425	0.235	0.235	0.235	0.235	0.235
Massachusetts[d]	0.21	0.21	0.21	0.21	0.081	0.21	0.21
Michigan	0.15	0.15	0.15	0.15	0.15	0.15	0.166
Minnesota	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Mississippi[j]	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Missouri[k,a]	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Montana[a,b]	0.27	0.2775	0.27	0.2775	0.2775	0.2775	0.2775
Nebraska[d]	0.257	0.257	0.257	0.257	0.257	0.257	0.257
Nevada[a]	0.23	0.27	0.23	0.23	0.23	0.23	0.23
New Hampshire	0.18	0.18	0.18	0.18	0.18	0.18	0.18
New Jersey[l]	0.105	0.135	0.105	0.0525	0.0525	0.105	0.105
New Mexico[a,m]	0.17	0.18	0.18	0.18	0.18	0.18	0.18
New York[a,n]	0.08	0.08	0.08	0.08	0.08	0.08	0.08
North Carolina[d]	0.22	0.22	0.22	0.22	0.22	0.22	0.22
North Dakota[o]	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Ohio[p]	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Oklahoma[b]	0.17	0.14	0.17	0.17	0.17	0.17	0.17
Oregon	0.24	0.24	0.19	0.24	0.24	0.24	0.19
Pennsylvania	0.224	0.224	0.224	0.224	0.224	0.224	0.224
Rhode Island[d]	0.28	0.28	0.28	0.28	0.28	0.28	0.28
South Carolina	0.16	0.16	0.1	0.16	0.16	0.16	0.1
South Dakota[a]	0.18	0.18	0.16	0.06	0.16	0.06	0.06
Tennessee[a]	0.214	0.184	0.18	0.14	0.14	0.18	0.18
Texas	0.2	0.2	0.2	0.15	0.15	0.2	0.2
Utah	0.195	0.195	0.195	0.03	0.03	0.03	0.03
Vermont[q]	0.16	0.17	0.16	0.16	0.16	0.16	0.16
Virginia	0.175	0.16	0.175	0.16	0.16	0.16	0.16
Washington	0.23	0.23	0	0.23	0.23	0	0

See notes at end of table.

Table 15. State Taxes on Alternative and Traditional Transportation Fuels (Continued)

State	Gasoline	Diesel	Gasohol	CNG	LPG	Methanol	Ethanol
West Virginia[e,r]	0.2535	0.2535	0.2535	0.2535	0.2535	0.2535	0.2535
Wisconsin[d]	0.234	0.234	0.234	0.234	0.234	0.234	0.234
Wyoming	0.09	0.09	0.09	0.09	0.09	0.09	0.09

[a]Local taxes may be imposed.

[b]Flat annual fee for CNG or LPG fueled vehicles; In Louisiana, $187 for motor vehicles and $93.50 for school buses; in Montana, fee ranges from $108 for passenger cars to $1,806 for trucks 48,000 pounds or more; in Oklahoma, fee ranges from $50-$100 for motor vehicles; in Alabama, fees range from $75 for light trucks to $175 for tractors.

[c]Gasoline tax schedule in Connecticut: 38 cents effective 10-1-96; 39 cents effective 1-1-97.

[d]Rate set periodically by tax officials; indexed in Florida; 9 percent of wholesale price in Kentucky; 19.1 percent of sales price in Massachusetts, 21 cents minimum; includes 7 percent of wholesale price in North Carolina, add 0.25-cent inspection fee; 13 percent of wholesale price in Rhode Island, 26 cents minimum; rate set by Wisconsin Department of Revenue.

[e] Includes sales tax at 6 percent of average retail price as set by Florida Department of Revenue, but not lower than 6.9 cents per gallon; includes total 4 percent tax (1 percent sales tax and 3 percent gasoline tax) on retail sales price in Georgia; includes sales tax at 5 percent of minimum average wholesale price as set Department of Tax and Revenue in West Virginia.

[f]Gasoline and diesel fuel taxes are 24.8 cents in Hawaii city, 32.5 cents in Honolulu city, 26 cents in Kauai city, and 29 cents in Maui city.

[g]Added taxes in Cook County, Illinois.

[h]In Illinois, 24.8 cents per gallon of gasoline for commercial motor vehicles on in-state highways.

[i]Heavy equipment motor carriers, 17.2 cents; more than 59,999 pounds, 19.2 cents; special fuels, 12 cents.

[j]In Mississippi, 14.4 cents per gallon of gasoline, when funding requirements are met.

[k]11 cents gasoline tax in Missouri effective 4-1-2008.

[l]Add 4 cents per gallon of petroleum products gross receipts tax in New Jersey.

[m]In New Mexico, 16 cents per gallon of gasoline effective as of 7-1-2003 or earlier.

[n]Motor carriers—composite rate (fuel tax plus sales tax): motor fuel, 15.8 cents; diesel, 16.2 cents; Aggregate rate (fuel tax plus sales tax plus petroleum business tax): motor fuel, 30.21 cents; diesel, 30.61 cents.

[o]17 cents per gallon of gasoline effective as of 1-1-98 in North Dakota.

[p]Commercial motor vehicles, 25 cents per gallon of gasoline in Ohio. In Ohio, State taxes are 15 cents per gallon for commercial motor vehicles.

[q]In Vermont, 15 cents per gallon of gasoline will be effective as of 4-1-2001.

[r]In West Virginia, 20.35 cents per gallon of gasoline will be effective as of 8-1-2001.

Sources: *Clean Cities: Guide to Alternative Fuel Vehicle Incentives and Laws*, U.S. Department of Energy, November 1995; *The Clean Fuels and Electric Vehicles Report*, J.E. Sinor Consultants, Inc., Vol. 8, No. 2, April 1996; *Statistical Abstract of the United States, 1995: The National Data Book*, U.S. Department of Commerce, 115th ed., p. 630; *State and Local Taxes: All States Tax Guide*, Vol. I and II (New York, NY: Research Institute of America, 1996), available on the Internet at: http:\\www.riatax.com.

the transportation[28] and off-highway[29] sectors amounting to 32 billion gallons in 1994,[30] U.S. production of bio-oils at 19.5 billion pounds during the 1994/1995 growing season[31] is equivalent to only 2.8 billion gallons of fuel.

Biodiesel Markets

Examples of niche markets being considered are urban mass transit buses, school buses, agricultural machinery, source, diverting 10 percent of all U.S. cropland dedicated to raising oil-bearing products could supply the entire agricultural demand for diesel fuel.[32] In addition, if transit buses complying with the 1998 guidelines imposed by the CAAA90 used a 20-percent blend of biodiesel, 65 million gallons of soy-based biodiesel[33] would be used each year, or roughly 2 percent of total U.S. diesel demand. This amount is equivalent to the oil from 43 million bushels of U.S. soybeans. (Other oils, of course, could also be used.) School bus fleets in 22 "consolidated metropolitan areas," are also subject to the CAAA90 deadline in 1998. Because

[28] The transportation sector includes on-highway, railroad, and vessel bunkering uses.

[29] The off-highway sector includes construction equipment and other uses, such as logging equipment.

[30] Energy Information Administration, Form EIA-821, "Annual Fuel Oil and Kerosene Sales Report," combined with Federal Highway Administration statistics of highway special fuels use to estimate on-highway diesel.

[31] U.S. Dept of Agriculture, Economic Research Service, Office of Energy and New Uses.

[32] C.L. Peterson and D. Reece, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83844-2040, Internet address: //http.www.uidaho.edu.bae.biodiesel/biodie.html, as of July 1, 1996.

[33] *Illinois Soybean Association*, Internet address http://www.ag.uiuc.edu/~il-qssh/talking.html.

Table 16. Comparison of Conventional Diesel and Biodiesel

Source	Soybeans[a]	Rapeseed[b]	No. 2 Diesel
Heat of Combustion (Btu/lb.)	17,650	17,500	19,600
Flash point (°F)	355	365	176
Pour point (°F)	20	-5	-18
Cloud point (°F)	24	30	7
Viscosity (centistokes @ 104° F)	4.06	6.10	3.51
Sulfur (percent by weight)	0.01	0.0008	0.36

[a]Analysis performed by Cleveland Technical Center, North Kansas City, Missouri.

[b]Analysis of biodiesel samples produced from rapeseed and ethanol (known as rape ethyl ester) by Phoenix Chemical Lab, Inc., Chicago, Illinois; analyses by Analytical Lab Services and Agricultural Engineering Analytical Lab, Moscow, Idaho.

Sources: **Soybean-based diesel:** "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," by L.G. Schumacher, D. Fossen, W. Goetz, S.C. Borgelt, and W.G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, MO 65211; **Rapeseed-based diesel:** C.L. Peterson and Daryl Reece, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83844-2040, Internet address //http.www.uidaho.edu.bae.biodiesel/biodie.html, as of July 1, 1996; **Diesel** (except Heat of Combustion): "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," by L.G. Schumacher, D. Fossen, W. Goetz, S.C. Borgelt, and W.G. Hires, University of Missouri, Agricultural Engineering Department, Room 235, Columbia, Missouri 65211; **Diesel** (Heat of Combustion): Energy Information Administration, *Annual Energy Review 1995*, DOE/EIA-0384(95) (Washington, DC 20585). Value shown represents conversion from original units of million Btus/barrel, based upon heating value for distillate fuel oil. The actual diesel fuel sample used in the comparative study, "6V-92TA DDC Engine Exhaust Emission Tests Using Methyl Ester Soybean Oil/Diesel Fuel Blends," had a heating value of 19,652 Btu/lb.

those buses consume about 180 million gallons of fuel per year, they represent a large potential for biodiesel.

Another factor that could nudge bio-oils into the fuel market is the health concern regarding many animal and vegetable oils. Biodiesel from these resources could offer a high-value alternative market for U.S. oil seed and tallow producers in the future.

Fuel Cells[34]

The Department of Energy is pursuing fuel cells for transportation applications because they offer the potential to triple the fuel economy of today's vehicles and significantly reduce emissions.

What Are Fuel Cells?

Fuel cells are devices that change chemical energy directly into electrical energy; no combustion is involved. Fuel cells are an efficient, inherently clean option for generating electricity and can be fabricated in a wide range of sizes without sacrificing either efficiency or environmental performance.

How Do Fuel Cells Work?

Fuel cells are simple electrochemical devices with no moving parts that generate electricity by harnessing the reaction of hydrogen and oxygen to make water.

Any hydrogen-rich material can serve as a possible fuel source of hydrogen. These materials include fuels such as natural gas, petroleum distillates, liquid propane, methanol, and gasified coal. For substances other than hydrogen, a fuel processor is required in a fuel cell system.

Unlike batteries or other storage devices, a fuel cell operates as long as fuel is supplied to it in the presence of air. Fuel cells are virtually pollution free and operate very efficiently.

Hydrogen can be made from solar or wind energy. A fuel cell operating from renewable hydrogen has literally zero greenhouse gas emissions and would not generate carbon dioxide emissions.

What Are the Types of Fuel Cells?

Fuel cells are often categorized by the electrolyte used. An electrolyte is defined as a substance that when disolved in

[34] Source: U.S. Department of Energy, Office of Propulsion Systems, Fuel Cell Systems Research and Development.

a specified solvent (usually water), produces an ionically conducting solution. Five major classes of fuel cells are generally considered to be mainstream of the technology:

Alkaline Fuel Cells. Used by the U.S. space program and incorporated into most of the manned space missions, alkaline fuel cells are reliable and offer high power outputs in relatively small sizes. Unfortunately, their potassium hydroxide electrolytes react with even minute traces of carbon dioxide and eventually render the cell useless. Extensive cleaning to remove residual carbon dioxide from the air and fuel is required.

Phosphoric Acid Fuel Cells (PAFC). PAFC's are the most technologically mature of the terrestrial fuel cells. The electrolyte tolerates carbon dioxide. The operating temperatures are above 400 degrees Fahrenheit and overall fuel-to-electricity efficiencies are about 40 percent (with cogeneration efficiencies approaching 85 percent). They are commercially available in sizes that range from a 24-volt, 250-watt portable unit for small appliances, to on-site power generators supplying up to 200 kilowatts of electricity, to a central station power plant in Tokyo that produces 11 megawatts of electricity. Phosphoric acid fuel cells, which are well suited for buildings and heavy-duty transportation applications, are used in the DOE Urban Transit Bus Program.

Proton Exchange Membrane (PEM) Fuel Cells. Also known as polymer electrolyte fuel cells, PEM cells operate at relatively low temperatures (175-200 degrees Fahrenheit), have high power density, meet shifts in power demand quickly, and are suited for applications where quick start-up is required. They are primary candidates for buildings and light-duty vehicles, and are potentially suited for much smaller applications.

Molten Carbonate Fuel Cells (MCFC). MCFC's use a lithium and potassium electrolyte, operate at about 1200 degrees Fahrenheit, and have efficiencies of 60 percent when generating electricity and 80 percent or more when cogenerating usable heat. This type of fuel cell is appropriate for electric utility applications. Capital costs are expected to be lower than those of phosphoric acid fuel cells. The first full-scale stacks have been tested, and demonstration units have begun operation in a California municipal utility and in a hospital.

Solid Oxide Fuel Cells (SOFC). Still in the research and development (R&D) stages, SOFC's use a hard ceramic material instead of a liquid electrolyte, allowing temperatures to approach 1800 degrees Fahrenheit. Efficiencies are projected to be 60 percent. These fuel cells can be configured in tubular, planar, or honeycomb structures. Their potential for internal fuel processing, high power density, and low cost makes them candidates for transportation applications.

