

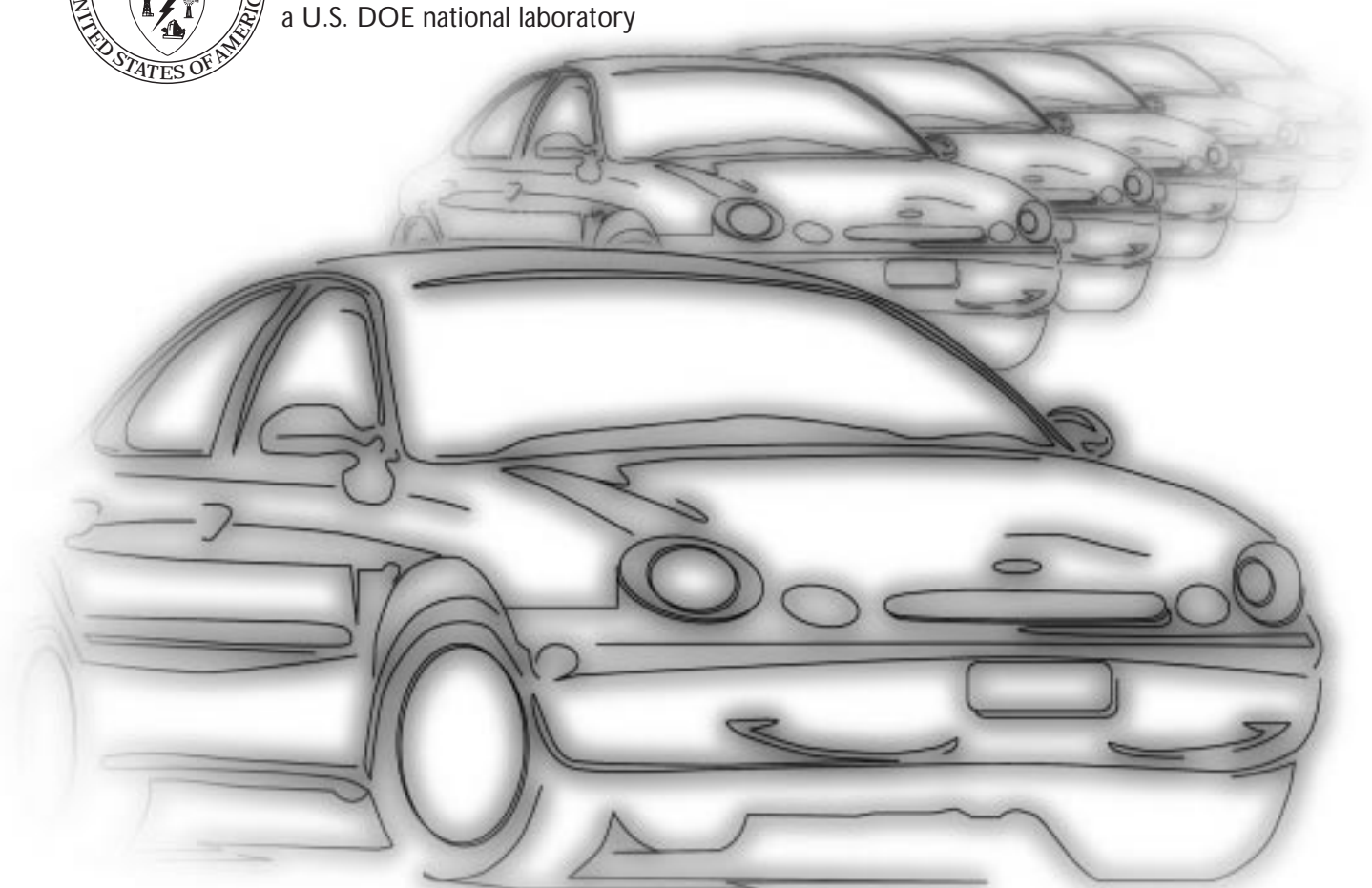
Perspectives on AFVs:

State and City Government Fleet Manager Survey

M. Whalen, T. Coburn, and L. Eudy



Produced for the U.S. Department of Energy (DOE)
by the National Renewable Energy Laboratory (NREL),
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Executive Summary

For this survey, interviews were conducted with state government and local government fleet managers who are operating light-duty alternative fuel vehicles (AFVs) in their fleets. Through a series of questions, the survey collected information about vehicle use and acceptability, fuel availability, fuel use, and vehicle performance. In all, data from 300 state government (all 50 states), and 287 local government (44 selected cities) fleet managers were collected and analyzed. Data were collected from fleets operating original equipment manufacturer vehicles fueled by compressed natural gas (CNG), ethanol (E85), methanol (M85), and electricity, and aftermarket conversion vehicles fueled by CNG and liquefied petroleum gas (LPG).

The survey results indicated that aftermarket conversions (CNG-fueled or LPG-fueled) were the most common primary AFV type in both the state and city government fleets. This was followed by ethanol flexible-fuel vehicles, again in both fleet manager groups. Fuel flexibility, as evidenced by the numbers of bi-fuel and flexible-fuel vehicles in these fleets, may be a factor in AFV selection for many of these fleets. Most of these state and city fleet managers reported having 10 or fewer AFVs in their fleets, and AFVs typically represented less than 6.5% of the light-duty vehicles in the fleets.

For the most part, these fleet managers assign their AFVs to individuals or groups, just like their gasoline vehicles. In both the state and city results, most fleet managers said their drivers do not have a preference for or against using AFVs. Among fleet managers who indicated their drivers do not want to drive AFVs, the most common reason cited was limited fuel availability.

Despite the concern about fuel availability, most of the fleet managers reported that alternative fuel is available reasonably near their fleet location. Among the different alternative fuel types, M85 appears to be the least available alternative fuel. More than half of the state and city fleet managers reported that their AFVs are most commonly refueled at public service stations.

Fuel availability does not necessarily translate to a high percentage of alternative fuel use in cases where drivers have a vehicle that can use either alternative fuel or gasoline. However, among the fleet managers whose primary AFV type was bi-fuel or flexible-fuel, the majority indicated that their AFVs are operated 50% or more of the time on the alternative fuel.

Perspectives on AFVs

Distributions of responses about reports of performance-related complaints, maintenance, operating costs, and overall satisfaction indicate that the AFVs being operated in these fleets compare reasonably well to their gasoline vehicles. There were some differences in the distributions of responses to performance-related queries by AFV type. Of note, the aftermarket conversions (CNG and LPG) received most of the fleet managers' reports of performance-related complaints and received the most reports of overall dissatisfaction.

The survey results indicate that both state and city government fleets are using the available AFV types in their fleet applications. Although there are fuel availability issues in some places and some vehicle performance issues associated with using the different types of AFVs, the AFVs generally appear to be meeting the needs of these state and city government fleets.



Introduction

In an effort to reduce national dependence on imported oil and to improve urban air quality, the U.S. Department of Energy (DOE) is promoting the development and deployment of alternative fuels and alternative fuel vehicles (AFVs). To support this activity, DOE has directed the National Renewable Energy Laboratory (NREL) to develop and conduct projects to evaluate the performance and acceptability of light-duty AFVs compared to similar gasoline vehicles. As part of this effort, NREL has undertaken a number of evaluation projects, including conducting surveys with fleet managers and drivers of AFVs in state government fleets and local government fleets.

For this survey report, fleet managers from state and local government were interviewed as a follow up to the previous surveys conducted with fleet managers and drivers operating AFVs in federal government fleets. The results from the federal fleet surveys have been summarized and reported previously (Whalen and Coburn, 1997). The surveys were developed to collect information on fuel use, fuel availability, vehicle performance, maintenance, and acceptability from the perspective of both drivers and fleets. This report summarizes the results of the survey.

AFVs Used in U.S. Fleets

Currently, under the Energy Policy Act (EPAct), state government and fuel providers are mandated to include a certain percentage of AFVs in their new vehicle purchases. In 1998, 50% of federal and 25% of state fleet vehicle purchases were required to be AFVs. In addition, 70% of fuel provider fleet vehicle purchases in covered areas were required to be AFVs. The current mandates do not include municipal and private fleets, but many of these fleets are voluntarily seeking to include AFVs in their fleets in anticipation of future requirements, or as part of local efforts to improve air quality. There are estimated to be more than 400,000 AFVs operating in fleets across the United States (Energy Information Administration [EIA], 1997). Of these AFVs, it is estimated that more than 328,000 are light-duty vehicles (LDVs). The LDV classification includes sedans, pickup trucks, and some passenger/cargo vans, and is generally applied to a vehicle with a gross vehicle weight up to 8,500 pounds. Nearly, 75,000 of these light-duty AFVs are being operated in state and local government fleets, and an additional 230,000 are being operated in private fleets. These vehicles are located throughout the country and are used in a variety of different applications.