Fuel Cells Differ From Internal Combustion Engines (ICE)

Fuel cells are unlike ICEs, turbines, and other heat engines in three fundamental ways:

1. Fuel cells produce power without chemical combustion, and thus are inherently cleaner than heat engines could ever be.

2. Fuel cells are not subject to the same fundamental laws of thermodynamics that limit the maximum efficiency of turbines and ICEs. Fuel cell efficiency is twice as high as current heat engine efficiencies.

3. Fuel cells have no moving parts, and therefore, are more quiet, have greater reliability, and require less maintenance than the high-speed rotating or reciprocating parts of ICEs and turbines.

Development Needs for Fuel Cells in Transportation

The constraints in using fuel cells in transportation applications are considerably different and more demanding than for those used in stationary applications. The volume and weight of current fuel cell designs preclude their use in many applications, particularly light-duty vehicles. Thus, the power density of fuel cells (power output per unit volume or weight) needs improvement. To achieve this result, fuel cell systems designed for use in vehicles need development in the areas of the fuel processor, the fuel cell stack, and the integration of the balance-of-plant components into a complete system.

DOE's Role in Developing Fuel Cells for Transportation

The fuel cells for transportation program began in fiscal year 1987 with development of three prototype PAFC buses. In 1990, development of PEM fuel cell technology began because it offers higher power density than most other fuel cell technologies. This ongoing light-duty vehicle program is based on the onboard reforming of methanol.[35] In 1994, a parallel effort was initiated to develop the PEM fuel cell system with onboard hydrogen storage. Using their own vehicle design, data, and analysis methods, the three major U.S. automakers are each pursuing different technical approaches under cost-shared research projects with DOE. In the last 5 years, significant accomplishments in the fuel cell stack have been made in increasing power density and decreasing platinum loadings and costs. DOE has also developed multifuel reforming technology that will enable the use of existing petroleum-based fuels as well as alternative fuels (like methanol, ethanol, and natural gas). The current DOE program emphasizes development of advanced PEM fuel cell stacks, fuel processors, and other system components, as well as core research in electrodes, membranes, and catalysts. Government and industry have agreed to form an alliance between the domestic automakers, fuel cell suppliers, national laboratories, and universities to conduct the necessary precompetitive Research and Development in a cooperative manner.

Alternative Fuel Refueling Sites

Increasing the availability and convenience of alternative fuel refueling facilities is a key element in the expansion of alternative fuel use. Table 17 shows the distribution of refueling sites across the United States.

Data on the locations of refueling sites for CNG, M85, E85, and LPG, including detailed information about the sites, are maintained by the Alternative Fuels Data Center. Information and maps are available on the World Wide Web at http://www.afdc.doe.gov. For additional refueling site information, contact the National Alternative Fuels Hotline at 1-800-423-1DOE.

[35] Pure hydrogen can be stored in the vehicle for use in fuel cells, or hydrogen can be produced by reforming a simple hydrocarbon fuel stored in the vehicle.

Table 17. Alternative Fuel Refueling Sites by State and Fuel Type

State	Methanol (M85)	Compressed Natural Gas (CNG)	Ethanol (E85)	Liquefied Petroleum Gas (LPG)	Electricity	Liquefied Natural Gas (LNG)	Total
Alabama		17		85			102
Alaska				8			8
Arizona	1	21		45			67
Arkansas		8		104			112
California	58	140		214	34		446
Colorado	2	43		48			93
Connecticut		11		19			30
Delaware		6		6			12
Dist. of Columbia	1	8	1				10
Florida	3	55		222			280
Georgia	0	62		80			142
Idaho		7		20			27
Illinois	2	25	10	163			200
Indiana		39	1	124			164
Iowa		5	6	108			119
Kansas		19	2	38			59
Kentucky		9		35			44
Louisiana		17		44		1	62
Maine				12			12
Maryland	2	28		21		1	52
Massachusetts		17		41			58
Michigan	2	36	1	182			221
Minnesota		17	5	125			147
Mississippi				75			75
Missouri		11	1	83			95
Montana		11		48			59
Nebraska		10	5	47			62
Nevada		10		20			30
New Hampshire		1		31			32
New Jersey		24		36			60
New Mexico		19		46			65
New York	7	55		100			162
North Carolina		10		72			82
North Dakota		5		17			22
Ohio	2	65		98			165
Oklahoma		48		56			104
Oregon		9		21			30
Pennsylvania	1	52		133			186
Rhode Island		4		5			9
South Carolina		3		43			46
South Dakota		5	7	24			36
Tennessee	2	6		80			88
Texas		87		202			289
Utah		63		20			83
Vermont		1		33			34
Virginia		31		39			70
Washington	2	30		37			69
West Virginia	1	42		16			59
Wisconsin		27	2	139			168
Wyoming		20		33			53
Total	**86**	**1,239**	**41**	**3,298**	**34**	**2**	**4,700**

Source: National Renewable Energy Laboratory, Alternative Fuels Data Center Database (Extracted October 17, 1996).

Appendix A

Estimation Methods and Data Quality

Appendix A

Estimation Methods and Data Quality

Estimation methods and data quality issues for alternative-fueled vehicle (AFV) inventories (Chapter 2) and alternative and replacement fuel consumption (Chapter 3) are presented in this appendix. For the most part, data for 1992 through 1994 are from *Alternatives to Traditional Transportation Fuels 1993* and *Alternatives to Traditional Transportation Fuels 1994–Volume 1.* Any revisions to those data are explained below. No substantial changes in methodology have been introduced in *Alternatives to Traditional Transportation Fuels 1995,* which focuses on historical data for 1995 and projected or planned data for 1997.

Alternative-Fueled-Vehicle Inventory

The methods employed to estimate the number of AFV's in use (AFV inventories) vary by vehicle ownership category (Federal Government, State and local government, and private) and by fuel type.

Federal

The number of Federal AFV's in use in 1995 and 1996 was estimated from vehicle acquisition data compiled by the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy. Those data were based on Federal agency counts of AFV's purchased or converted and AFV's planned to be purchased or converted. The acquisition data were adjusted to account for retirements of AFV's. Estimates of retirements were based on information from the U.S. General Services Administration (GSA). The geographic and weight class distributions of Federal AFV's were obtained separately through contacts with the Federal agencies that operate AFV's.

Federal AFV inventory estimates for 1997 were based on estimated acquisitions needed to meet the requirements of the Energy Policy Act of 1992 (EPACT), which calls for one-third of the Federal light-duty vehicles purchased in fiscal year 1997 to be AFV's. Light-duty vehicle purchases were projected by GSA.

In a few cases, the estimated number of Federal AFV's in use prior to 1995 were revised. The revision was made because new information was obtained about the years in which vehicles were acquired. The revision primarily affected electric vehicle counts.

State and Local Government Fleets and Privately Owned AFV's

Liquefied Petroleum Gas (LPG) Vehicles. The U.S. total of LPG vehicles in use is estimated from State-level data. The motor vehicle departments or fuel tax offices of all 50 States were contacted for data on LPG vehicles or on all AFV's. Sixteen States reported data on AFV's or LPG vehicles that were deemed reasonably accurate.[36] If States reported total AFV's only, LPG vehicles were estimated by subtracting estimated vehicle counts for compressed natural gas vehicles, alcohol-fueled vehicles and electric vehicles from the total AFV counts. For the 34 States without reasonably accurate data, the numbers of LPG vehicles in use were imputed. To impute the vehicle counts, an estimate of average fuel consumption (gallons of LPG per vehicle) was calculated for the 16 enumerable States using estimates of LPG consumption in onroad transportation engines, as reported in the *State Energy Data Report 1994.*[37] A State's total LPG consumption was then divided by the implied average consumption per vehicle to estimate the minimum number of LPG vehicles

[36] These States are Alabama, Arkansas, Colorado, Iowa, Kentucky, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Mexico, Oklahoma, Texas, Vermont, and Washington.

[37] Energy Information Administration, State Energy Data Report 1994, DOE/EIA-0214(94)(Washington, DC, July 1996).

in the State.[38] The national LPG vehicle inventory is therefore the aggregation of reasonably accurate vehicle counts in 16 States and imputed minimum vehicle counts in 34 States.

As indicated above, reasonably accurate government or private sources of data on the number of onroad LPG vehicles exists for about one-third of the States. The most accurate estimates are from States that combine a mandatory fuel use decal program with a rigorously enforced annual inspection and registration program. A comprehensive review of the 50 States and the District of Columbia suggests that no more than 4 States (dropping to 3 States starting in mid-1995) are in this category. Even in these four States, adjustments are necessary for non-LPG alternative fueled vehicles, especially natural-gas-fueled vehicles.

An additional 10 states have either a decal program that is nominally optional but effectively preferable to paying fuel taxes at the pump or a mandatory decal program but lax or nonexistent annual vehicle inspections. Reasonable estimates of the minimum number of vehicles are available in these 10 States. However, many of these States acknowledge that underreporting and misreporting is common among vehicles converted to LPG, and fuel use identification for vehicle registration (either new or converted) is routinely ignored by end-users and State governments.

Two other States have credible estimates of vehicle counts based on data from the State propane gas association, the State department of transportation, or some combination of sources.

It is worth noting that the States for which credible vehicle counts can be estimated change from year to year because several States during the past few years have either introduced or discontinued decal programs or annual inspection and registration requirements.

It is also important to note that the quality of data on LPG usage as an onroad engine fuel varies from State to State. States with pump-based fuel taxes tend to have more accurate estimates than States with decals in lieu of pump-based taxes. On the other hand, States with lax or nonexistent annual inspection programs tend to have more misreporting of fuel use regardless of decals or pump-based taxes. The implied usage of fuel per vehicle per year varies widely (by more than a factor of 5) from State to State. Other data on sales of tanks for use in road vehicles confirm the inconsistencies (on average) for reported fuel usage and vehicle counts.

Data limitations also create uncertainty in identifying the weight and ownership classifications of vehicles. Only a few States can supply unambiguous decal counts by weight class. No two States use the same definition of weight classes. For the States with detailed vehicle counts by weight class, the percentage represented by heavy-duty vehicles varies by at least a factor of three. States with a strong LPG vehicle infrastructure have much higher percentages of light-duty vehicles than those where LPG is used mostly for non-vehicular applications. Similar variations exist for the ownership by State and local governments and private entities. The estimated fractions used in this report (20-percent heavy-duty and 20-percent State and local) are approximate figures drawn from a limited sample of widely divergent State inputs. The ownership percentages, however, are believed to more accurately reflect the distributions than percentages estimated in previous years. For that reason, data for 1992 to 1994 have been revised with this report.

Although very careful enumeration and imputation generates a fleet count of roughly 259,000 in 1995, the actual count could be as high as 300,000 to 350,000. The known data limitations, the inconsistencies between tank sales and decal sales, and the widespread acknowledgment of misreporting and underreporting of vehicles and fuels imply that the values reported in this document are minimum values.

Compressed Natural Gas (CNG) Vehicles. Estimates of the number of CNG vehicles in use as of the end of 1995 and expected to be in use in 1996 and 1997 were derived from a private, independent survey of natural gas suppliers and owners of CNG refueling stations conducted in 1996. This survey updates similar surveys conducted in 1993, 1994, and 1995. Respondents reported the number of vehicles served in their service areas (by vehicle type and ownership) as of the end of the calendar year. Data were collected by ownership class, including utility, private, and government (State-owned, local government-owned, and federally owned).

Overall, the quality of CNG vehicle data is slightly lower than in past years. The 1996 survey had a response rate of about 92 percent compared to almost 100 percent in 1995. Several of the largest fuel suppliers either did not report data or reported the data in a manner that required

[38] The estimated average LPG consumption per vehicle per year is significantly higher than average fuel consumption for gasoline vehicles. A higher percentage of LPG vehicles are heavy-duty vehicles. Undercounting of LPG vehicles may also be responsible for the difference.

imputation of a part of the data. In most cases, imputations were based on previous year's responses. There were also some inconsistencies in reporting caused by differences in recordkeeping among the respondents. Variability within the industry has increased dramatically over the past year due to a number of factors, and most of the growth in CNG vehicle use now appears to be occurring at the utilities with the largest fleets. A fair number of utilities were sufficiently uncertain of their near-term outlook that they omitted forecasts.

Liquefied Natural Gas (LNG) Vehicles. Estimates of the number of LNG vehicles are based on reported or planned purchases of LNG transit buses and other vehicles. Data were obtained from fuel suppliers, transit bus fleets, and other fleet operators. Fleet operators were identified from industry literature and other contacts.

The LNG-fueled vehicle data are reasonably accurate; ownership is concentrated at transit bus companies and a few truck operations, so data collection consists primarily of identifying all LNG users. The local natural gas companies are not sufficient sources for LNG information because they do not necessarily supply the LNG. The numbers reported are believed accurate with a margin of error between 3 percent and 5 percent.

Alcohol-fueled Vehicles. Vehicle counts for each State were obtained from State energy offices (or their equivalents) and, to a lesser extent, transportation departments, corn growers associations (ethanol only), fuel supply companies, vehicle demonstration programs, and manufacturers and converters of vehicles and engines.

Because almost all methanol vehicles are operated in California, an accurate enumeration in that State would virtually ensure an accurate national count. California methanol vehicle counts were obtained principally from the California Energy Commission (CEC). Starting in 1995, CEC data are based on vehicle sales by model year. It is unclear how the CEC adjusts these data for retirements and reconversions. The CEC counts were adjusted to account for the phase-out of M100 buses by the Los Angeles County Metropolitan Transit Authority. Counts of methanol-fueled vehicles for all other States are considered fairly accurate because they are based on State-by-State enumerations of relatively small vehicle fleets.

Ethanol-fueled vehicle data are reliable. The national total is based on an enumeration from individual State government agencies, corn growers associations, fuel suppliers, and, to a lesser extent, vehicle manufacturers. The number and size of ethanol-fueled vehicle fleets are small. Therefore, vehicles can be easily tracked by State offices and private associations.

Electricity. Data from States with appreciable numbers of electric vehicles were collected from telephone contacts with State energy, transportation, or conservation offices; national electric vehicle associations (the Electric Automobile Association's State and local chapters and the Electric Transit Vehicle Institute); and electric utilities. Original equipment manufacturers and converters were also contacted. Independent surveys by the Electric Vehicle Association of the Americas and the Electric Transit Vehicle Institute, were the principal sources used to disaggregate total vehicle counts by vehicle type.

Some degree of uncertainty is associated with the electric vehicle data. Uncertainty is caused by differences in the definitions of an onroad electric vehicle, by the relatively large percentage of electric vehicles that do not operate the same way as conventional vehicles, and by possible incentives for vehicle associations to inflate estimates. Some of this uncertainty has been removed by slightly restricting the definition of electric vehicles. For example, prototypes, large golf carts, school-based kit vehicles, unconfirmed hobbyist vehicles, and nonhighway vehicles were excluded from the electric vehicle definition. Electric vehicle counts for 1992 to 1994 have been revised to reflect these definitional changes.

Alternative Fuel Consumption

Alternative fuel consumption was calculated using the following four basic inputs:

1. *Alternative-Fueled Vehicle Inventories*: By vehicle fuel (e.g., M85, M100, E85), ownership (i.e., private, State and local government, Federal Government), and classification (e.g., autos, light-duty trucks, heavy-duty trucks, school buses, and transit buses).

2. *Conventional Vehicle Miles Traveled (VMT)*: In miles per year, by vehicle ownership and classification.

3. *Miles-per-Gallon (MPG) on Conventional Fuel*: For gasoline or diesel, by vehicle classification.

4. *Thousands of Btu (kBtu) per Native Unit of Fuel*: By neat (i.e., pure) replacement fuel. The native units used are gallons (M85, M100, E85, E95, LPG, and LNG), therms (CNG), and kWh (electricity).

The following is a description of the seven-step approach to estimate total annual fuel consumption.

1. Alternative-Fueled Vehicles Categorization

Alternative-fueled vehicles in a given year were categorized according to vehicle classification (auto, light-duty truck, heavy-duty truck, school bus, and transit bus); fuel (M85, M100, E85, E95, LPG, CNG, LNG, and electricity); and ownership (privately owned and government owned).

2. Vehicle Miles Traveled (VMT) by Alternative-Fueled Vehicle Classification and Fleet Type

The annual VMT values known from conventional fleets were assigned to each vehicle classification. Light-duty vehicles were segmented further into three broad fleet types: rental and service vehicles, private passenger and car pool vehicles, and government pool vehicles. Heavy-duty trucks as defined by EPACT were segmented into medium- and heavy-duty categories. The conventional fleet characteristics used in the estimation process are listed in Table A1.

3. Adjustments to Alternative-Fueled Vehicle Annual Vehicle Miles Traveled

The annual VMT values of conventional vehicles shown in Table A1 were revised downward to reflect the less intensive use of AFV's when compared to conventional vehicles. Average VMT is lower for AFV's than for conventional vehicles due to differences in vehicle classification and issues of choice. Conventional light-duty fleet vehicles are typically rental cars and high-usage service vehicles, whereas AFV light-duty fleet vehicles are typically government pool vehicles and relatively low-usage service vehicles. Factors that reduce AFV utilization relative to conventional vehicles include the following:

- More frequent refueling because of lower heat content of alternative fuels
- Range restrictions because of limited fuel availability
- Higher maintenance needs and increased incidence of mechanical failures
- Operator perceptions (when choice is available, fleet and vehicle operators may drive conventional vehicles more often than AFV's because of their perceptions of safety, cost, environmental impact, vehicle performance, and refueling ease, regardless of whether these perceptions are correct).

4. Alternative Fuel Consumption Adjustments

As defined in EPACT, alternative transportation fuels (ATF's) may be in either a neat form (e.g., pure CNG, LNG, LPG, M100, or electricity), or in a blend (e.g., M85, E85, E95). In the latter case, consumption of ATF's includes both the replacement (i.e., alcohol) and conventional fuel components.

For several AFV types, the effective total fuel cycle of ATF consumption per mile of travel is higher than commonly thought. Consumption of ATF's is almost always estimated by assuming that Btu-equivalent amounts of

Table A1. Typical Conventional Vehicle Characteristics

Vehicle Classification/Fleet Type	Vehicle Weight (pounds)	Annual Vehicle Miles Traveled	Miles per Gallon
Automobile/Private Rental and Service	0-8,500	24,600	24
Automobile/Passenger Vehicles and Car Pools	0-8,500	12,000	24
Automobile/Government Pool	0-8,500	8,000	24
Light-Duty Truck	0-8,500	16,400	16
Medium-Duty Truck	8,501-14,000	16,400	8
Heavy-Duty Truck	14,001-26,000	16,400	6
School Bus	All	8,000	8
Transit Bus	All	33,200	4

Source: Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (McLean, VA, July 1996).

ATF and traditional fuel produce the same VMT.[39] This assumption is not strictly accurate because of venting of fuel vapor during refueling and maintenance, leakage of gaseous fuels from fuel lines and storage cylinders, engine efficiency differences, and vehicle weight differences. Although natural gas utilities, transit bus facilities, fleet owners, and related industry members are not generally able to isolate and quantify these factors, the net effect is lower miles per Btu for most AFV's than for conventional vehicles.

The efficiencies in miles per gallon of gasoline were determined for all vehicle categories. These values were adjusted to account for higher effective fuel consumption for LNG-, CNG-, and electricity-fueled vehicles. For these AFV's, the miles per Btu ratio was lowered by decreasing the nominal heating values per native unit of fuel (Table A2).

Table A2. Original and Adjusted Lower Heating Values of Conventional and Replacement Fuels
(Thousand Btu per Native Unit of Fuel)

Fuel Type	Original Heating Value per Native Unit of Fuel[a] (thousand Btu)	Added Fuel Loss (percent)	Adjusted Heating Value per Native Unit of Fuel (thousand Btu)
Methanol	57.00/Gallon	0.01	57.00/Gallon
Ethanol	76.00/Gallon	0.01	76.00/Gallon
Liquefied Petroleum Gases (LPG)	84.00/Gallon	0.00	84.00/Gallon
Compressed Natural Gas (CNG)	93.00/Therm	0.50	92.54/Therm
Electricity	3.41/kWh	2.00	3.34/kWh
Liquefied Natural Gas (LNG)	68.00/Gallon	2.00	66.64/Gallon
Diesel	128.00/Gallon	0.00	128.00/Gallon
Gasoline	115.00/Gallon	0.00	115.00/Gallon

[a]Lower heating value.
Source: Science Applications International Corporation, emissions model prepared for the Energy Information Administration, (McLean, VA, updated 1994).

5. Vehicle Miles Traveled and Fuel Consumption Adjustments for Bi-, Dual- and Flexible-Fuel Vehicles

Dedicated vehicles were assumed to be fueled exclusively by replacement fuels; therefore, no adjustment was necessary. However, bi-, dual-, and flexible-fuel AFV's consume proportions of replacement and traditional fuels that may be significantly different from the nominal proportions in blended fuels. Flexible-fuel vehicles using M85, for example, do not necessarily consume 85-percent methanol and 15-percent gasoline. To obtain the net amount of alternative fuel used by bi-, dual-, and flexible-fuel vehicles, their VMT values were divided by their adjusted consumption proportions of alternative versus traditional fuels. These proportions are a function of the following:

- *Replacement Fuel Availability*: The percentage of traditional fuel used because no replacement fuel is available at the time of refueling
- *Operator's Fuel Choice*: The percentage use of replacement fuel that results from the vehicle operator's fuel choice when available. Choice is affected by perceptions of safety, cost, environmental impact, vehicle performance, and refueling ease, and by familiarity with the fuel.

These adjustments can be expressed as follows:

VMT on 100% alternative fuel = (fuel availability) × (fuel choice) .

6. Conversion to Replacement and Alternative Fuel Consumption in Native Units

The net adjusted annual VMT for 100-percent alternative fuel use were then divided by miles per unit of alternative fuel. The result was alternative fuel consumption by AFV's.

[39] A notable exception is in Argonne National Laboratory, Center for Transportation Research, *Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity*, ANL/ESD/TM-22, prepared by Dr. Mark Delucchi, Vol. 1 (Argonne, IL, November 1991) and Vol. 2 (Argonne IL, November 1993), which provides miles-per-Btu adjustment factors for AFV's.

7. *Conversion to Gasoline-Equivalent Gallons*

Fuel consumption in terms of gasoline-equivalent gallons was computed by dividing the lower heating value of the alternative fuel by the lower heating value of gasoline and multiplying this result by the alternative fuel consumption value (from step 6).

Oxygenate Consumption

The consumption of ethanol and MTBE from 1992 through the first quarter of 1996 was estimated from production, net imports, and stock change data obtained from *Petroleum Supply Monthly* (DOE/EIA-0109). *Petroleum Supply Monthly* compiles data from the Monthly Petroleum Supply Reporting System, a series of surveys that collect data from refiners, importers, and transporters of crude oil and petroleum products. Oxygenate data are also collected on the Form EIA-819M, "Monthly Oxygenate Telephone Report." Oxygenate consumption is calculated as production plus net imports less stock change. For the remainder of 1996 and for 1997, consumption is derived from unpublished data prepared in support of the *Short Term Energy Outlook, Third Quarter 1996*, DOE/EIA-0202(96/3Q).