The AFVs in the light-duty fleets can be grouped by the alternative fuel used: compressed natural gas (CNG), liquefied petroleum gas (LPG, often referred to as propane), methanol (M85), ethanol (E85), and electricity (ELEC). CNG vehicles can be any of three different types—dedicated original equipment manufacturer (OEM) models, which run only on CNG; aftermarket conversions, which can be dedicated or bi-fuel; and bi-fuel OEM models. The bi-fuel vehicles can run on either CNG or gasoline, but not on both at the same time. LPG vehicles include both aftermarket conversions (the vast majority of LPG vehicles) and a limited number of bi-fuel OEM vehicles. As with CNG vehicles, bi-fuel LPG vehicles can be operated on LPG or gasoline, but not at the same time. The ethanol and methanol vehicles are flexible-fuel models from the OEMs. Flexible-fuel means the vehicles can operate on any combination of the alternative fuel and gasoline, up to a blend of 85% alternative fuel and 15% gasoline or 100% gasoline. The electric vehicle category includes both OEM vehicles and gasoline vehicles converted to operate on electricity.

According to EIA estimates (EIA, 1997), LPG vehicles are the most numerous AFV types used in state/local government and private fleets—estimated to represent 60% and 77% of AFVs, respectively, in these fleets. The next most common AFV type is a CNG-fueled vehicle, estimated to be 22% of state/local government fleet AFVs. E85, M85, and electric vehicles each represent less than 10% of the AFVs in these fleets.

Other AFV Surveys

Other AFV-related surveys have been conducted in recent years, each with differing objectives and approaches. DOE's EIA has conducted several surveys to collect information on AFVs and alternative fuel use (EIA 1996, 1997). The EIA surveys focused on estimating the numbers and types of AFVs in use, the consumption of alternative fuel, and the number and types of AFVs available. EIA relied heavily on secondary sources for much of its data, including government agencies (federal, state, and local), AFV manufacturers, and energy suppliers.

In 1996, a survey was conducted with federal fleet managers who were operating AFVs (Whalen and Coburn, 1997). This survey was designed to collect information from fleet managers about in-service AFVs in federal fleets. It also sought some comparative information from fleet managers about similar gasoline vehicles in their fleets. The current survey is very similar, but the target population includes state and local government fleet managers.



Survey Development, Implementation, and Data Analysis

State and city fleet managers were selected as the target population for this survey, which is a follow-up to the previous survey with the U.S. federal fleet. As with the federal fleet survey, the population of state and city fleet managers is functionally and geographically diverse, with no single comprehensive list of names available. Therefore, a detailed contact list of appropriate state and local government fleet managers had to be constructed, drawing on several different sources, including the National Fleet Vehicle database and the American Business Institute's white pages. The development of the contact list included identifying fleet managers in all 50 states (for the state government survey), and in 48 selected cities (for the local government survey). In all, a list of more than 4,500 fleet managers was developed, including state and local government contacts. Fleet managers were randomly selected from the contact list, with some effort made to choose participants in areas where alternative fuels were known to be available. No attempt was made to stratify the sample in advance according to AFV type, model, make or manufacturer of vehicle, although such information was collected from each respondent.

After evaluation of survey resources and population, a target sample size of 250 state fleet managers and 288 local government fleet managers was established. The goal was to complete interviews with five fleet managers in each state and to complete interviews with six fleet managers in each city. In total, 617 fleet managers (state and city) were interviewed from the list of 4,549 contacts, yielding an overall sampling rate of 13.6%. The fleet managers interviewed included 303 state government and 314 local government fleet managers. The desired number of interviews was exceeded in several states and cities, and at least five interviews were completed in each state. The interviewers left messages when they were not able to directly contact fleet managers, and would proceed to make other contacts. Many of the fleet managers called back, and the interviewers would conduct the interview(s) even if they had reached their quota for that state or city. Some problems were encountered in trying to complete the desired number of interviews in four of the originally selected cities. These cities were replaced with other comparable-sized cities, and the goal of completing six interviews in each selected city was reached.

On evaluation of both complete data sets, a number of responses were eliminated from the detailed data analysis. Some reasons for excluding responses included the primary AFV type identified was not a light-duty vehicle, the response was from a city which was replaced, or the response was from outside the designated coverage area for the city. In all, data from 300 state government (all 50 states), and 287 local government (44 of the selected cities) responses were included in the detailed analysis.

The 300 state fleet managers and 287 city fleet managers interviewed reported operating 25,628 AFVs (combined total, with 17,500 in the state fleets and

8,128 in the city fleets) in their fleets. This total represents 34% of all the light-duty AFVs (74,820) estimated by the EIA (1997) to have been operated by state and city government organizations during 1996. Along with the sampling rates of 11.8% for the state fleet managers, and 14.3% for the city fleet managers, this information points to a highly representative sample on which to base survey conclusions.

The sample size in this survey is sufficient to maintain an overall margin of error of approximately 4% at 95% confidence. For the two subgroups, state fleet managers and city fleet managers, the margins of error are estimated to be 6% and 5%, respectively, at 95% confidence. The margins of error associated with percentages or proportions of other subgroups of the population may be higher, due to smaller effective sample sizes.

NREL personnel developed the survey questionnaire, which included questions about AFV acceptability, fuel use, and subjective vehicle performance. The survey included the same questions asked of federal fleet managers during an earlier survey (Whalen and Coburn, 1997), in addition to several new questions. The new questions sought additional feedback on fuel stations, vehicle maintenance, overall satisfaction, and costs of operating AFVs. The survey was conducted from October through early December 1997.

The staff of Petroleum Information-Dwights, a subcontractor to NREL, conducted the interviews using conventional telephone interviewing techniques. All survey responses were recorded on individual survey forms, and tabulated for subsequent analysis. There was essentially a 100% response rate in this survey, in that every subject responded to at least part of the interview. Such a high degree of success is attributable to the fleet managers' interest in AFVs. State fleets are required to include a certain percentage of AFVs in their new light-duty vehicle purchases. Many state fleets have used AFVs in their fleets for some time, so many of them are accustomed to being questioned about their AFVs. Many cities are looking to AFVs as part of addressing local air quality issues, or in anticipation of potential mandates.

The general approach to the analysis of the survey data involved use of cross-tabulations and contingency tables, with survey data subdivided into appropriate groupings. Descriptive statistics (such as means, percentages, and standard deviations) were also compiled. Formal tests of statistical significance were performed to assess differences between categories and groups, where appropriate. Some of the results of such tests are reported (usually in the form of Chi-square statistics and associated probabilities) in appropriate sections of this report. All data analyses were conducted using the JMP statistical software from the SAS Institute.

The principal grouping involved subdivision by primary AFV type operated by each fleet. The state government data was also analyzed and compared by census region (Northeast, Midwest, South, and West) to determine if any regional differences in responses would be revealed. In addition, the local government data were analyzed according to whether the city/area is a participant in the DOE's Clean Cities Program. Clean Cities is a locally based government/industry partnership coordinated by DOE, and focused on expanding use of alternatives to gasoline and diesel fuel. No target numbers by AFV type were established in advance, because we wanted to ascertain which of the AFV types are being most commonly operated in fleets across the country.



Respondent and Fleet Characteristics

As discussed in the previous section, the results from 300 state government and 287 local government interviews were included in the detailed data analysis. The number of interviews conducted in each state and city are summarized in Table 1 and Table 2. At least five interviews were completed in each state, with a maximum of 11 completed with fleet managers in Iowa. The final analysis included responses from 44 different cities, each with at least 6 interviews completed.

The cities were selected to geographically represent the country, and to include different size cities. Of the selected cities, 50% (22 of 44) were designated as, or were participants in, city or regional Clean Cities programs as of September 30, 1997. The city sizes are defined by population as follows: large, greater than 500,000 people; medium, from 200,000 to 500,000 people; and small, less than 200,000 people. The survey encompassed 14 large cities, 16 medium cities, and 14 small cities, equally divided between Clean Cities and other cities.

During the interview process, fleet managers were asked to identify the primary type of AFV in their fleets. Figure 1 shows the number of respondents whose primary AFV type was a CNG, E85, electric, M85, or LPG model. The responses about CNG models were further divided into aftermarket conversions (CNG-CON), and OEM dedicated (CNG-DED) or OEM bi-fuel (CNG-BI) vehicles.