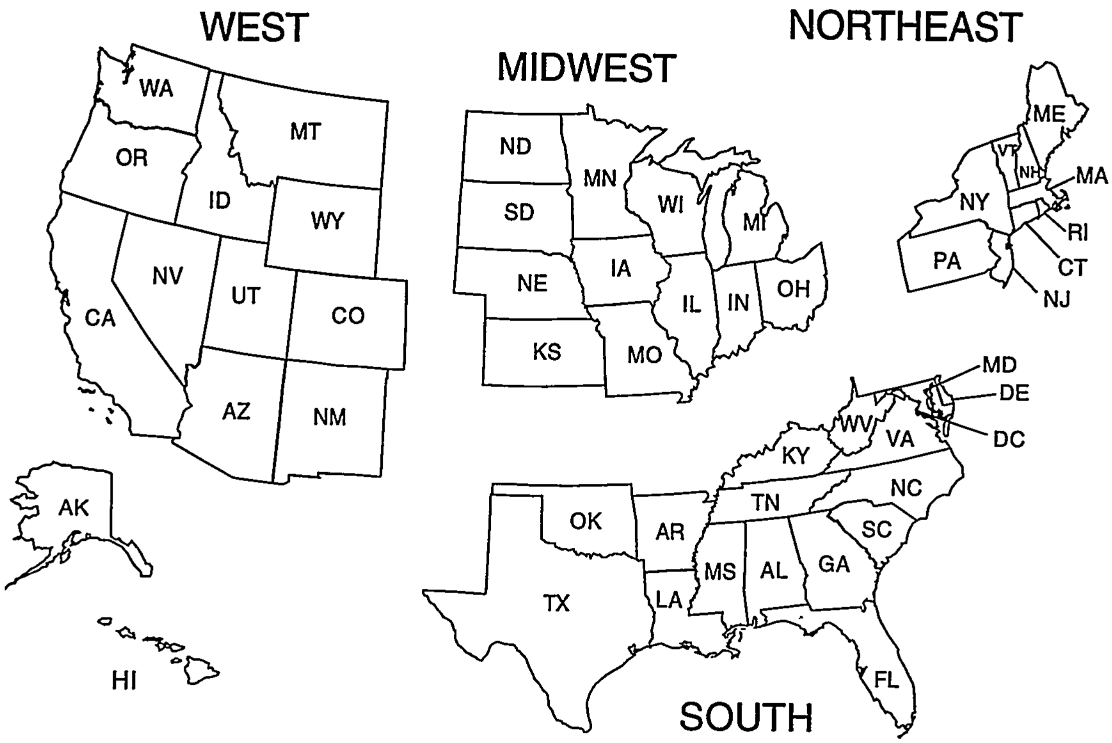
Appendix B

U.S. Census Region Map

Appendix B

U.S. Census Region Map

Figure B1. U.S. Census Region Map



Source: U.S. Department of Commerce, Bureau of the Census

Appendix C

Alternative-Fueled Vehicle Suppliers

Table C1. Alternative-Fueled Vehicle Suppliers

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
4-Wheel Driveline Systems	1160 Castleon Ave.	Staten Island	NY	10310	Jay Losey	(718) 447-3038	Converter	LD/CNG
A-1 Auto Electric	2305 Stairislaus Ave.	Fresno	CA	93721	Mark Gilio	(209) 485-4427	OEM	LD/CNG
A.D. Lift Truck	5434 Natural Bridge Ave.	St. Louis	MO	63120	Bob Perkins	(314) 389-1720	Converter	Other/CNG
AMFAB	1410 E Broadway Rd.	Phoenix	AZ	85040-2308	Phil Terry	(602) 243-5833	Converter	LD/Electric
ARKLA (a NorAm Energy Co.)	P.O. Box 21734	Shreveport	LA	71151	Wm. L. Link	(318) 429-4180	Converter	CNG
AZ Technologies, Inc.	Rt. 2, Box 77	Hard (Highland)	AR	72542	Les Adam	(501) 856-3737	OEM	LD/Electric
Ace Gas Co.	1111 Rt. 37 West	Toms River	NJ	08755	Brian Clayton	(908) 349-1586	Converter	LD/LPG
Acme Alternate Fuels Sys., Inc.	110 Butterworth St.	Mankato	MN	56001	Dale R. Hudson	(507) 345-4000	Converter	LD/CNG
Advanced Vehicle Systems, Inc.	3101 Parker Ln.	Chattanooga	TN	37419	Joe Ferguson	(423) 821-3146	OEM	Electric/Buses
Air Quality Environmental, Inc	8119 East 48th St.	Tulsa	OK	74145	Vic Ham	(918) 663-1700	Converter	LD/CNG
Alabama Gas Corp.	2101 6TH Ave. N.	Birmingham	AL	35203	Bob Strickland	(205) 326-8449	Converter	Other
All-State Ford Truck Sales	1357 Gardiner Ln.	Louisville	KY	40213	John R. Jackson	(502) 459-0550	Converter	LD/Other
Allen Forklift Inc.	425 West Lamar	Sherman	TX	75092	Pat Patterson/ Doug Allen	(903) 893-5196	Dealer	LPG
Allied Propane Service, Inc.	5000 Seaport Ave.	Richmond	CA	94804	Philip Teaderman	(510) 237-7077	Converter	LD/LPG
Alternate Energy Corp.	3 Brook St.	Providence	RI	02903	Tom Aubee	(401) 351-1232	Converter	LD/CNG
Alternate Fuel Consul. & Conv.	#1 Vorhees Dr.	Little Rock	AR	72209	Lloyd White-Whitey	(501) 568-5771	Converter	LD/CNG
Alternate Fuel Technologies	17092 Gothard St.	Huntington Beach	CA	92647	Bruce Eikelberger	(714) 842-3017	Converter	LD/CNG
Alternate Fuel Conversions	Rt. 2, Box 46A	Caldwell	TX	77836	Brian Kilpatrick	(409) 272-3026	Converter	LD/LPG
Alternative Dual Fuels, Inc.	6532 L.B.J.	Dallas	TX	75240	Robert A. Lynch	(214) 392-1949	Converter	LD/CNG
Alternative Fuel Conversion Center	9256 Bermudez St.	Pico Rivera	CA	90660	Jeff Johnson	(310) 932-9400	OEM	LD/CNG
Amectran Corporation	7950 West Flamingo	Las Vegas	NV	89117	Edmond Ramirez	(702) 876-8997	OEM	Other/Electric
American Clean Cities Corp.	28 Garden St.	New Rochelle	NY	10801	Richard Mulle	(914) 632-6666	Converter	LD/CNG
American Dual Fuels, Inc.	7182 Hwy. 14 Suite 701	Middleton	WI	53562	Dan Mackin	(608) 836-6300	Converter	LD/LPG
American Natural Gas Power, Inc.	6601 Long Pont Rd.	Houston	TX	77019	Gary Leuck	(713) 681-4700	Converter	LD/CNG
AmeriGas	P.O. Box 965	Vally Forge	PA	19482-0965	Jack McMonagle	(610) 337-7000	Converter	LD/LPG
Anthony Abraham Chevrolet	4181 SW 8th St.	Miami	FL	33134	Melvin Shifke	(305) 443-9000	Dealer	LD/CNG
Artkansas Western Gas Co.	P.O. Box 1288	Fayettville	AR	727023	Charles W. Holt	(501) 521-5400	Converter	LD/CNG
Askins Propane	202 Commerce St.	Robert Lee	TX	76945	Rhonda Askins	(915) 453-2060	Converter	LD/LPG
Athey Products Corp.	P. O. Box 669	Raleigh	NC	27602	Ray Akermann	(919) 556-5171	OEM	LD/CNG
Atlantic Detroit Diesel Allison, Inc.	180 Rt. 17 South	Lodi	NJ	07644	Tim Meade	(201) 489-5800	Converter	LD/CNG
Atlantic Lift Systems, Inc.	5736 Seliger Dr.	Norfolk	VA	23502	Paul Haynsworth	(804) 466-9280	Converter	LD/CNG
Automotive Diagnostic Service	5730-A Roseville Rd.	Sacramento	CA	95842	Ahmed Mohamed	(916) 332-5333	Converter	LD/LPG
Automotive Inc.	1730 East 18th	Owensboro	KY	42303	Steve Roberts	(502) 926-9731	Converter	LD/CNG
B.H.P. The Gas Company	P.O. Box 3379	Honolulu	HI	96842	Brad Saito	(808) 594-5584	Converter	LD/LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Baker Electromotive	3200 W. Moore St.	Richmond	VA		Joseph G. Baker, Jr.	(804) 358-0481	Converter	LD/Electric
Ballard Gas Service, Inc.	1695 S. State St.	San Jacinto	CA	92583	Frances Ballard	(909) 652-6854	Converter	LD/LPG
Ballard Power Systems	9000 Glenlyon Pkwy.	Burnaby	BC	V5J5J9	Paul Lancaster	(604) 454-0900	NA	Other
Baltimore Gas & Electric Co.	7210 Windsor Blvd.	Baltimore	MD	21244	Leslie E. Stephenson, Sr.	(410) 597-7601	Converter	LD/CNG
Barbour Brothers, Inc.	301 N. 87 Ave. / Box 66	Tulia	TX	79088	Ray Barbour	(806) 995-3366	Dealer	LPG
Barnes Energy Service, Inc.	113 North Ave.	Moberly	MO	65270	James Barnes	(816) 263-1130	Converter	LD/LPG
Battery Auto. Trans. International					Bill Wason	(818) 565-5551	Converter	LD/Electric
Baytech Corporation	P.O. Box 1148	Los Altos	CA	94023	Rebecca Royer	(415) 949-1976	OEM	Other/LD
Beacon Power Systems, Inc.	447 E. Elmwood	Troy	MI	48083	Joann Blankenship	(810) 589-7888	OEM	LD/CNG
Bemer Petroleum Corp.	210 Commerce St.	Glastonbury	CT	06033	T. Michael Morrissey	(203) 659-3515	Dealer	LPG
Benson Repair Service, Inc.	402 SE Water Ave.	Sonora	TX	76950	Fredrick C. Benson	(915) 387-2966	Converter	LD/CNG
Berkshire Gas Company, The	115 Cheshire Rd. P.O. Box 1388	Pittsfield	MA	01202-9987	David Grande	(413) 442-1511	Converter	N/A
Big H, Inc.	240 Denny Way	El Cajon	CA	92020	Howard F. Hawkins	(619) 449-6263	Converter	LD/CNG
Bill's Propane	1635 West Point	Colorado City	TX	79512	Randy Wilkinson	(915) 728-3749	Converter	LD/LPG
Blue Bird Corporation	North Camellia Blvd.	Fort Valley	GA	31030	Bruce Miles	(912) 822-6646	OEM	Buses/CNG
Blue Skies NGV Conversion Co.	2022 E Francis St.	Ontario	CA	91761	Brian Brown	(909) 923-8780	Converter	Buses/CNG
Blue Valley Goodyear	7908 State Ave.	Kansas City	KS	66112	Buck Bales	(913) 788-7272	Converter	LD/CNG
Bowgen Fuel Systems, Inc.	3392 S. Bowgen Pkwy.	Springfield	MO	65807	Christina Watts	(417) 887-4773	Converter	LD/CNG
Bowie Butane Gas Co.	P.O. Box 248	Bowie	TX	76230	Ken Reynolds	(817) 872-2266	Converter	LD/LPG
Brodie	10 Ballard Rd.	Lawrence	MA	01843	Bob Harron	(508) 682-6300	Converter	Other/LPG
Buckley Energy Group	146 Admiral St.	Bridgeport	CT	06605	Robert J. Magas	(203) 336-3541	Dealer	Other
Burkhardt Turbines	1258 N. Main St., # B2B	Fort Bragg	CA	95437	John A. Takes	(707) 961-0459	Converter	LD/Electric
Bus Manufacturing USA	325-C Rutherford Ave.	Goleta	CA	93117	Yolanda Davis/ Robert Davis	(805) 964-0970	OEM	LD/CNG
C. Clark Propane, Inc.	916 Wilks	Pampa	TX	79065	Mark Clark	(806) 665-4018	Converter	LD/LPG
C & M	2230 E Main St.	Visalia	CA	93292	Doug Martin	(209) 625-3619	Converter	LD/CNG
CLI Worldwide	515 N.E. 190 St.	Miami	FL	33179	Jason Green	(305) 651-2220	Converter	Buses/LNG
CNG Services of Pittsburgh, Inc.	3940 Old Wm Penn Hwy. Suite 453	Pittsburgh	PA	15235	Robert Petsinger	(412) 372-5568	Converter	LD/CNG
Cady Oil Co.	5023 N. Galena Rd.	Peorisa Heights	IL	61614	Craig Dupuy	(309) 688-2111	OEM	LD/CNG
Cajun Propane of Lafayette, Inc.	111 Patin Rd.	Scott	LA	70583	Mike Kibodeaux	(318) 261-1294	Converter	LD/LPG
California Electric Cars, Inc.	1661 Del Monte Blvd.	Seaside	CA	93955	Thomas Brooks	(408) 655-3969	OEM	LD/Electric

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Calvin Gas Co., Inc.	1805 1/2 E. Scott	Wichita Falls	TX	76307	Patti Bryant	(817) 766-0561	Converter	LD/Flex
Capuano GMC	37 Winsted Rd.	Torrington	CT	06790	Roger Hackbarth	(860) 492-2323	Converter	LD/CNG
Car Doctor Inc., The	3705 Industrial Rd.	Las Vegas	NV	89109	Jan Monaghan	(702) 732-0112	Converter	LD/CNG
Carb. Equipment of El Paso	3230 Gateway East	El Paso	TX	79905	Louis R. Davila	(915) 533-1315	Converter	LD/LPG
Carburetion & Turbo Systems, Inc.	1897 Eagle Creek Blvd.	Shakopee	MN	55379	David E. Leivestad	(612) 445-3910	Converter	LD/CNG
Carburetion Labs of Midwest	1819 Ridge Rd. P.O. Box 1088	Evanston	IL	60204	Peter Suttle	(847) 328-3161	Converter	Buses/CNG
Cardinal Automotive, Inc.	7200 Fifteen Mile Rd.	Sterling Heights	MI	48312	Todd Rogers	(810) 268-3800	Converter	LD/CNG
Carolina Natural Gas Vehicles.	107 Center Ln.	Hunterville	NC	28078	Larry Lane	(704) 875-2034	Converter	LD/CNG
Champagne Alternate Fuel Systems	200 W 5th St.	Lansdale	PA	19446	Doug Marino	(215) 361-1304	Converter	LD/CNG
Chance Coach, Inc.	4219 Irving	Wichita	KS	67209	Bob Ward	(316) 942-7411	OEM	Buses/CNG
Chesapeake Auto Enterprises, Inc.	Rear 47 Main St.	Reistertown	MD	21136	Bill Brill	(410) 833-7700	Converter	LD/CNG
Checkeye LPG Carburetion, Inc.	651 Pittsburgh St.	Springdale	PA	15144	Lyle Checkeye	(412) 274-8778	Dealer	LD/CNG
Chico Butane Gas Co.	Hwy 101 South	Chico	TX	76431	Mr. Buckner	(817) 644-2624	Converter	LD/LPG
City of Las Vegas	400 E. Stewart Ave.	Las Vegas	NV	89101	Dan Hyde	(702) 229-6446	Converter	LD/CNG
City of Mesquite	1101 E. Main	Mesquite	TX	75149	Gereal Hogue	(214) 216-6903	Converter	LD/LPG
City of Philadelphia	1600 Arch St. 4th floor	Philadelphia	PA	19154	Timothy K. Lynch	(215) 686-1840	Converter	LD/CNG
Clean Air Fuels	1945 Las Plumas	San Jose	CA	95133	Bill Gainey	(408) 259-5710	Converter	LD/CNG
Clean Air Partners, Inc.	5066 Santa Fe St.	San Diego	CA	92109	Paul Beck	(619) 581-5600	OEM	Buses/CNG
Clean Vehicle Systems	1160 Castleton Ave.	Staten Island	NY	10310	Robert Meeker	(718) 447-3038	Converter	LD/CNG
Comm. Truck & Tractor Repair, Inc	330 Stiles St. P.O. Box 8253	Nutter Fort	WV	26301	Michael W. Davis	(304) 623-0981	Converter	LD/CNG
Commonwealth Propane, Inc	9200 Arboretum Pkwy. Suite 140	Richmond	VA	23236	Tim Chase	(804) 327-1310	Converter	LD/LPG
Compressed Natural Gas Corp.	2809 C Broadbent	Alburquerque	NM	82107	Adrienne Stone/ David Crutchfield	(505) 343-8808	Converter	LD/CNG
Concho Butane Co.	8750 N U.S. Highway 87	San Angelo	TX	76901	Tommy Tomerlin	(915) 653-8924	Converter	LD/LPG
Connecticut Natural Gas Corp	P.O. Box 1500	Hartford	CT	06144-1500	Peter Casarella	(860) 727-3264	Converter	LD/Other
Conversions of Connecticut	226 Pratt St.	Southington	CT	06489	Doug Mitchell	(203) 238-3932	Converter	LD/CNG
Coots Carburetion & Service Ctr	505 Center St.	Lathrop	MO	64465	Harold Coots	(816) 528-4505	Converter	LD/LPG
Crane Carrier Company	1925 N. Sheridan	Tulsa	OK	74115	Reginald Wallace	(918) 836-1651	OEM	HD/CNG
Crawford Motors	351 Richmond St.	Chatham	ON	N7M1P5	Dan Crawford	(519) 352-4957	Converter	LD/CNG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Crittenden Butane Co., Inc.	1315 E San Rayburn Dr.	Bonham	TX	75418	Jim Crittenden	(903) 583-4212	Dealer	LD/LPG
Cryogas, USA, Inc.	401 Alexander Ave. Building # 326	Tacoma	WA	98421	M.D. Herron	(206) 272-6544	Converter	LD/LNG
Cummins Southwest Inc.	2239 N. Black Canyon Hwy.	Phoenix	AZ	85009	Mike Depew/ Dave Crawford	(602) 252-8021	OEM/Buses	CNG
Cushman	900 N. 21 St.	Lincoln	NE	68501	Dammika Weeratunga	(402) 474-8433	OEM	LD/Electric
DRV Energy, Inc.	1225 S.E. 29th	Oklahoma City	OK	73129	Sheri Vanhooser	(405) 670-9099	Converter	LD/CNG
Dee's Auto & Truck Service	1428 N. Summit	Arkansas City	KS	67005	Don Rottmayer	(316) 442-2781	Converter	LD/LPG
Diesel Equipment /Auto Air	441 University Blvd.	Birmingham	AL	35205	Pat McKim	(800) 733-3791	Converter	LD/CNG
Doran Motor Co.	624 S. Archer St.	Anaheim	CA	92804	Rick Doran	(702) 359-7356	OEM	LD/Electric
Dr. Dan's Alt. Fuel Works	912 NW 50th St.	Seattle	WA	98107	Dan Freeman	(206) 783-5728	Converter	LD/CNG
E-Motion Electric Vehicles	7025 Riverside Dr.	McMinnville	OR	97128	Lon Gillas	(503) 434-4332	OEM	LD/Electric
E-Z-Go (Textron)	P.O. Box 388	Augusta	GA	30903	F.O. Smith	(800) 448-7476	OEM	Other/Electric
EDO Automotive Natural Gas, Inc	265 N. Janesville St. P.O. Box 39	Milton	WI	53563	Chuck Nelson	(608) 868-4626	Other	Other
EV Development	P.O. Box 1025	Monroe	NC	28111	Lawson Huntley	(704) 283-1025	OEM	LD/Electric
East Bay Ford Truck Sales, Inc.	333 Filbert St.	Oakland	CA	94607	Bob Holden	(510) 272-4400	Converter	LD/LPG
East Texas Lift Trucks, Inc..	P.O. Box 8251	Tyler	TX	75711	John Ellis	(903) 581-1828	Converter	Other/LPG
Eastern Maine Tech. College	354 Hogan	Bangor	ME	04401	Gene Fadrigon	(207) 941-4600	Converter	LD/Electric
Eastern Truck & Auto. Repair	50 Upton St.	Manchester	NH	03103	Jacqueline Benard	(603) 669-8555	Converter	LD/CNG
EcoElectric Corp.	1033 E. Miles P.O. Box 85247	Tucson	AZ	85754	Mary Ann Chapman	(520) 770-9444	OEM	LD/Electric
Electric Launch Co., Inc.	261 Upper North Rd.	Highland	NY	12528	Charles Houghton	(914) 691-3777	OEM	Electric
Electric Motor Cars Sales & Serv.	4301 Kingfisher	Houston	TX	77035	K.D. Bancroft	(713) 729-8668	Converter	LD/Electric
Electric Vehicles Northwest	306 S. Michigan	Seattle	WA	98108	O. Sundin	(206) 762-4404	Converter	LD/Electric
Electric Vehicles of America	48 Acton St.	Maynard	MA	01754	Bob Batson	(508) 897-9393	Converter	LD/Electric
Electricar Corp. of America	720 Laramie Dr.	Lewisville	TX	75067	Michael Bain	(214) 221-4840	Converter	LD/Electric
Energy Conversion Corp.	Route 6, Box 25B	Santa Fe	NM	87501	Calvin Hildebrand	(505) 438-9192	Converter	LD/CNG
Energy Conversions, Inc.	6411 Pacific Hwy., E.	Tacoma	WA	98424	Paul Jensen/ Scott Jensen	(206) 922-6670	OEM	Other/CNG
Engine Technology Center	121 Bartlett St.	Marlboro	MA	01752	Richard E. Stakutis	(508) 480-0937	OEM	Buses/CNG
Enginuity	1424 N. Great Neck Rd.	Virginia Beach	VA	23454	Bill Dozier	(804) 481-7374	OEM	LD/CNG
Environmental Conversions, Inc.	944 W. 2Oth St.	Ogden	UT	84401	Jerry Williamson	(801) 629-0999	Converter	LD/CNG
Envirotech	202 Country Club Rd.	Sherwood	AR	72116	Nelson Brumley	(501) 835-1209	Converter	CNG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Evans Propane Service	1305 North 3rd St.	Ironton	OH	45638	Dave Evans	(614) 532-7817	Converter	LD/LPG
ExproFuels	500 N. Loop 1604 E. Suite 250	San Antonio	TX	78232	Frank Alderman	(210) 490-9400	Converter	LD/CNG
Fallsway Equipment Co.	15 Florist St.	Youngstown	OH	44505	Donald Fischer	(330) 744-3333	Dealer	Other/CNG
Farr Automotive Specialists	136 West Main	Bozeman	MT	59715	Francis Farr	(406) 587-8781	Converter	LD/CNG
Fleet Authority	3170 Draper Dr. Bay 10	Fairfax	VA	22031	Phil Jones	(703) 691-2100	Converter	LD/CNG
Fletcher Service Co.	9800 Hwy 1021	Eagle Pass	TX	78852	Douglas J. Fletcher, III	(210) 773-2816	Converter	LD/LPG
Flowers Pontiac-Cadillac Co.	5915 Broadway	Galveston	TX	77553	Bob Tillman	(409) 744-5711	Converter	LD/CNG
Ford Motor Company					AFV products hotline	(800) ALT-FUEL	OEM	LD/CNG
Fosseen Manu. & Develop. LTD	206 May St. P.O. Box 10	Radcliffe	IA	50230-0010	Dwayne Forseen	(515) 899-2115	Converter	LD/Other
Fraley Butane Co.	4301 Pine St	Abilene	TX	79601	James Holmes	(915) 673-3766	Converter	LD/LPG
Frank's Fuels, Inc.	3410 W. Loop 338	Odessa	TX	79764	Jeff Straint	(915) 332-0829	Converter	LD/LPG
Frank's Repair	18951 Wolf Rd.	Makena	IL	60948	Frank Stone	(708) 479-4407	Converter	LD/CNG
Franklin & Son, Inc.	308 W. Front	Stanton	TX	79782	Barbara McKenzie	(915) 756-2808	Converter	LD/LPG
Fricks Butane Gas, Inc.	2307 E 9th St.	Texarkana	AR	71854	Clay Fricks	(501) 774-5892	Converter	LD/LPG
Fuel Tec, United	707 N Main	S. Hutchinson	KS	67505	Stan Matlock	(316) 663-6300	Converter	LD/LPG
G&M Service Center, Inc.	7901-5 Hill Park Ct.	Lorton	VA	22079	Mike Kalcheff	(703) 550-1467	Converter	LD/CNG
G.M. Barnadol & Son	7659 Airline Hwy.	Baton Rouge	LA	70814	Dale Babbin	(504) 924-5378	Converter	LD/LPG
GFI Control Systems, Inc.	100 Hollinger Cres.	Kitchener	ON	N2K2Z3	Susan Cudahy	(800) 667-4275	Converter	LD/CNG
GWU/CMEE Program	801 22nd St., NW	Washington	DC	20052	Dr. Bedewi	(202) 994-6915	OEM	LD/Electric
Gales Gas Service	2100 Airport Rd.	Pierre	SD	57501	Jack Nafus	(605) 224-5518	Converter	LD/LPG
Garrison Oil Company	1107 Walter Griffin St.	Plainview	TX	79072	David Wood	(806) 296-6353	Converter	LD/LPG
Gas Development Resources, LLC	8480 E. Valley Rd.	Prescott Valley	AZ	86314	Demetri Wagner	(602) 772-6000	Converter	LD/CNG
GassWagen, Inc.	1250 Bittner Blvd.	Lebanon	PA	17046	Rick Arnold	(717) 270-4530	Converter	LD/CNG
General Motors Corporation	3044 West Grand Blvd. Mail Code 482-112-257	Detroit	MI	48202	Dr. Gerald J. Barnes	(313) 556-7723	OEM	LD/Electric
Georgia Gas Distributors, Inc.	3715 Northside Pkwy. Bldg. 200 Northcreek, Ste. 625	Atlanta	GA	30327	Wayne Register	(404) 364-4427	Dealer	LD/LPG
Gillig Corporation	25800 Clawiter Rd.	Hayward	CA	94545	Charles Koske	(510) 264-5031	OEM	Buses/Electric
Glaser Gas, Inc.	215 Auburn Dr.	Colorado Springs	CO	80909	David E. Glaser	(719) 596-4765	Converter	LD/LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Glendale Dial-A-Ride	6210 West Myrtle Ave. Suite111	Glendale	AZ	85301	Larry Plew	(602) 930-2621	Converter	LD/LPG
Glenn's Sales & Service	1711 Rt. 21	Shotrsville	NY	14505	Glenn Salisbury	(716) 289-4298	Converter	N/A
Globe Gas Corp	5843 Paramount Blvd.	Long Beach	CA	90805	Ed Humphrey	(310) 422-0405	Converter	MD/LPG
Graeber Brothers, Inc.	P.O. Box 188	Clarksdale	MS	38614	James Graeber	(601) 624-4326	Converter	LD/LPG
Green Motorworks	5228 Vineland Ave.	N. Hollywood	CA	91601	William Meurer	(818) 766-3800	Dealer	LD/Electric
Green's Blue Flame Gas Co., Inc.	14823 Packard	Houston	TX	77040	Joe Green	(713) 462-5414	Converter	LD/CNG
Greene's Auto Service	111 W Raymond St.	Indianapolis	IN	46225	Kenny Pearson	(317) 786-6253	Converter	LD/CNG
Greengas America	685 Ramsey Ave.	Hill Side	NJ	07205	Al Venezio	(210) 344-4442	Converter	LD/CNG
Greenville Automatic Gas Co.	FM 118	Greenville	TX	75403	Tim Stainback	(903) 455-4546	Converter	LD/LPG
Greenway Environmental Res.	40104 Industrial Park Cir.	Georgetown	TX	78626	Don Greenway	(512) 869-7278	Converter	Buses/CNG
Griffin Butane Co.	5537 W 22nd St.	Odessa	TX	79763	Calvin Yancey	(915) 381-2481	Dealer	LD/LPG
Griffin Propane	107 Murchison P.O. Box 540	Eldorado	TX	76936	Curtis Griffin	(915) 853-2880	Dealer	LD/LPG
Gtr Cleveland Reg. Transit Auth.	615 Superior Ave., West	Cleveland	OH	44113	Maynard Z. Walters	(216) 665-5224	Other	Other
Haigood & Campbell	P.O. Box 427	Archer City	TX	76351	Herb Victory	(817) 574-4622	Converter	LD/LPG
Hall Propane Co.	P.O. Box 602	Port Lavaca	TX	77979	Sharon Hall	(512) 552-5587	Converter	LD/LPG
Hargreaves Propane	P.O. Box 7	George West	TX	78022	Henry Hargreaves	(512) 449-1051	Converter	LD/LPG
Harvey's LP Gas Co.	P.O. Box 101	Los Fresnos	TX	78566	Alfredo Escalante	(210) 233-4356	Converter	LD/LPG
Heritage Propane Corp.	P.O. Box 5745	Helena	MT	59604	Pat West	(406) 442-9759	Converter	MD/LPG
Hunter Propane	2001 W. Corpus Christy	Beeville	TX	78104	John Hunter/ Sammy Mondez	(512) 358-5097	Converter	LD/LPG
IEV Corp.	NAWC Tech. Park	Warminster	PA	18974	Jim Smith	(215) 646-8686	Converter	LD/Electric
IMPCO Technologies, Inc.	16804 Gridley Place	Cerritos	CA	90703-1741	Pearl Kamdar	(206) 575-1594	Converter	Buses/CNG
IMPCO Technologies, Inc.	708 Industry Dr.	Seattle	WA	98188	David Smith	(310) 860-6666	Dealer	Other/Other
Independent Oil Co. dba Dixie LP	305 N. Waco St.	Hillsboro	TX	76645	Lynn B. Gray	(817) 582-5359	Dealer	LD/LPG
Industrial Truck Sales & Service	4100 Randelman Rd.	Greensboro	NC	27407	Ted Hand	(910) 275-9121	Dealer	LD/CNG
Institute of Gas Technology	1700 S. Mt. Prospect Rd.	Des Plaines	IL	60018	Chris Blazek	(312) 890-6466	Converter	LD/CNG
Intermountain Gas Company	555 S. Cole Rd.	Boise	ID	83707	Micheal E. Huntington	(208) 377-6059	Converter	LD/CNG
J & L Propane, Inc.	Rt. 1 Box 3383 Miller Rd.	Krum	TX	76249	Raymond Johnson	(817) 482-3225	Converter	LD/LPG
J-W Operating Company	36629 U S Highway 385	Wray	CO	80758	Kendall Read	(970) 332-3151	Converter	LD/Electric
JL Associates (JLA)	22 Enterprise Pkwy.	Hampton	VA	23666	Curtis Higbie	(804) 838-8400	Converter	LD/CNG
Jettgas	302 Boomtown Rd.	Laredo	TX	Laredo	Eloy Garza	(210) 723-5551	Converter	LD/LPG
Kamps Propane	7750 N. Sepulveda	Van Nuys	CA	91405	Robert Bagshaw	(818) 989-7559	Converter	LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Kaylor Energy Products	20000 Big Basin Way	Boulder Creek	CA	95006	Roy Kaylor	(408) 338-2200	OEM	LD/Electric
Kelly's Truck Repair, Inc.	P.O. Box 210	Oakland	CA	94604	Kelly Green	(510) 655-9090	Converter	LD/CNG