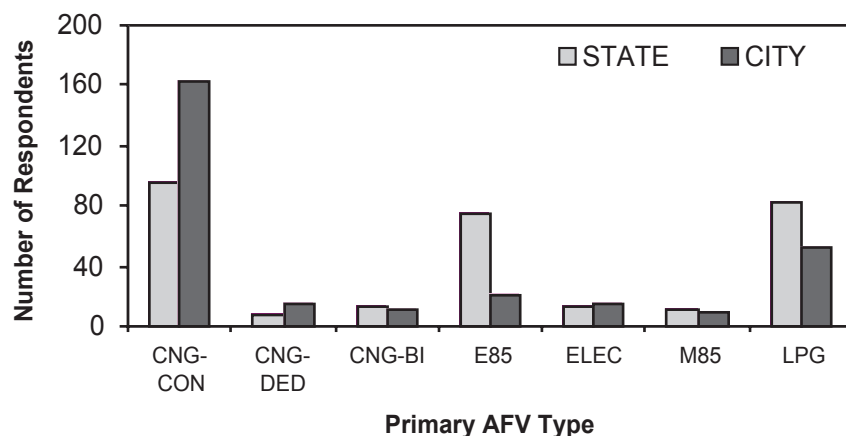


Figure 1. Numbers of state and city fleet managers by primary AFV type in their fleets

Perspectives on AFVs

STATE	CNG-CON	CNG-DED	CNG-BI	E85	ELEC	M85	LPG	TOTAL
AK	4	1						5
AL	2			2		1	2	7
AR	5	1						6
AZ	3		1			1	1	6
CA	1				1	5	1	8
CO	1	1	1				3	6
CT	3						3	6
DE	2		1				2	5
FL					2		4	6
GA	4						1	5
HI					3		2	5
IA	1			1				2
ID	1			4				5
IL				7				7
IN	2			3				5
KS	1			4				5
KY	1			4				5
LA	4						1	5
MA	2						3	5
MD	4		4				1	9
ME							5	5
MI	3						1	4
MN				5			1	6
MO	4			4			2	10
MS	3						2	5
MT							5	5
NC					2		7	9
ND	1			6				7
NE	1			6				7
NH	1					1	3	5
NJ	2	1					2	5
NM				1			9	10
NV	4		1				1	6
NY	2					1	2	5
OH	1			3			1	5
OK	3		1	1				5
OR	3	2						5
PA	2		2				1	5
RI	1	2	1				1	5
SC	1				1		4	6
SD	1			5				6
TN				3	1		1	5
TX	1						5	6
UT	6							6
VA	2		1				2	5
VT	1				4			5
WA	2			1		2		5
WI	1			5			1	7
WV	4		1				2	7
WY	5						1	6
TOTAL	96	8	14	74	14	11	83	300

Table 1. Number of responses from state fleet managers by state and primary AFV type

State and City Government Fleet Manager Survey

Table 2. Number of responses from city fleet managers by city and primary AFV type

CITY	CNG-CON	CNG-DED	CNG-BI	E85	ELEC	M85	LPG	TOTAL
ALBUQUERQUE, NM	7	1						8
ANCHORAGE, AK	1	1						8
ATLANTA, GA	4	2						6
AUSTIN, TX	1						5	6
BALTIMORE, MD	5						1	6
BATON ROUGE, LA	5		1					6
BISMARCK, ND	5			1	1			7
BOSTON, MA	6							6
BUFFALO, NY	6							6
CARSON CITY, NV	2		1				3	6
CHARLESTON, WV	8							8
CHEYENNE, WY	7							7
CHICAGO, IL	1			4	1			6
COLUMBUS, OH	6			1			1	8
DENVER, CO	5						3	8
HONOLULU, HI							6	6
HOUSTON, TX	4		2					6
INDIANAPOLIS, IN	4	1		1			1	7
KANSAS CITY, MO	4	2						6
LANSING, MI	6							6
LITTLE ROCK, AR	3	2	1					6
LOS ANGELES, CA	5				1	4	1	11
MADISON, WI	1			2			3	6
MEMPHIS, TN	2			2			2	6
MISSOULA, MT							6	6
NASHVILLE, TN			1	3		1	1	6
NORWICH, CT	6							6
OAKLAND, CA	2	2	2		1			7
OKLAHOMA CITY, OK	6							6
OMAHA, NE	4						2	6
PEORIA, IL	6			2				8
PHOENIX, AZ	4					1	1	6
PORTLAND, ME	2				4		1	7
PORTLAND, OR	4				1		2	7
PROVO, UT	6							6
RALEIGH, NC	3				1		2	6
RICHMOND, VA	5		1					6
ROANOKE, VA	1	1	1				4	7
SACRAMENTO, CA	2					4		6
SAN ANTONIO, TX							6	6
SEATTLE, WA	5						1	6
ST PAUL, MN	1	1		4			1	7
SYRACUSE, NY	2	1	2		1			6
TOLEDO, OH	5	1						6
TOTAL	162	15	12	2	15	1	53	287

Perspectives on AFVs

One hundred eighteen state fleet managers (39.3%) identified CNG models as the primary AFV type in their fleets, followed by 83 (27.7%) identifying LPG models, 74 (24.7%) identifying E85 models, 14 (4.7%) indicating ELEC models, and 11 (3.7%) M85 models. Among respondents with CNG models as their primary AFV type, fleets with aftermarket conversions predominated, with 96 of the total 118 CNG responses.

When evaluated by census region (see Figure 2a), some differences in distribution of responses by primary AFV type can be seen. In the South and the West, CNG-fueled vehicles were the AFV type reported most often (46.7% and 47.4% of respondents, respectively). In the Northeast, the most commonly reported primary AFV type was evenly split between CNG- and LPG-fueled AFVs (43.5% each). Ethanol-fueled (E85) AFVs dominated the primary AFV types (72.5%) reported by the state fleet managers in the Midwest.

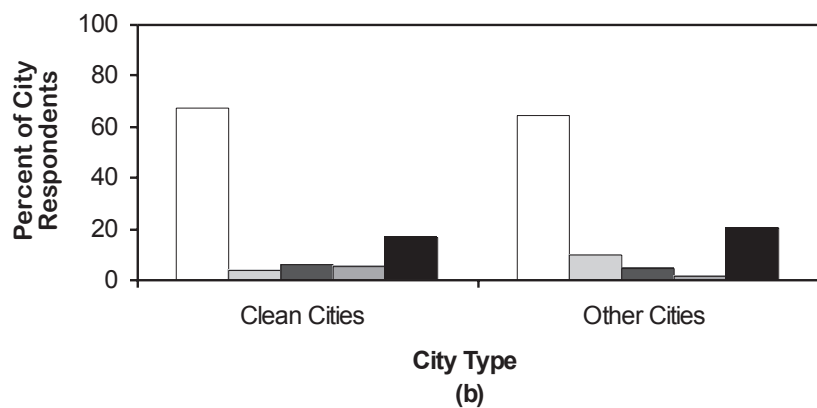
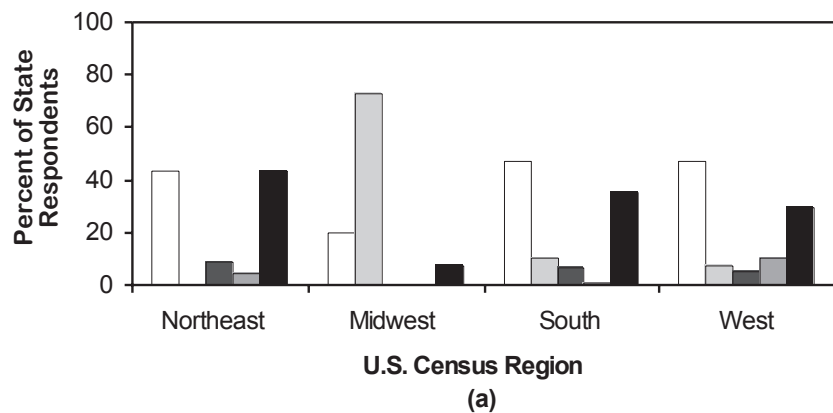


Figure 2. Percentage distribution of respondents by primary AFV type in their fleets: (a) state fleet managers by census region and (b) city fleet managers by city type

Overall, the local government fleet manager responses about primary AFV type came out in the same order as that of the state fleet managers—CNG, LPG, E85, electric, and M85—but nearly 27% more respondents indicated their primary AFV type was CNG-fueled (189 or 65.8% of respondents). This is followed by 18.5% indicating LPG models, 7.0% indicating E85 models, 5.2% responding electric models, and 3.5% saying M85 models. When grouped by Clean Cities and other cities (see Figure 2b), there was

little difference in the distribution of the primary AFV type identified by the responding fleet managers.

The fleets represented by the 300 state survey respondents contained a total of 274,509 light-duty vehicles (all types combined). In the case of the local government respondents, the fleets represented included a total of 167,031 light-duty vehicles (all types combined).

Of particular interest are the numbers of AFVs contained in the fleets of the survey respondents. The responding state fleet managers reported having a total of 17,508 AFVs (6.4% of all vehicles) in their fleets. The city fleet managers reported having a total of 8,128 AFVs (4.9% of all vehicles) in their fleets. In a somewhat surprising finding, the total number of AFVs reported in designated Clean Cities was less than that reported in the other selected cities—2,884 AFVs (3.3% of all vehicles) compared to 5,244 AFVs (6.6% of all vehicles), respectively.

In evaluating the distribution of fleet sizes (see Figure 3), fleets containing 500 or more vehicles were most common for both the state and local fleets represented by the survey. Thirty-three percent of the state fleet managers and nearly 26% of the local government fleet managers reported fleet size at 500 or more vehicles. When evaluating the distribution of numbers of AFVs in the fleets, the results were quite different. Most state fleet managers (169 out of 300, or 56.3%) and city fleet managers (182 out of 287, or 63.4%) reported having 10 or fewer AFVs in their fleets.

The fleet sizes represented by the respondents varied widely from thousands of vehicles to only one or two vehicles. The overall median fleet size was determined to be 200 vehicles for both the state and local government fleets. The median, or 50th percentile, is an average value that is not sensitive to wide numerical fluctuations. Figure 4 shows the median fleet sizes for total fleets and total AFVs, grouped by primary AFV types. For the state fleets, this figure indicates that fleets with CNG vehicles as their primary AFV type tend to be larger than fleets with other vehicles as their primary AFV type. It also indicates that the median numbers of AFVs are small in comparison—less than 20 for the state fleets and less than 10 vehicles for city fleets.