King County	900 King Co. Admin. Bldg. 500 4th/Rm. 858	Seattle	WA	98104	Bill Glenn	(206) 296-6521	Converter	LD/CNG
Kleenair Systems, Inc.	1003 Fairfax Ave.	Martinsburg	WV	25401	James M. Seibert	(304) 267-6441	Converter	LD/CNG
Kress Service Center	196 Butler St.	Etna	PA	15223	Frederick Kress	(412) 781-9837	Converter	LD/CNG
Krutsinger Services, Inc.	5402 E. Hanna Ave.	Tampa	FL	33610	Steven M. Krutsinger	(813) 216-4484	Converter	LD/LPG
LP Gas Carb. & Appliance Svc.	601 N I-27	Lubbock	TX	79403	Travis Callaway	(806) 765-9573	Converter	LD/LPG
LEKTRO, Inc.	1190 SE Flightline Dr.	Warrenton	OR	97146	Eric Paulson	(800) 535-8767	OEM	Other/Electric
LP Gas Equipment	12475 W. Custer	Butler	WI	53007	John Pfeiffer	(414) 781-5777	Converter	LD/LPG
LP Propane Service, Inc.	20638 Krick Rd.	Cleveland	OH	44146	Les Ashby	(216) 232-4111	Dealer	LD/CNG
Lamesa Butane Co.	501 S. Lynn	Lamesa	TX	79331	Arlen Morris	(806) 872-5200	Converter	LD/LPG
Leahy's Metered Gas Service	130 White St. P.O. Box 130	Danbury	CT	06813-0130	Stephen G. Rosentel	(203) 748-3539	Converter	LD/LPG
Lee County Sheriff's Dept.	2955 Van Buren	Ft. Myers	FL	33916	Lt. Firmes	(914) 338-2505	Converter	LD/LPG
Liberty Propane	P.O. Box 563	Alvord	TX	76234	Bubba Bell	(817) 427-3721	Converter	LD/LPG
Loren's Auto Repair	817 West Center St	Kalispell	MT	59901	Loren Sallie	(406) 755-7757	Converter	LD/CNG
Lovett's LP Gas	2618 Central Dr.	Junction City	KS	66441	Jerry Lovett	(913) 762-5160	Converter	LD/LPG
M&M Propane	P.O. Box 502	Donna	TX	78537	Troy McMillan	(210) 464-3522	Converter	LD/LPG
M.F. Automotive	416 W. 6th	Amarillo	TX	79101	Mark Francis	(806) 379-6941	Converter	LD/LPG
Mack Trucks, Inc.	P.O. Box 1907	Allentown	PA	18105	Ed Merkel	(610) 709-8125	OEM	HD/CNG
Martin LP Gas	2606 N. Longview St.	Kilgore	TX	75666	Jerry Sullivan	(903) 984-0781	Converter	LD/LPG
Mathes Electric Motor Car Corp.	P.O. Box 44	Ocala	FL	34478	Charles West, Jr.	(352) 307-9068	OEM	LD/Electric
McClures Fuel Service, Inc.	P.O. Box 247	Konawa	OK	74849	George Winters	(405) 925-3256	Dealer	LD/LPG
McKie Ford	P.O. Box 740	Rapid City	SD	57709	Kevin Haberstroh	(605) 348-1400	Converter	LD/CNG
Mid-Continent LP Service	3711 N. Main P.O. Box 369	Great Bend	KS	67530	Dick Cougherty	(316) 793-3573	Converter	LD/LPG
Midamerican Energy Company	509 Douglas St.	Sioux City	IA	51102	Terry W. Slaughter	(712) 277-7603	Converter	LD/CNG
Midtex LP Gas	3675 Highway 287 E.	Midlothian	TX	76065	Rodney Jenkins	(214) 723-3900	Converter	LD/LPG
Miller's Truck Repair, Inc.	145 Higginson Ave.	Lincoln	RI	02865	Bob Miller	(401) 723-9030	Converter	MD/LPG
Mission Gas Co.	10625 Hwy 181 S.	San Antonio	TX	78223-5040	Ted Terry	(210) 633-0721	Converter	LD/LPG
Modern Auto Service Ltd.	111 3rd St. West	Brooks AB	CANADA	T1R 1B3	Larry Hartmann	(403) 362-3425	Converter	LD/CNG
Modern Engineering	15201 N. Commerce Dr.	Dearborn	MI	48120	Bob Childs	(313) 317-9510	Converter	LD/CNG
Monroe Truck Equipment	901 Joliet St.	Janesville	WI	53545	Deb Sisko	(608) 755-3940	Converter	HD/LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Montana Dakota Utilities	801 Airport Rd.	Bismarck	ND	58501	Don Knapp	(701) 224-5881	Converter	LD/CNG
Montana Power Company	40 East Broadway	Butte	MT	59701	Wally Norley	(406) 723-5421	Converter	LD/CNG
Morrison Knudsen Locomotive	4600 Apple St	Boise	ID	83705	Michael Nelson	(208) 389-4800	OEM	Other/CNG
Morton's CNG Conversions	13404 Jefferson Davis Hwy.	Woodbridge	VA	22191	Jerry Morton	(703) 494-7914	Converter	LD/CNG
Motorfuelers, Inc.	13790-B 49th Street, N	Clearwater	FL	34622	James E. Morton	(813) 572-9762	Converter	LD/CNG
Moulden Supply Co., Inc.	3600 Hwy. 80 W.	Jackson	MS	39209	John Titcomb	(601) 922-4611	Converter	CNG
Mountain Fuel Supply Co.	1175 West 130, S	Salt Lake City	UT	84104	Terry Keddington	(801) 539-3673	Converter	CNG
Multi-Fuel Corp	2384 Cedar Key	Lake Orion	MI	48360	Tony Lorts	(810) 391-3524	Converter	CNG
Mutual Liquid Gas & Equipment	17117 S. Broadway	Gardena	CA	92704	Steven Moore	(310) 515-0553	Converter	LPG
NACCO Materials Handling Group	5200 Greenville Blvd., NE	Greenville	NC	27834	Peter M. Siessel	(919) 931-5154	OEM	Other/CNG
NESC, Williams Inc.	5333 Northfield Rd. 18 Harrison St.	Cleveland	OH	44146	Earl Biederman	(216) 662-0225	Converter	LD/CNG
NEVCORP	120 Cleveland.	Eugene	OR	97402	Carl Watkins	(541) 687-5939	OEM/LD	LD/Electric
NGC	1381 SR 125 Suite 11C	Amelia	OH	45102	George McAuliffe	(513) 753-4614	Converter	LD/CNG
NGV Ecotrans Group, Inc.	2424 East Olympic Blvd. Bldg. #3	Los Angeles	CA	90021	Dennis Osaka	(213) 362-7281	Converter	LD/CNG
NGV Refuel. & Conv. of AR, Inc	716 E. 9th	Little Rock	AZ	72202	Mary Yelenich	(501) 375-0804	Converter	LD/CNG
NGV Southeast Technology Ctr	616 Hwy 138	Riverdale	GA	30067	Pat McKim	(770) 907-0999	Converter	LD/CNG
National Fuel Gas	365 Mineral Springs Rd.	Buffalo	NY	14210-1999	Carment E. Rossi	(716) 827-5520	Converter	LD/CNG
Natoma Auto Center	12181 Folsom Blvd.	Rancho Cordova	CA	95742	Rick Yakesh	(916) 985-3618	Converter	LD/CNG
Natural Fuels Corp.	5855 Stapleton Dr. N Suite 135	Denver	CO	80216-3312	Paul Nelson	(303) 322-460	Converter	LD/CNG
Natural Gas 2000, Inc.	808 North Pike Rd.	Cabot	PA	16023	Chuck Martin	(412) 352-9100	Converter	LD/CNG
Naumann/Hobbs Material Hand	4336 S. 43rd Place	Phoenix	AZ	85040	Ken Settle	(602) 437-1331	Converter	LD/CNG
New Flyer Industries Limited	600 Pandora Ave. W	Winnipeg	MB	R2C3T4	Rick G. Zebinski	(204) 224-6378	OEM	CNG
New Haven Body, Inc.	395 State St.	North Haven	CT	06473	David Cataldo	(203) 248-6388	Converter	LD/CNG
New York State Electric & Gas	432 E. Main St.	Endicott	NY	13760	Stanley Augustine	(607) 786-3290	Converter	LD/CNG
Norman's Automotive Svcs, Inc.	7649A Fullerton Rd.	Springfield	VA	22153	Norman Canfield	(703) 451-9222	Converter	LD/CNG
North American Fleet Services	3820 East Winslow Ave.	Phoenix	AZ	85040	Macy Neshati	(602) 254-4366	Converter	LD/CNG
North Valley Propane	526 S. Butte St.	Willows	CA	95988	Vance L. Pattison	(916) 934-7005	Converter	LD/LPG
Northeast Energy Equipment	128A South Country Rd.	Bellport	NY	11713	Frank Dupointe	(516) 286-5600	Converter	LD/LPG
Northwest Natural Gas Company	220 NW 2nd Ave.	Portland	OR	97209	Douglass Dunford	(503) 721-2476	Converter	LD/CNG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Northwest Propane Sales, Inc.	8450 Depot Rd.	Lynden	WA	98264	Steve VanderYacht	(360) 354-4471	Converter	LD/LPG
Nova BUS Incorporated	42 Earl Cummings Loop, W	Roswell	NM	88201	Jim McDowell	(505) 347-7513	OEM	Buses/CNG
O'Gwynn Inc.	303 Mildred St.	Montgomery	AL	36104	Benny J McDaniel	(334) 264-2243	Converter	CNG
Old Dominion University		Norfolk	VA	23529	Griff Mcree	(804) 683-3789	Converter	LD/CNG
Omni Instruments					Joe Stevenson	(707) 766-8587	OEM	LD/Electric
Orion Bus Industries	165 Base Rd.	Oriskany	NY	13424	John Riet	(315) 768-8101	OEM	Buses/CNG
Olivia Electric Vehicle Co.	6990 Lake View Pt.	Longmont	CO	80503	Carl Lawrence	(303) 444-0569	OEM	Other/Electric
PACA/TEECO Products Co., Inc.	7471 Reese Rd.	Sacramento	CA	95828	Gary Lane	(916) 688-3535	Converter	LD/CNG
Pacific Electric Vehicles,LLC	3907 N. State St., #18B	Ukiah	CA	95482	Bill Warf	(707) 485-5799	OEM	LD/Electric
Peterbilt Motors Company	3200 Airport Rd.	Denton	TX	76201	Jim Zito	(817) 566-4084	OEM	HG/LNG
Petty Butane Co.	10224 Hwy. 287, W	Vernon	TX	76384	Scott Inglish	(817) 552-7072	Dealer	LD/LPG
Piedmont Natural Gas Co. Inc,	1915 Rexford Rd.	Charlotte	NC	28211	Greg A. Johnson	(704) 364-3120	Converter	LD/CNG
Pinnacle CNG Systems, LLC	3400 West 7th	Big Spring	TX	79720	Drew Diggins	(915) 866-7002	Converter	LD/CNG
Potomac Industrial Trucks	P.O. Box 940	Stephens City	VA	22655	Bill Wisham	(540) 869-6100	Converter	Other/CNG
Pro Energy Corporation	11 Apple St.	Tinton Falls	NJ	07724	Ron Cassell	(908) 747-3795	Converter	LD/CNG
Quality Auto Service	303 S. Wyoming St.	Butte	MT	59701	Carl M. Popovich	(406) 723-9213	Converter	LD/CNG
Queen Oil & Gas Co.	606 West Richey	Artesia	NM	88210	Richard B. Leaton	(505) 746-4322	Converter	LD/LPG
R & W Supply, Inc.	Hwy 385 South	Littlefield	TX	79339	Shawn Pickrell	(806) 385-4447	Converter	LD/CNG
RODAGAS Energy Systems	10355 Capital	Oak Park	MI	48237	Gerald G. Flood	(810) 398-3660	Dealer	LD/CNG
Ranch Butane Inc.	Rt 3 Box 298	Corpus Christi	TX	78415	Nelson Lanam	(512) 855-7231	Converter	LD/LPG
Recreational Electric Veh, Inc.	9330 Industrial Trace	Alpharetta	GA	30201	Stephen Janis	(770) 664-6559	OEM	Other/Electric
Reliable Gas Co.	P.O. Box 4039 13776 Hwy 69, N	Tyler	TX	75712	David Guthrie	(903) 882-6106	Converter	LD/LPG
Richter Enterprises	5120 Cane Run Rd.	Louisville	KY	40216-1157	Troy Royalty	(502) 447-7304	Converter	Other/CNG
Rust Tractor Company	4000 Osuna Rd., NE	Albuquerque	NM	87109	Pete Van Dyk	(505) 345-8411	Dealer	HD/LPG
Sales Equipment	P.O. Box 82455	Oklahoma City	OK	73148	Chris Link	(405) 634-2426	Converter	LD/LPG
San Francisco State University	Transportation Dept. 1600 Holloway Ave.	San Francisco	CA	94132	Patrica Tolar	(415) 338-6029	OEM	Other/Electric
Sarasota Sheriff's Dept.	425 Old Venice Rd.	Osprey	FL	34229	Steven W. Meadows	(941) 486-2363	Converter	LD/LPG
Savage Auto Care	P.O. Box 179	North Hyde Park	VT	05665	John Savage	(802) 635-9733	Converter	LD/LPG
Sawtooth Repair	1708 East Lincoln Rd.	Idaho Falls	ID	83401	Joel Phelps	(208) 522-9697	Converter	LD/LPG
Schagrin Gas	1000 N. Broad St.	Middleton	DE	19709	Christopher Cafarella	(302) 378-2000	Converter	LD/LPG
Schless Engineering, Inc	3165 E Main St.	Ashland	OR	97520	Ely Schless	(541) 488-8226	OEM	LD/Electric
Servigas	6319 Doniphan Dr.	El Paso	TX	79932	David Chavez	(915) 833-2961	Converter	LD/LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Sharp, E.O., Butane Co., Inc.	P.O. Box 599	Smithville	TX	78957	Ted Parks	(512) 237-2521	Converter	LD/LPG
Shelton's Propane Company	149 W Industrial	Sulphur Springs	TX	75482	James D. Shelton	(903) 885-7666	Converter	LD/LPG
Smith & Smith Propane Service	327 S. 38th St.	Killeen	TX	76543	L.R. Smith	(817) 699-5343	Converter	LD/LPG
Solectria Corporation	68 Industrial Way	Wilmington	MA	01887	Karl Thidemann	(508) 658-2231	OEM	LD/Electric
Soleq	7137 Austin Ave.	Niles	IL	60714	S. Ohba	(312) 792-3811	OEM	LD/Electric
Southeastern Michigan Gas	2915 Lapeer Rd.	Port Huron	MI	48061	Charles F. Lambert	(810) 987-7900	Converter	LD/CNG
Southern Arizona Gas	186 N. Old Tuscon Rd.	Nogales	AZ	85621	Darrell Miller	(520) 281-2028	Converter	LD/LPG
Southern LP Gas	512 East Stillwell	Dequeen	AR	71832	Ron Moore	(501) 642-2234	Converter	LD/LPG
Southwest Lift	7505 Mines Rd.	Laredo	TX	78041	Danny Ortiz	(210) 722-0988	Converter	LD/LPG
Spartan Motors	1000 Reynolds Rd.	Charlotte	MI	48813	John Gaedert	(512) 543-6400	Converter	Buses/CNG
Stewart & Stevenson-Albuquerqu	2929 Vassar Dr., NE	Albuquerque	NM	87107	Nelson Koontz	(505) 881-3511	Converter	LD/CNG
Stewart & Stevenson-Farmington	1515 West Murray Dr.	Farmington	NM	87401	Dale Stevens	(505) 325-5071	Converter	CNG
Stix Gas Co., Inc.	Hwy 77	Sinton	TX	78387	Steve Schmalstieg	(512) 364-2284	Converter	MD/LPG
Suburban Propane	P.O. Box 206	Whippany	NJ	07981	Bill Coulter	(201) 503-9963	Converter	LD/LPG
Sunset Auto Repair	22 Sunset Dr.	Kalispell	MT	59901	Joe Drewnick	(406) 752-7479	Converter	LD/CNG
TRANSTAR Technologies	2415 Beatrice	Dallas	TX	75208	Barry White	(214) 741-1647	Converter	LD/CNG
Teledyne Brown Engineering	300 Sparkman Dr. Mail Stop 78	Huntsville	AL	35807-7007	Terry Reiman	(205) 726-1340	Converter	N/A
Texgas Propane	4344 S. Main	Pearland	TX	77581	Ronnie Yard	(713) 482-7007	Converter	LD/LPG
Flxible Corporation, The	970 Pittsburgh Dr.	Delware	OH	43105	Dave Kossler	(614) 362-2607	OEM	Other/CNG
People's Natural Gas Co., The	625 Liberty Ave. CNG Tower	Pittsburgh	PA	15222	Vincent J. Meinert	(412) 497-5612	Converter	LD/CNG
Thompson's Gas, Inc.	1431 N. Illinois St.	Belleville	IL	62220	Phil Thompson	(618) 233-6541	Converter	LD/LPG
Tiger Tractor Corp.	P.O. Box 1340	Lee's Summit	MO	64063-1340	Eli Durante	(816) 525-3900	OEM	Other/CNG
Tipton Oil & Butane	119 E Houston	Floydada	TX	79235	Wayne Tipton	(806) 983-3144	Converter	LD/LPG
Tonawanda Truck Repair Inc.	1453 Military Rd.	Kenmore	NY	14217	Melvin A. Raab	(716) 873-1044	Converter	LD/CNG
Torchiana Automotive	1119 West Chester Pike	West Chester	PA	19382	Joseph H. Tochiana, III	(610) 431-4564	Converter	LD/CNG
Transport. Design & Manu.	13000 Farmington Rd.	Livonia	MI	48150	Ted Hansen	(313) 458-9100	Converter	LD/CNG
Transportation Systems, Inc.	729 Thomas Dr.	Bensenville	IL	60106	Paul J Valention	(708) 787-0170	Converter	LD/CNG
Tri-Co Propane	109 W. Mesquite	Rogers	TX	76569	Jack E. Walzel Jr.	(817) 642-3885	Dealer	LD/LPG
Tri-Tex Energy Co.	1408 IH-20W	Cisco	TX	76437	Rick Roark	(817) 442-1611	Converter	LD/LPG
Trio Fuels	P.O. Box 1190	Big Spring	TX	79720	Clark Durham	(915) 267-9434	Converter	LD/LPG