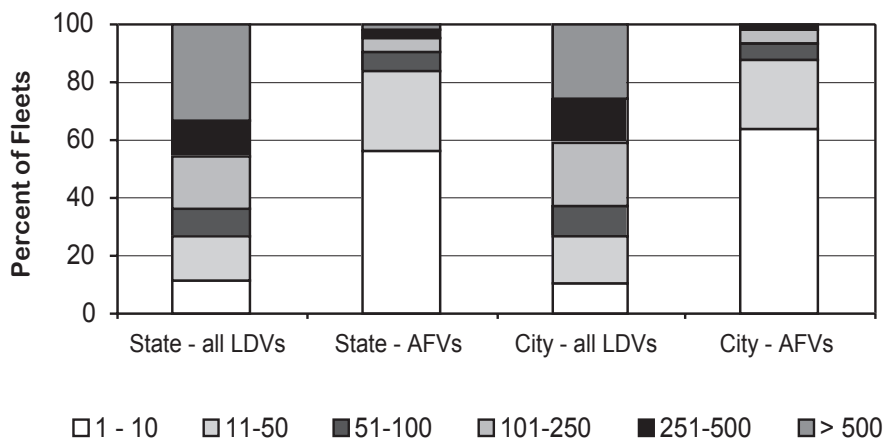


Figure 3. Fleet size distribution (number of vehicles per fleet) for all light-duty vehicles and AFVs

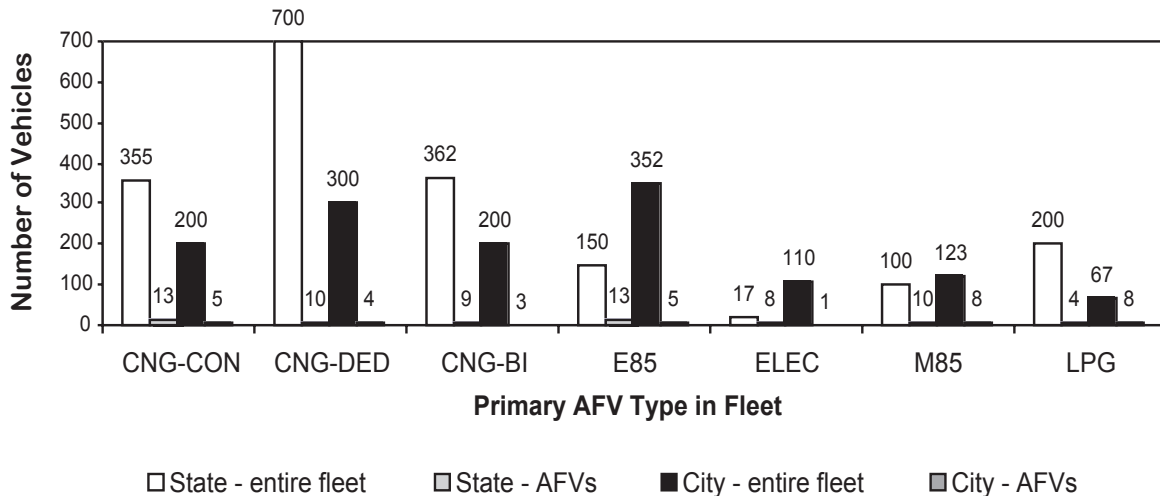


Figure 4. Median sizes of fleets by primary AFV type in those fleets

Operation of more than one AFV type was reported by 65 out of 300 (21.7%) state fleet, and 41 out of 287 (14.3%) local government fleets. This means their fleets include AFVs that operate on one of the other alternative fuels, besides the fuel of their primary AFV type.

Results: Vehicle Use, Performance, and Acceptability

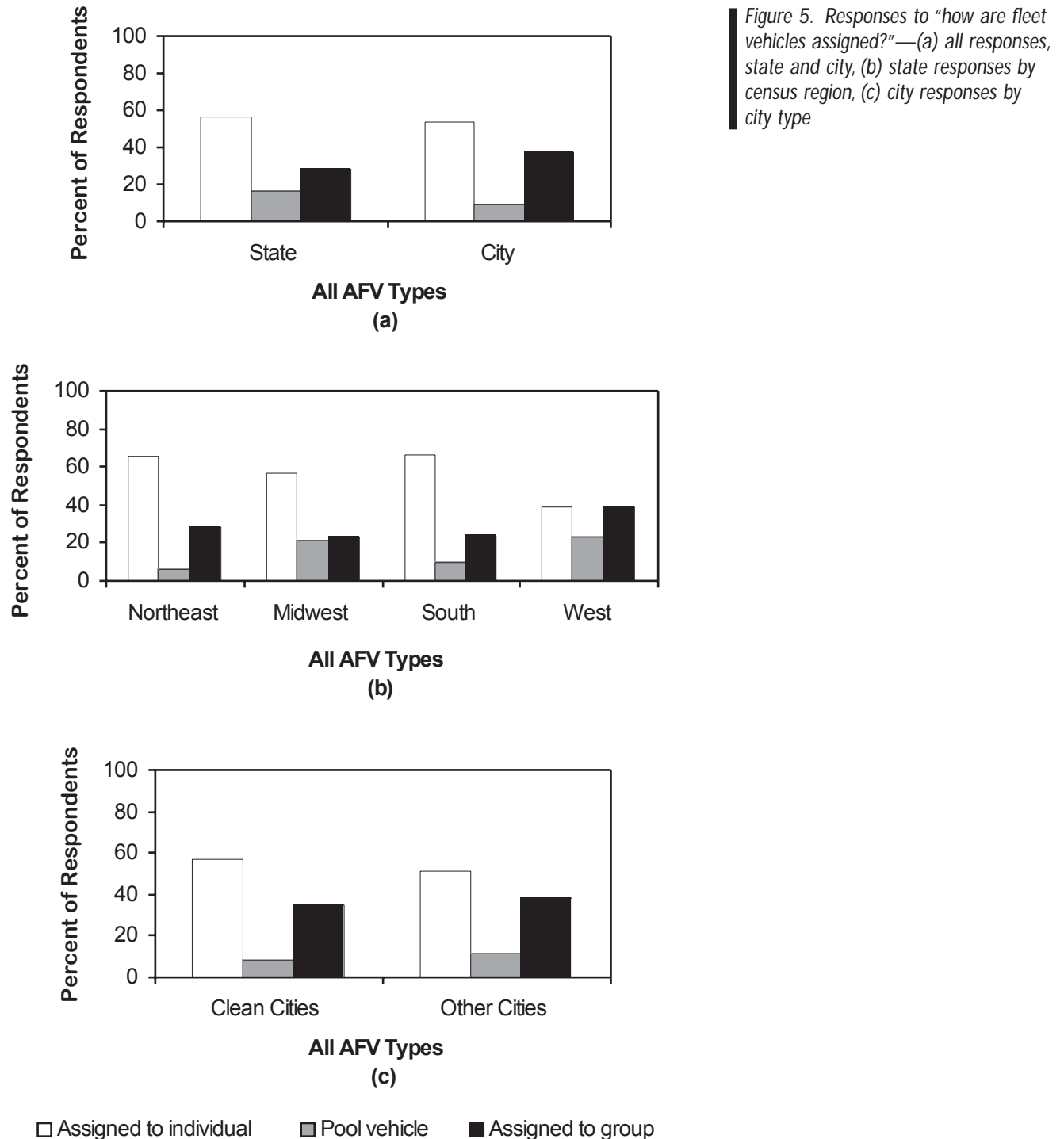
The use and incorporation of AFVs into fleets has increased over the last several years, mostly as a result of mandates under EPA Act. The survey results presented in the following sections provide information on the experiences of a number of state and local government fleet managers who are operating AFVs in their fleets. Most of the graphs and tabulations presented summarize all responses by fleet type—state or city government. Additional information is presented by region (state government response) or by city type (Clean Cities or other cities), where interesting differences were uncovered. (Other results pertaining to analyses by region or city type are included in Appendix A.)

Vehicle Assignment

Most survey participants (56% of state respondents and 54% of city respondents) reported that their fleet vehicles are assigned to a specific driver, as shown in Figure 5a. Only 16% of the state respondents and 9% of the city respondents indicated that the vehicles they manage are assigned to a vehicle pool. These results are quite different from those of the federal fleet survey, where the majority of respondents (67%) indicated vehicles are assigned to a group or department. This implies that most of the vehicles represented in this survey have only one driver, which may affect the types and amount of feedback the fleet managers receive about them.

A statistically significant difference ($\chi^2 = 20.1$, d.f. = 6, $\alpha = 0.02$) in response to the question about vehicle assignment was found when the state fleet manager responses were grouped by region (see Figure 5b).

State and City Government Fleet Manager Survey



Fleets with vehicles assigned to individual drivers are much less common in the West than in other regions (38.5% compared to a range of 56% to 66% in the other regions). When a similar comparison is done with the city responses grouped by Clean Cities and other selected cities (see Figure 5c), no difference is seen in how vehicles are assigned. Again, vehicle assignment may influence the types and amounts of feedback fleet managers receive about their vehicles and their subsequent survey responses, reported below.

Driver Acceptability

Fleet managers were asked whether their fleet vehicle drivers specifically want AFVs. The responses by primary AFV type are summarized in Figure 6 for the state fleet managers and in Figure 7 for the city fleet managers. In both the state and city results, with the exception of fleets whose primary AFV type is electric vehicles, more fleet managers said their drivers do not indicate a preference for or against use of AFVs. In regards to ELEC vehicles, most fleet managers—state and city—indicated drivers want to drive the electric vehicles. It is worth noting that many fleet managers also indicated that drivers generally do not have a choice of what vehicle they are assigned. Among the state fleet managers who indicated their drivers do not want to drive AFVs, the most common reason they gave was the limited availability of the alternative fuel. Similarly, city fleet managers reported vehicle performance problems, followed closely by limited vehicle range, as the most common reason drivers did not want to drive AFVs.

Figure 6. State fleet manager responses to "how acceptable are AFVs to drivers?" by fleet's primary AFV type

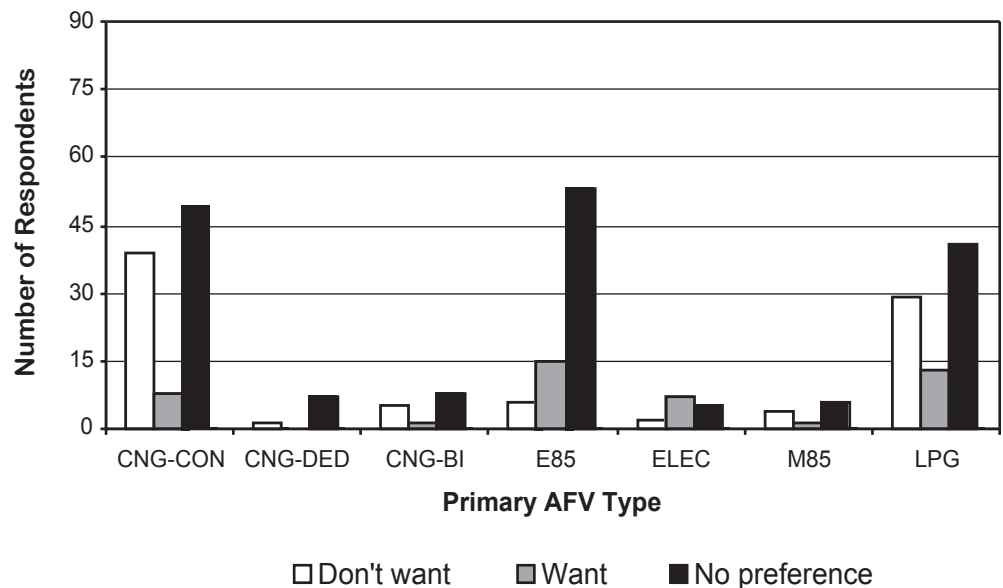
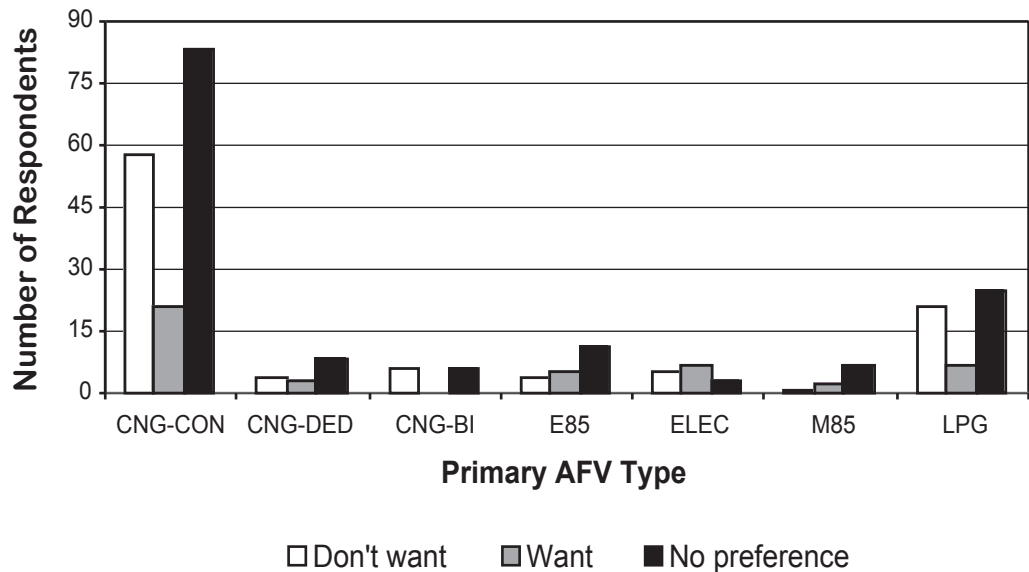


Figure 7. City fleet manager responses to "how acceptable are AFVs to drivers?" by fleet's primary AFV type



Alternative Fuel Availability

Fleet managers were questioned about the availability of alternative fuel in the area where their fleet operates. More than 72% of the state fleet managers and nearly 80% of the city fleet managers indicated an alternative fuel station is reasonably nearby. State and city fleet manager responses by primary AFV type are summarized in Figures 8 and 9, respectively. Alternative fuel stations were reported to be reasonably close to 60% or more of respondents operating most of the AFV types. However, it appears that state fleet managers operating M85 vehicles and city fleet managers operating dedicated CNG vehicles as their primary AFV type have less access to the alternative fuel.

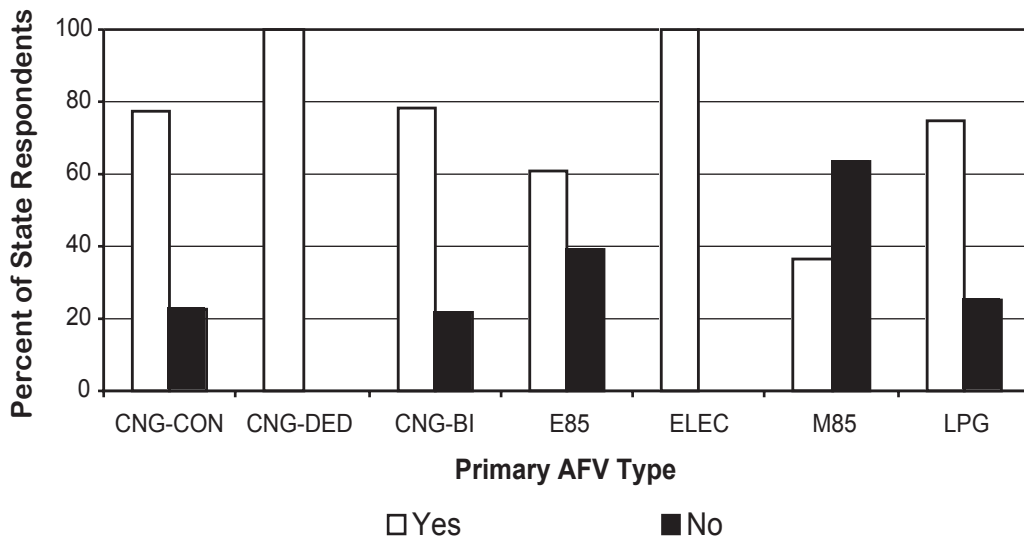


Figure 8. State fleet manager responses to "is there an alternative fuel station nearby?" by primary AFV type in fleet