See notes at end of table.

Table C1. Alternative-Fueled Suppliers (Continued)

Name of Organization	Address	City	State	Zip	Contact	Phone	Type of Operation	Vehicle/Fuel Type
Truck Suppliers, Inc.	2401 West Towne	Glendive	MT	59330	Jim Stanfill	(406) 365-5284	Converter	LD/CNG
U.S. Electricar	5 Thomas Mellon Cir.	San Francisco	CA	94134	Scott Cronk	(415) 656-2414	OEM	LD/Electric
U.S. NGVs	1695 S. 7th St.	San Jose	CA	95112	Ray Tate	(408) 292-6487	NA	Other
United Propane Corp.	200 E. Minner	Bakersfield	CA	93308	Don Atkins	(805) 393-4088	Converter	LD/LPG
Vermont Electric Car	RD 3 Box 3272	Middlesex	VT	05602	Hilton Dier	(802) 223-6652	Converter	LD/Electric
Villa Marin Chevrolet	2699 Richmond Ter.	Staten Island	NY	10303	Dennis Clancy	(718) 442-1155	Dealer	LD/CNG
Vinyard Engine Systems, Inc.	7373 Caribou	San Antonio	TX	78238	Mr. Shannon Vinyard	(210) 520-7924	Converter	Buses/CNG
Virginia LP Trucks, Inc,	11486 Blue Star Hwy.	Strong Creek	VA	23882	Jim Mathews	(804) 246-8257	OEM	LD/LPG
Walker Automotive	Rt. 4 Box 702	Jacksonville	TX	75766	Charlie Walker	(903) 586-6008	Converter	LD/Electric
Welsh Technologies, Inc	Box 4214	River Edge	NJ	07661	Jonathan W. Welsh	(210) 489-3465	Converter	LD/CNG
Western Natural Gas Company	2960 Strickland St.	Jacksonville	FL	32254	George Pompilius	(904) 387-3511	Converter	LD/LPG
Westex Propane	5524 El Paso Dr.	El Paso	TX	79905	Gary Vera	(915) 772-1404	Converter	LD/LPG
Will-Press	501 Avenue C, SW	Winterhaven	FL	33880	Bill Myers	(941) 299-1474	Converter	LD/CNG
Williams Automotive Service	200 E. 5th	Fort Stockton	TX	79735	Mike Williams	(915) 336-2341	Converter	HD/LPG
Wilmutt Gas & Oil Company	P.O. Box 1649	Hattiesburg	MS	39403	Greg Ryland	(601) 544-6001	Converter	LD/CNG
Wisconsin Industrial Truck Co.	4500 N. 1119th St.	Milwaukee	WI	53225	Doug Wilson	(414) 466-9900	Converter	LD/CNG
Wise Oil Co.	Old Dallas Hwy.	Hillsboro	TX	76645	Russ W. Wise	(817) 582-2261	Converter	LD/LPG
Wylie LP Gas, Inc.	Hwy 54 W P.O. Box 707	Petersburg	TX	79250	Jerry Bright	(806) 667-3591	Converter	LD/LPG
Yellow, Checker, Star Cab Co.	3950 W. Tompkins	Las Vegas	NV	89103	Jack Owens	(702) 873-8012	Converter	LD/LPG
Yosemite Sam's	611 NW Gordon	Topeka	KS	66608	Sam Veal	(913) 235-5411	Converter	LD/LPG
ZAP Power Systems	117 Morris St.	Sebastopol	CA	95472	James McGreen	(707) 824-4150	OEM	Other/Other
Zeigler LP Systems, Inc.	456 Pan American	Livingston	TX	77351	Bob Zeigler	(409) 327-2225	Converter	LD/LPG

CNG = Compressed natural gas.
HD = Heavy duty.
LD = Light duty.
LNG = Liquefied natural gas.
LPG = Liquefied petroleum gas.
MD = Medium duty.
NA = Not applicable.
NG = Natural Gas.
OEM = Original Equipment Manufacturer.
Source: Energy Information Administration, Form EIA-886, "Alternative Fuel Vehicle Suppliers' Annual Report."

Glossary

Aftermarket Conversion: A standard, conventionally fueled, factory-produced vehicle to which equipment has been added that enables the vehicle to operate on an alternative fuel.

Alcohols (CH_3-$(CH_2)_n$-OH): The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. The series of molecules vary in chain length and are composed of a hydrocarbon, plus a hydroxyl group (for example, methanol, ethanol, and tertiary butyl alcohol).

Aldehydes: One of several families of compounds formed as products of incomplete combustion in engines using gasoline, methanol, ethanol, propane, or natural gas as fuels. As a general rule of thumb, the presence of methanol or methyl ethers in the fuel will lead to formaldehyde as the primary aldehyde in the exhaust, while ethanol or ethyl ethers will lead to acetaldehyde as the primary aldehyde in the exhaust. In both cases, other aldehydes are present, but in much smaller quantities. Formaldehyde and acetaldehyde are toxic and possibly carcinogenic.

Alternative Fuel: As defined pursuant to the EPACT, methanol, denatured ethanol, and other alcohols, separately or in mixtures of 85 percent by volume or more (or other percentage not less than 70 as determined by DOE rule) with gasoline or other fuels, CNG, LNG, LPG, hydrogen, coal-derived liquid fuels, fuels other than alcohols derived from biological materials, electricity, or any other fuel determined to be substantially not petroleum and yielding substantial energy security benefits and substantial environmental benefits.

Alternative-Fueled Vehicle (AFV): A vehicle either designed and manufactured by an original equipment manufacturer or a converted vehicle designed to operate in either dual-fuel, flexible-fuel, or dedicated modes on fuels other than gasoline or diesel. This does not include a conventional vehicle that is limited to operation on blended or reformulated gasoline fuels.

Alternative-Fueled Vehicle Converter: An organization (including companies, government agencies, and utilities), or an individual who performs conversions involving alternative fueled vehicles. An AFV converter can convert (1) conventionally fueled vehicles to AFV's, (2) AFV's to conventionally fueled vehicles, or (3) AFV's to another alternative fuel.

Barrel: A volumetric unit of measure for crude oil and petroleum products equivalent to 42 U.S. gallons.

Bi-Fuel Vehicle: A vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional fuel using only one fuel at a time.

Biodiesel: Any liquid biofuel suitable as a diesel fuel substitute or diesel fuel additive or extender. A diesel substitute made from transesterification of oils of vegetables such as soybeans, rapeseed, or sunflowers (end product known as methyl ester) or from animal tallow (end product known as methyl tallowate). Biodiesel can also be made by transesterification of hydrocarbons produced by the Fisher-Tropsch process from agricultural byproducts such as rice hulls.

British Thermal Unit (Btu): A standard unit for measuring the quantity of heat energy equal to the quantity of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit.