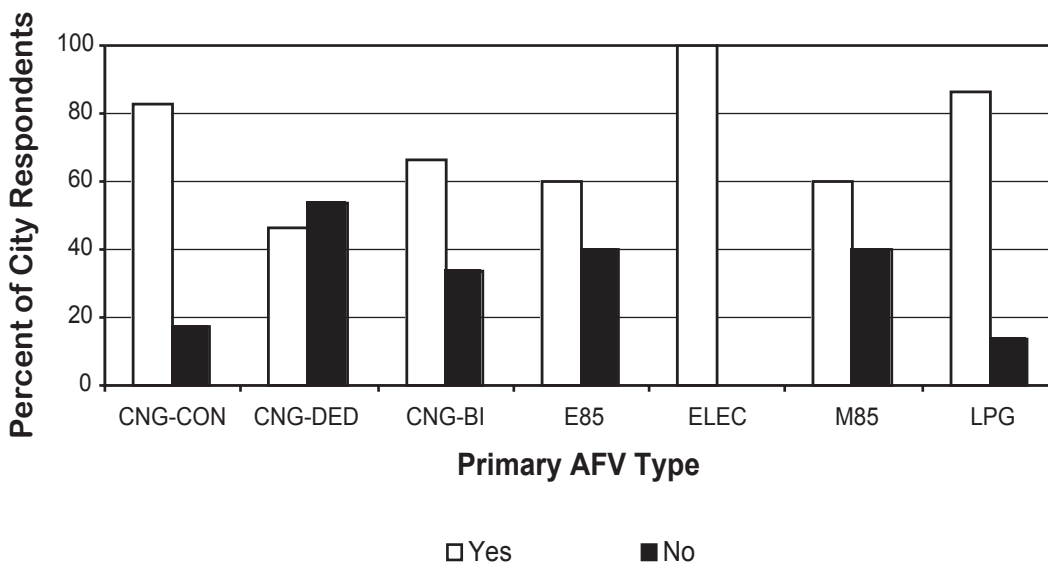


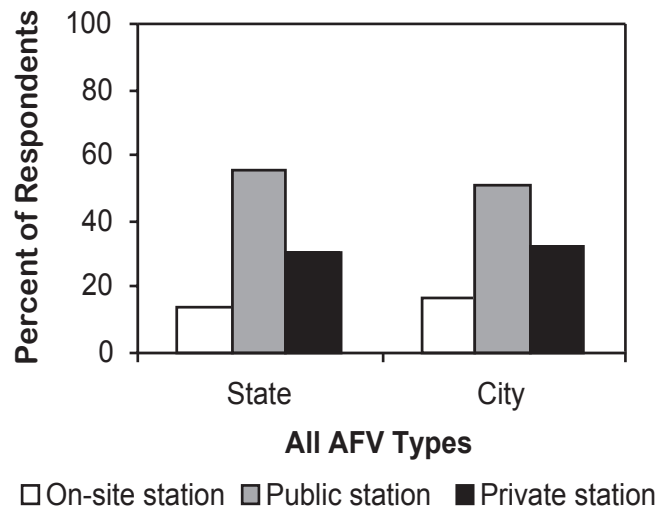
Figure 9. City fleet manager responses to "is there an alternative fuel station nearby?" by primary AFV type in fleet

In a related question, fleet managers were asked the type of fueling station used most often by their AFV fleets. Specifically they were asked whether they used an on-site, a public or a local private station. Most state and city fleet managers (55.7% and 51.2%, respectively) reported that public stations are used by their AFV fleets, as shown in Figure 10. On-site refueling stations were the least common types of station used according to both the state and city fleet managers.

Fueling Practices

Fleet managers were asked whether their AFVs are usually fueled with alternative fuel or gasoline. The responses are summarized in Figure 11a and 11b, and include only responses from fleet managers whose primary AFV types are bi-fuel and flexible-fuel vehicles (operators of dedicated vehicles must use the design fuel or not use their vehicle). Overall, 92.7% (278 of 300) of the state respondents and 89.5% (257 of 287) of the city respondents indicated their primary AFV types are either bi-fuel or flexible-fuel AFVs. Most of these state and city fleet managers (89.9% and 86.8%, respectively) responded that the AFVs in their fleets are mostly operated on alternative fuel. When the state results were analyzed by region, there were differences in the percent of responses among the regions, but these differences were not statistically significant. In addition, no difference was found in fuel use based on the responses from city fleet managers when grouped by Clean Cities and other selected cities (see Figures A-1 and A-2 in the Appendix). These findings are different from those in the survey of federal fleet managers, where only about 63% of respondents indicated their bi-fuel or flexible-fuel AFVs are operated on alternative fuel most of the time.

Figure 10. Fleet manager responses about the type of fueling station used by the AFV fleet



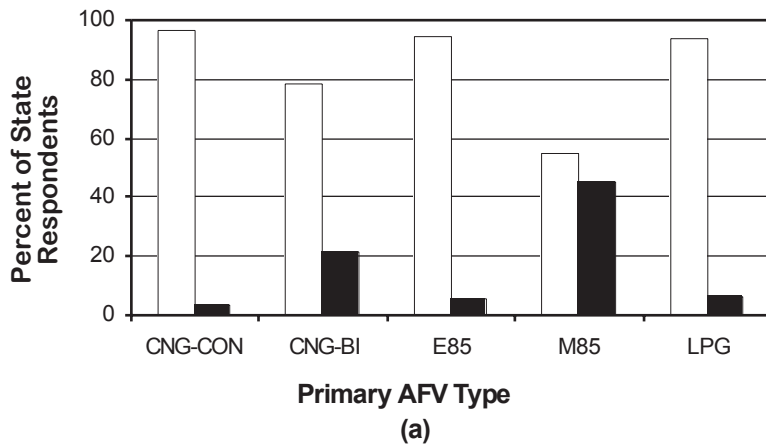
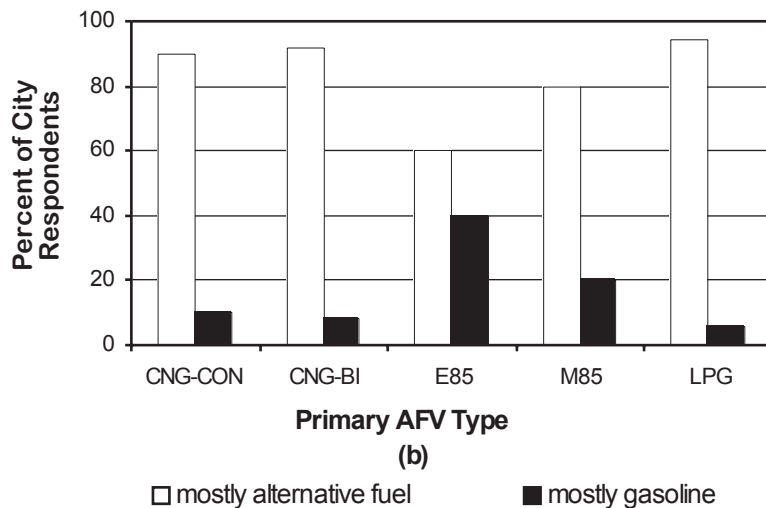


Figure 11. Fleet manager responses to "what fuel are your AFVs usually operated on?"—(a) state and (b) city, by primary AFV type in the fleet

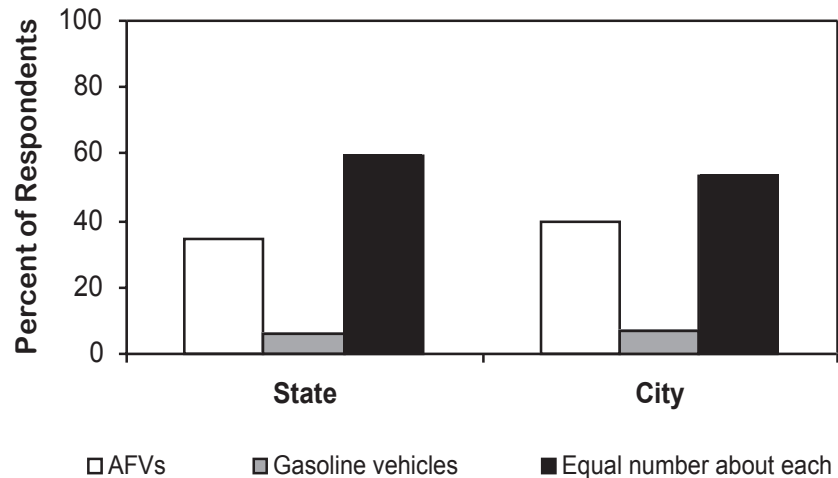


Vehicle Performance

Fleet managers were asked if their drivers tended to report more vehicle performance complaints about AFVs or about similar gasoline vehicles. The results for the state and city fleet managers, which are summarized in Figure 12, were very similar, with the majority of both (59.7% of state respondents and 53.7% of city respondents) indicating they get the same amount of complaints about AFVs and gasoline vehicles. Slightly more than 34% of the state respondents and 39% of the city respondents indicated that they receive more complaints about AFVs than gasoline vehicles. Finally, only 6% of state and 7% of city fleet managers said they receive more complaints about their gasoline vehicles.

Perspectives on AFVs

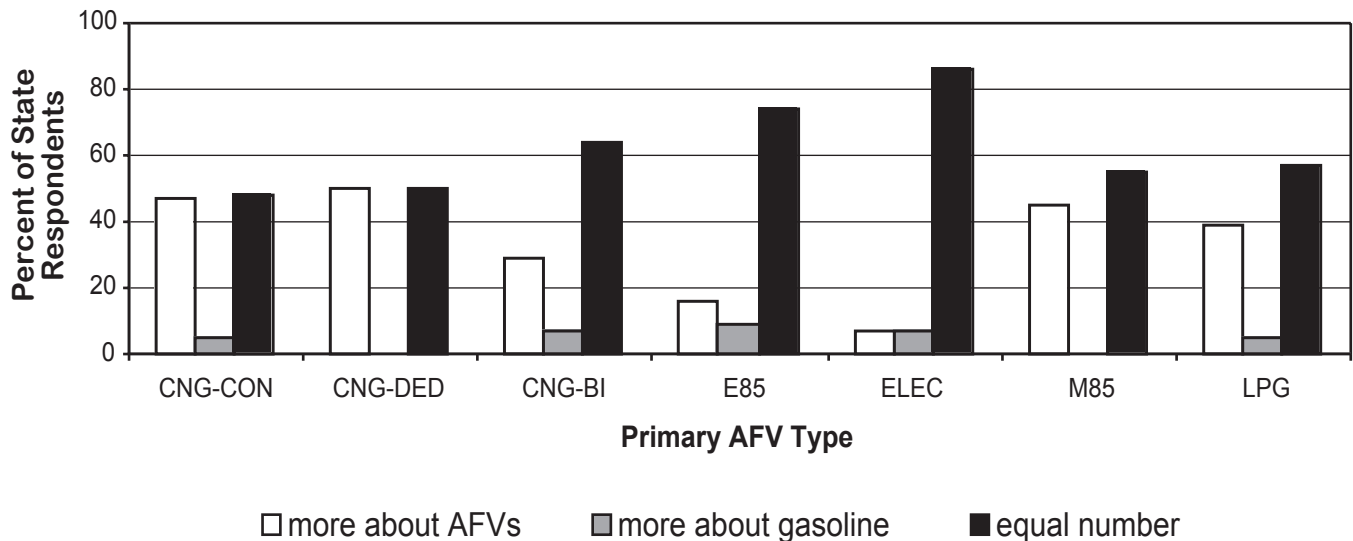
Figure 12. Responses to “which vehicle type do you receive more complaints about?”



When the responses were grouped by region, state fleet managers in the West were found to have reported significantly more complaints about AFVs than their counterparts in the other regions (52.6% of responses compared to 30.4% in the Northeast, 25.0% in the Midwest, and 29.2% in the South, respectively). The difference was significant at >99% confidence level ($\chi^2=18.67$, d.f.=6). No difference was found in reports of complaints received when the city fleet manager data were grouped by Clean Cities and other selected cities.

When the fleet manager responses about driver complaints were evaluated by primary AFV type, no statistically significant difference was found for the city fleet manager responses. However, differences were seen among state fleet manager responses. The state fleet managers operating CNG-CONs, CNG-OEMs and M85 vehicles as their primary AFVs reported significantly more complaints about their AFVs than fleets operating the other AFV types (see Figure 13). The differences among state fleet manager responses were found to be statistically significant at a >99% confidence level ($\chi^2=29.16$, d.f.=12).

Figure 13. State fleet manager responses to “which vehicle type do you receive more complaints about?” by primary AFV type



State and City Government Fleet Manager Survey

Fleet managers were asked whether they had received any of eight specific performance-related complaints about their AFVs in the last month. The number of state and city fleet managers reporting specific complaints is tabulated in Table 3 and 4, respectively. The data in these tables are grouped by primary AFV for each of the eight specific performance-related complaints, and the number of fleet managers reporting complaints. Twenty-eight percent of the state and 33% of the city fleet managers reported receiving at least one of the performance complaints about their AFVs. The most commonly reported complaints for both groups of fleet managers were vehicles “lacking power,” followed by vehicles being “hard to start.”

Table 3. State fleet manager reports of specific performance-related complaints about AFVs, by primary AFV type in the fleet

Problem Reported	Primary AFV Type															
	CNG-CON		CNG-DED		CNG-BI		E85		ELEC		M85		PROPANE		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Hard to start	12	18.8	1	33.3	1	16.7	4	25.0	0	0.0	2	25.0	15	19.5	35	20.1
Stall after starting	4	6.3	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	5	6.5	10	5.7
Stall in traffic	7	10.9	0	0.0	0	0.0	2	12.5	0	0.0	0	0.0	6	7.8	15	8.6
Poor idle	6	9.4	0	0.0	2	33.3	1	6.2	0	0.0	0	0.0	12	15.6	21	12.1
Hesitation	7	10.9	0	0.0	0	0.0	1	6.2	0	0.0	2	25.0	13	16.9	23	13.2
Lack of power	22	34.4	2	66.7	3	50.0	5	31.3	0	0.0	2	25.0	20	26.0	54	31.0
Engine ping	2	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	3	1.7
Check engine light on	4	6.3	0	0.0	0	0.0	3	18.8	0	0.0	1	12.5	5	6.5	13	7.5
Total	64	100	3	100	6	100	16	100	0	0	8	100	77	100	174	100
Fleet Managers Reporting Complaints																
Number	29 of 96		3 of 8		3 of 14		13 of 74		0 of 14		3 of 11		33 of 83		84 of 300	
%	30.2		37.5		21.4		17.6		0.0		27.3		39.7		28.0	
Notes: 44 fleet managers reported multiple performance complaints about AFVs operating in their fleet 216 fleet managers did not report any of the above specific performance complaints about AFVs in their fleet																

Table 4. City fleet manager reports of specific performance-related complaints about AFVs, by primary AFV type in the fleet

Problems Reported	Primary AFV Type															
	CNG-CON		CNG-DED		CNG-BI		E85		ELEC		M85		LPG		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Hard to start	21	18.7	0	0	1	7.1	3	50	0	0	0	0	11	24.4	36	19.0
Stall after starting	7	6.3	0	7	2	14.3	0	0	0	0	1	25	4	8.9	14	7.4
Stall in traffic	14	12.5	1	25	2	14.3	1	16.7	0	0	1	25	3	6.7	22	11.7
Poor idle	7	6.3	0	0	2	14.3	0	0	0	0	2	50	7	15.6	18	9.5
Hesitation	10	8.9	1	25	1	7.1	0	0	2	50	0	0	8	17.8	22	11.7
Lack of power	42	37.5	1	25	4	28.7	2	33.3	2	50	0	0	11	24.4	62	32.8
Engine ping	3	2.7	1	25	1	7.1	0	0	0	0	0	0	0	0	5	2.6
Check engine light on	8	7.1	0	0	1	7.1	0	0	0	0	0	0	1	2.2	10	5.3
Total	112	100	4	100	14	100	6	100	4	100	4	100	45	100	189	100
Fleet Managers Reporting Complaints (by primary AFV type)																
Number	57 of 162		3 of 15		4 of 12		5 of 20		2 of 15		3 of 10		21 of 53		95 of 287	
%	35.2		20.0		33.3		25.0		13.3		30.0		39.6		33.1	
Notes: 43 fleet managers reported multiple performance complaints about AFVs operating in their fleet 192 fleet managers did not report any of the above specific performance complaints about AFVs in their fleet																

Overall, a considerable number of performance-related complaints about AFVs were reported by these state and city fleet managers. The number of these fleet managers reporting vehicle performance problems was markedly higher than the results seen in a previous survey (Whalen and Coburn, 1997) involving federal government fleet managers (28% of state and 33% of city fleet managers reported performance complaints compared to just over 5% of the federal fleet managers). One possible reason is the disparity in the composition of the fleets. Most respondents in the federal fleet survey reported their primary AFVs to be OEM models, whereas most of the city and state fleet respondents indicated their primary AFVs to be CNG or LPG conversions. In spite of the differences in the fleets and the number of fleet managers reporting complaints in the two surveys, one common finding is that more fleet managers whose primary AFV types were conversions reported receiving complaints than fleet managers whose primary AFVs were OEMs. It is also important to note that in the previous survey an attempt was made to balance the number of surveys among the AFV types, whereas no attempt was made to achieve such a balance in the current survey.

Vehicle Maintenance

Most responding state (79%) and city (84%) fleet managers indicated that maintenance on the vehicles in their fleet is performed in their own shops. Therefore, these fleet managers are generally informed and knowledgeable about maintenance and repair of their fleet vehicles. Most (90.6% of state and 89.2% of city fleet managers) indicated that no different or additional scheduled maintenance was required on their primary AFVs. These results are similar to those from the federal fleet manager survey, where 92% of the fleet managers indicated no difference in scheduled maintenance for AFVs. Figure 14 shows the results by primary AFV type for both the city and state fleet managers. The differences among the primary AFV types were not significant for the city fleet managers. However, the differences among state fleet manager responses were significant at a >99% confidence level ($\chi^2=18.35$, d.f. =6), with a higher percentage of fleets having M85 and electric vehicles as their primary AFVs reporting additional scheduled maintenance. When asked to identify what types of additional scheduled maintenance were required, no one maintenance item was dominant, although several respondents indicated oil changes or special oil.

Survey participants were also asked about the frequency and types of unscheduled maintenance, and Figure 15 summarizes these results. As in the case of the scheduled maintenance results, most interviewees (94.3% of state and 90.5% of city fleet managers) responded that they experienced no difference in the types or frequency of unscheduled maintenance for their primary AFVs. Again, these results are similar to those from the federal fleet manager survey, where 94% of respondents indicated no difference in