California Air Resources Board (CARB): A State regulatory agency charged with regulating the air quality in California. Air quality regulations established by the Board and often stricter than those set by the Federal Government.

Carbon Cycle: All reservoirs and fluxes of carbon; usually thought of as a series of the four main reservoirs of carbon interconnected by pathways of exchange. The four reservoirs, regions of the Earth in which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). Each of these global reservoirs may be subdivided into smaller pools ranging in size from individual communities or ecosystems to the total of all living organisms (biota). Carbon exchanges from reservoir to reservoir by various chemical, physical, geological, and biological processes.

Carbon Dioxide (CO_2): A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion. Although CO_2 does not directly impair human health, it is a greenhouse gas that traps the earth's heat and contributes to the potential for global warming.

Carbon Monoxide (CO): A colorless, odorless gas slightly lighter than air. It is poisonous if inhaled, in that it combines with blood hemoglobin to prevent oxygen transfer. It is produced by the incomplete combustion of fossil fuels with a limited oxygen supply (as in automobiles). It is a major component of urban air pollution, which can be reduced by the blending of an oxygen-bearing compound such as alcohols and ethers into hydrocarbon fuels.

Chlorofluorocarbons (CFC's): A family of inert, nontoxic, and easily liquified chemicals used in refrigeration, air conditioning, packaging, and insulation, or as solvents or aerosol propellants. Because they are not destroyed in the lower atmosphere, they drift into the upper atmosphere where their chlorine components destroy ozone.

Clean Alternative Fuel: Any fuel (including methanol, ethanol, or other alcohols (including any mixture thereof containing 85 percent or more by volume of such alcohol with gasoline or other fuels), reformulated gasoline, diesel, natural gas, liquefied petroleum gases, and hydrogen) or power source (including electricity) used in a clean fuel vehicle that complies with the standards and requirements of the Clean Air Act Amendments of 1990.

Compressed Natural Gas (CNG): Natural gas compressed to a volume and density that is practical as a portable fuel supply (even when compressed, natural gas is not a liquid).

Carbon Monoxide Nonattainment Area: Areas with carbon monoxide design values of 9.5 parts per million or more (generally based on data for 1988 and 1989).

Converted Vehicle: A vehicle originally designed to operate on gasoline that has been modified or altered to operate on an alternative fuel.

Criteria Pollutant: A pollutant determined to be hazardous to human health and regulated under the Environmental Protection Agency's National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require the Environmental Protection Agency to describe the health and welfare impacts of a pollutant as the criteria for inclusion in the regulatory regime.

Dedicated Vehicle: A vehicle designed to operate solely on one alternative fuel.

Diesel Fuel: A complex mixture of hydrocarbons with a boiling range between approximately 350 and 650 degrees Fahrenheit. Diesel fuel (simply referred to as "diesel") is composed primarily of paraffins and naphthenic compounds that auto-ignite from the heat of compression in a diesel engine. Diesel is used mainly by heavy-duty road vehicles, construction equipment, locomotives, and by marine and stationary engines.

Dual-Fuel Vehicle: A vehicle designed to operate on a combination of alternative fuel, such as CNG or LPG, and conventional fuel, such as gasoline or diesel. These vehicles have two separate fuel systems which inject both fuels simultaneously into the engine combustion chamber.

E85: A fuel containing a mixture of 85 percent ethanol and 15 percent gasoline.

E95: A fuel containing a mixture of 95 percent ethanol and 5 percent gasoline.

Energy Efficiency: The inverse of energy intensiveness: the ratio of energy outputs from a process to the energy inputs (for example, miles traveled per gallon of fuel).

Environmental Protection Agency (EPA): A government agency, established in 1970. Its responsibilities include the regulation of fuels and fuel additives.

Ethyl Tertiary Butyl Ether (ETBE), $(CH_3)_3COC_2H_5$: A colorless, flammable, oxygenated hydrocarbon blend stock formed by the catalytic etherification of isobutylene with ethanol.

Ethanol (C_2H_5OH): Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. However, it forms a binary azeotrope with water, with a boiling point of 78.15 degrees Celsius at a composition of 95.57 percent by weight ethanol. It is used in the United States as a gasoline octane enhancer and oxygenate (10 percent concentration). Ethanol can also be used in high concentrations in vehicles optimized for its use.

Ether: The family name applied to a group of organic chemical compounds composed of carbon, hydrogen, and oxygen, and which are characterized by an oxygen atom attached to two carbon atoms (for example, methyl tertiary butyl ether).

Flexible-Fuel Vehicle: A vehicle with the ability to operate on alternative fuels (such as M85 or E85), 100 percent traditional fuels, or a mixture of alternative fuel and traditional fuels.

Global Warming: The theoretical escalation of global temperatures caused by the greenhouse effect.

Greenhouse Effect: A popular term used to describe the roles of water vapor, carbon dioxide, and other trace gases in keeping the Earth's surface warmer than it would be otherwise. These radiatively active gases are relatively transparent to incoming shortwave radiation, but are relatively opaque to outgoing long wave radiation. The latter radiation, which would otherwise escape to space, is trapped by these gases within the lower levels of the atmosphere. The subsequent reradiation of some of the energy back to the Earth maintains the surface at temperatures higher than they would be if the gases were absent.

Greenhouse Gases: Those gases, such as water vapor, carbon dioxide, tropospheric ozone, nitrous oxide, and methane, that are transparent to solar radiation but opaque to long wave radiation. Their action is similar to that of increased humidity in a greenhouse.

Gross Vehicle Weight Rating: The weight of the empty vehicle plus the maximum anticipated load weight.

Heavy Duty Vehicles: Pursuant to the EPACT, trucks and buses having a gross vehicle weight rating of 8,500 pounds or more.

Hydrogen (H_2): The lightest of all gases, the element (hydrogen) occurs chiefly in combination with oxygen in water. It also exists in acids, bases, alcohols, petroleum, and other hydrocarbons.

Light Duty Vehicles: Automobiles and trucks having a gross vehicle weight rating of less than 8,500 pounds.

Liquefied Natural Gas (LNG): Natural gas that has been refrigerated to temperatures at which it exists in a liquid state.

Liquefied Petroleum Gases (LPG): Propane, propylene, normal butane, butylene, isobutane, and isobutylene produced at refineries or natural gas processing plants (includes plants that fractionate raw natural gas plant liquids).

Lower Heating Value (LHV): The Btu content per unit of fuel excluding the heat from the condensation of water vapor in the fuel.

M85:A fuel containing a mixture of 85 percent methanol and 15 percent gasoline.

M100: 100 percent (neat) methanol.

Methane (CH_4): The simplest of the hydrocarbons and the chief constituent of natural gas. Methane, a gas at normal temperatures and pressures, boils at -263 degrees Fahrenheit.

Methanol (CH_3OH): A colorless liquid with essentially no odor and very little taste. The simplest alcohol, it boils at 64.7 degrees Celsius. It is miscible with water and most organic liquids (including gasoline) and is extremely flammable, burning with a nearly invisible blue flame. Methanol is produced commercially by the catalyzed reaction of hydrogen and carbon monoxide. It was formerly derived from the destructive distillation of wood, which caused it to be known as wood alcohol.

Methyl Tertiary Butyl Ether (MTBE), $(CH_3)_3COCH_3$: A colorless, flammable, liquid oxygenated hydrocarbon that contains 18.15 percent oxygen and has a boiling point of 55.2 degrees Celsius. It is a fuel oxygenate produced by reacting methanol with isobutylene.

Midwest Census Region: This U.S. Census Bureau region includes the following States: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

Mcf: Million cubic feet.

Motor Gasoline Blending of Oxygenates: Blending of gasoline and oxygenates under the Environmental Protection Agency's "Substantially Similar" Interpretive Rule (56 FR [February 11, 1991]).

Natural Gas: A mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions. The primary constituent compound is CH_4. Gas coming from wells also can contain significant amounts of ethane, propane, butanes, and pentanes, and widely varying amounts of carbon dioxide and nitrogen. Pipeline-quality natural gas has had most, but not all natural gas liquids and other contaminants removed. On board a vehicle, it is stored under high pressure at 2,500 to 3,600 pounds per square inch (psi). A gallon of natural gas at 2,000 psi contains about 20,000 Btu; at 3,600 psi, a gallon contains about 30,000 Btu.

Neat Alcohol Fuels: Straight alcohol (not blended with gasoline) that may be either in the form of ethanol or methanol. Ethanol, as a neat alcohol fuel, does not need to be at 200 proof; therefore, it is often used at 180 to 190 proof (90 to 95 percent). Most methanol fuels are not strictly "neat," since 5 to 10 percent gasoline is usually blended in to improve its operational efficiency.

Nitrogen Oxides (NO_x): Air-polluting gases contained in automobile emissions, which are regulated by the Environmental Protection Agency. They comprise colorless nitrous oxide (N_2O) (otherwise known as dinitrogen monoxide, or as the anaesthetic "laughing gas"), colorless nitric oxide (NO), and the reddish-brown-colored nitrogen dioxide (NO_2). Nitric oxide is very unstable, and on exposure to air it is readily converted to nitrogen dioxide, which has an irritating odor and is very poisonous. Nitrogen dioxide contributes to the brownish layer in the atmospheric pollution over some metropolitan areas. Other nitrogen oxides of less significance are nitrogen tetroxide (N_2O_4) and nitrogen pentoxide (N_2O_5). Nitrogen oxides are sometimes collectively referred to as "NO_x" where "x" represents any proportion of oxygen to nitrogen.

Nonattainment Area: A region that exceeds minimum acceptable National Ambient Air Quality Standards (NAAQS) for one or more criteria pollutants, in high population density areas, in accordance with the U.S. Census Bureau population statistics. Such regions (areas) are required to seek modifications to their State Implementation Plans, setting forth a reasonable timetable using means (approved by the Environmental Protection Agency) to achieve attainment of NAAQS by a certain date. Under the Clean Air Act, if a nonattainment area fails to attain NAAQS, the Environmental Protection Agency may superimpose a Federal Implementation Plan with stricter requirements or impose fines, construction bans, or cutoffs in Federal grant revenues until the area achieves applicable NAAQS.

Northeast Census Region: This U.S. Census Bureau region includes the following States: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

Original Equipment Manufacturers (OEM's): Vehicle manufacturers that provide the original design and materials for assembly and manufacture of their product. They are directly responsible for manufacturing and modifying vehicles, making the vehicles commercially available, and providing a warranty for the finished product.

Oxygenated Fuel: Any fuel substance containing oxygen (includes oxygen-bearing compounds such as ethanol and methanol). Oxygenated fuel tends to give a more complete combustion of its carbon into carbon dioxide (rather than monoxide), thereby reducing air pollution from exhaust emissions.

Oxygenated Gasoline: Gasoline with an oxygen content of 1.8 percent or higher, by weight, that has been formulated for use in motor vehicles.

Ozone (O_3): An oxygen molecule with 3 oxygen atoms that occurs as a blue, harmful, pungent-smelling gas at room temperature. The stratospheric ozone layer, which is a concentration of ozone molecules located at 6 to 30 miles above sea level, is in a state of dynamic equilibrium. Ultraviolet radiation forms the ozone from oxygen, but can also reduce the ozone back to oxygen. The process absorbs most of the ultraviolet radiation from the sun, shielding life from the harmful effects of radiation. Tropospheric ozone is normally present at the ground level in low concentrations. In cities where high levels of air pollutants are present, the action of the sun's ultraviolet light can, through a complex series of reactions, produce a harmful concentration of ozone in the air. The resulting air pollution is known as photochemical smog. Certain air pollutants (e.g., chlorofluorocarbons) can drift up into the atmosphere and damage the balance between ozone production and destruction, resulting in a reduced concentration of ozone in the layer.

Ozone Precursor: A chemical compound (such as nitrogen oxides, methane, nonmethane hydrocarbons and hydroxyl radicals) that, in the presence of solar radiation, reacts with other chemical compounds to form ozone.

Petroleum: A generic term applied to oil and oil products in all forms (such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and finished petroleum products).

Propane (C_3H_8): A normally gaseous straight-chain hydrocarbon, it is a colorless paraffinic gas that boils at a temperature of -43.67 degrees Fahrenheit. It is extracted from natural gas or refinery gas streams.

Reformulated Gasoline (RFG): Gasoline whose composition has been changed (from that of gasolines sold in 1990) to 1) include oxygenates, 2) reduce the content of olefins and aromatics and volatile components, and 3) reduce the content of heavy hydrocarbons to meet performance specifications for ozone-forming tendency and for release of toxic substances (benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and polycyclic organic matter) into the air from both evaporation and tailpipe emissions.

Replacement Fuel: The portion of any motor fuel that is methanol, ethanol, or other alcohols, natural gas, liquefied petroleum gases, hydrogen, coal derived liquid fuels, electricity (including electricity from solar energy), ethers, or any other fuel the Secretary of Energy determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits.

South Census Region: This U.S. Census Bureau region consists of the following States: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

Tax Incentives: In general, a means of employing the tax code to stimulate investment in or development of a socially desirable economic objective without the direct expenditure from the budget of a given unit of government. Such incentives can take the form of tax exemptions or credits.

Tertiary Amyl Methyl Ether (TAME) $(CH_3)_2(C_2H_5)$-$COCH_3$: An oxygenate blend stock formed by the catalytic etherification of isoamylene with methanol.

West Census Region: This U.S. Census Bureau region consists of the following States: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.