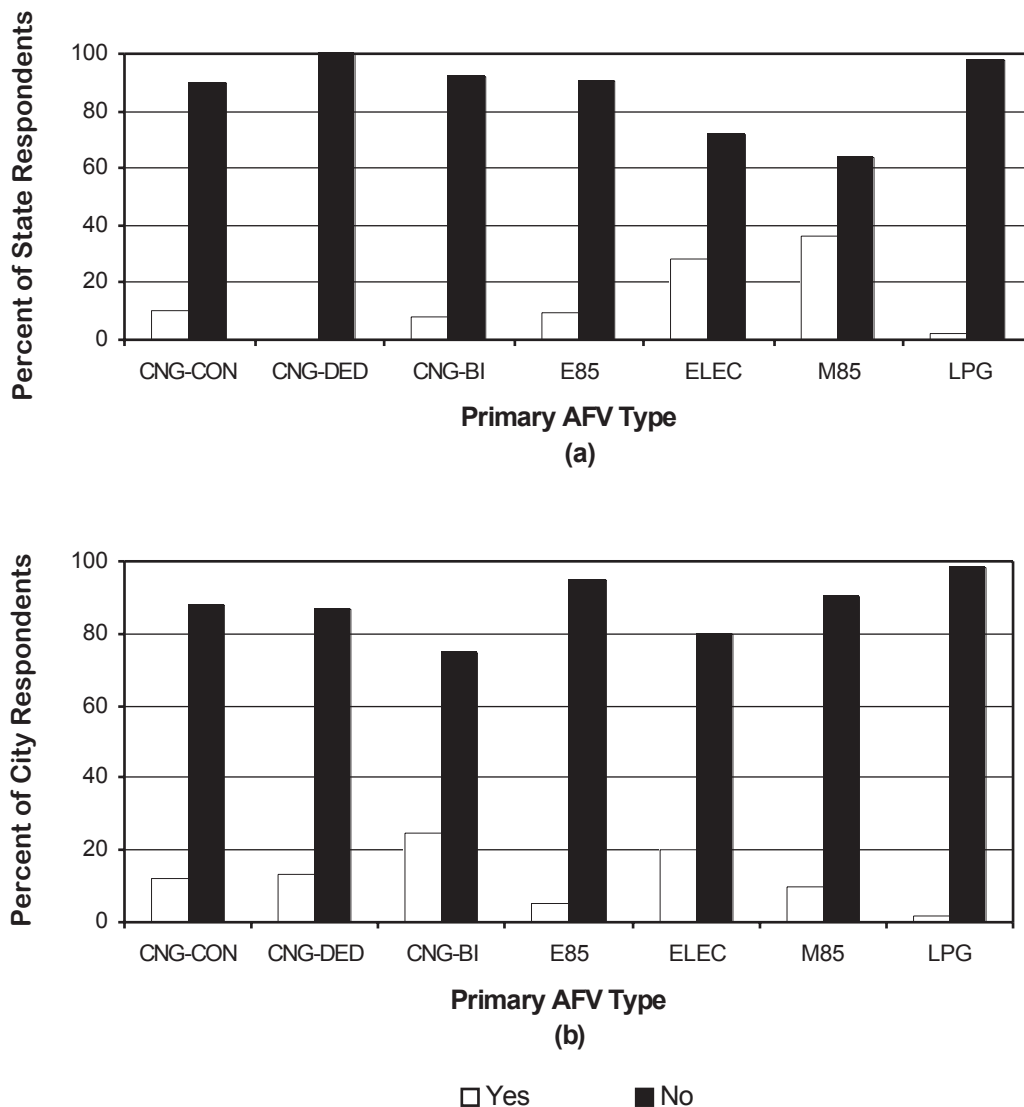


Figure 14. Responses to “do your AFVs require more or different scheduled maintenance than similar gasoline vehicles?” by primary AFV type in fleet—(a) state and (b) city fleet managers

unscheduled maintenance of AFVs. The differences by primary AFV type were not significant for either the state or city manager responses. When the fleet managers who reported differences in unscheduled maintenance were asked what types of unscheduled repairs were common, several of both the state and city fleet managers reported fuel system related repairs. The most reports of this type were from fleet managers whose primary AFV type is CNG-CON or LPG vehicles.

Perspectives on AFVs:

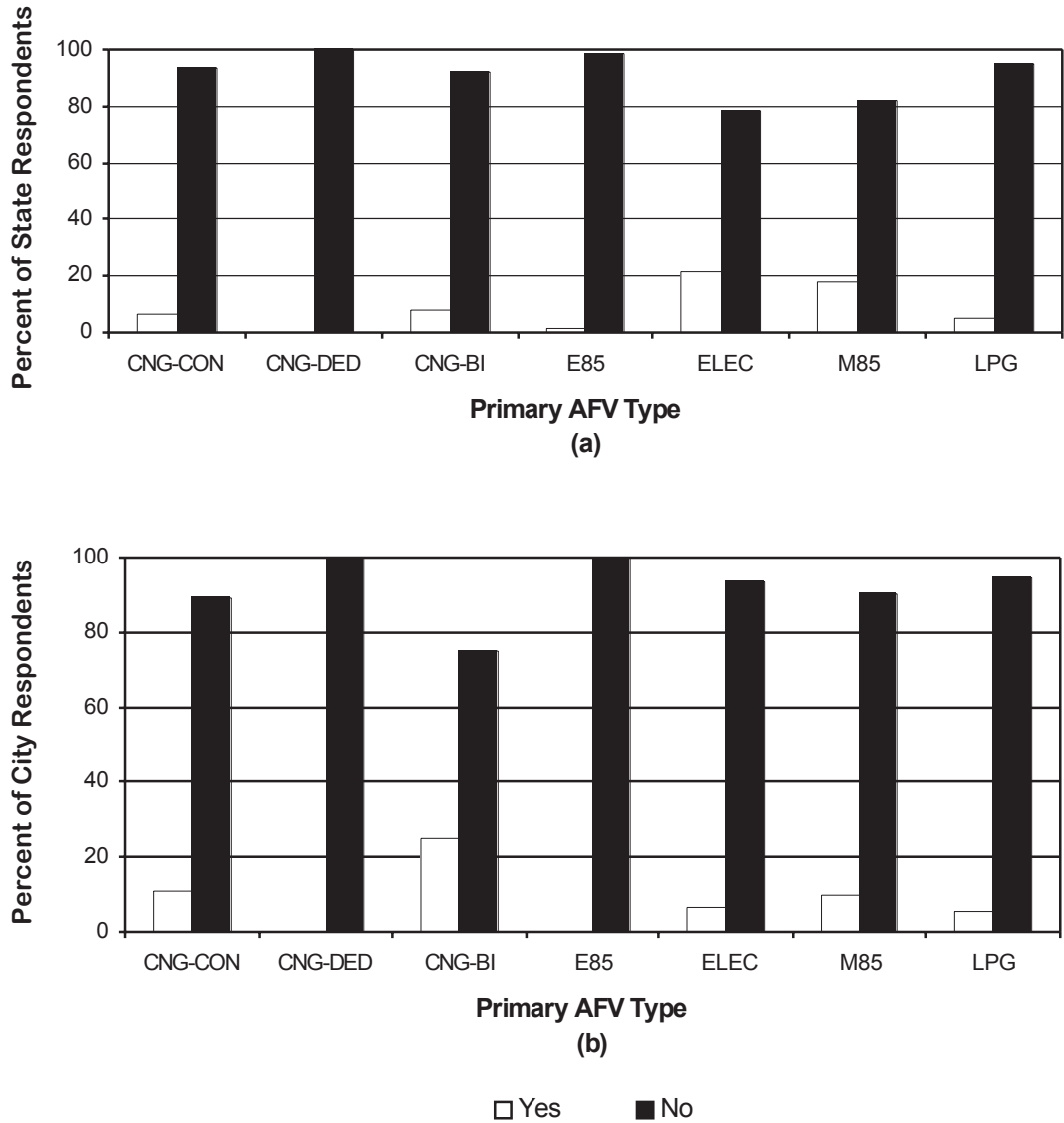


Figure 15. Responses to “do your AFVs require more or different unscheduled maintenance than similar gasoline vehicles?” by primary AFV type—(a) state and (b) city fleet managers

Grouping the state fleet manager responses about scheduled maintenance by region did not reveal any regional differences (see Figure A-11). However, when the unscheduled maintenance responses were grouped by region, some regional differences were uncovered (see Figure A-13). Compared to the total number of fleet managers responding, proportionally more state fleet managers in the Midwest reported no difference in unscheduled maintenance (98.7% responded this way), while proportionally fewer fleet managers in the South (89.6%) reported no such difference. On the other hand, when the city fleet manager responses concerning scheduled and unscheduled maintenance were grouped by Clean Cities participants and other cities, the percentage distributions of responses were no different than the overall percentage distributions (see Figures A-12 and A-14).

Another maintenance-related question dealt with AFV vehicle downtime compared to that of similar gasoline vehicles. Approximately 85% of the state fleet managers and 82% of the city fleet managers indicated no difference in downtime between the AFVs and the gasoline vehicles in their fleets. Most of these fleet managers (89% of state and 90% of city respondents) also reported that typical vehicle downtime in their fleets is less than one day per month. Of the remaining fleet managers who said there was a difference in vehicle downtime, just over 64% of the state respondents and nearly 55% of the city respondents indicated that the AFVs in their fleet typically have more downtime than gasoline vehicles.

Vehicle Operational Costs

Each of the state and city fleet managers was asked whether the costs associated with owning and operating AFVs differs from those of gasoline vehicles. The results, grouped by AFV costs being higher, lower or about the same as those typically seen for gasoline vehicles, are summarized in Figure 16. Some 40.6% of state fleet managers and 36.7% of city fleet managers indicated costs associated with AFVs are higher than those of similar gasoline vehicles. However, most state fleet managers (59.4%) and city fleet managers (63.3%) responded that costs associated with AFVs are about the same or lower than those of gasoline vehicles. The distribution of responses by fuel type varied somewhat, but the differences were not statistically significant. When the state responses were grouped by region and the city responses grouped by Clean Cities and other cities, no differences in the percentage distributions, compared to the overall distributions, were uncovered.

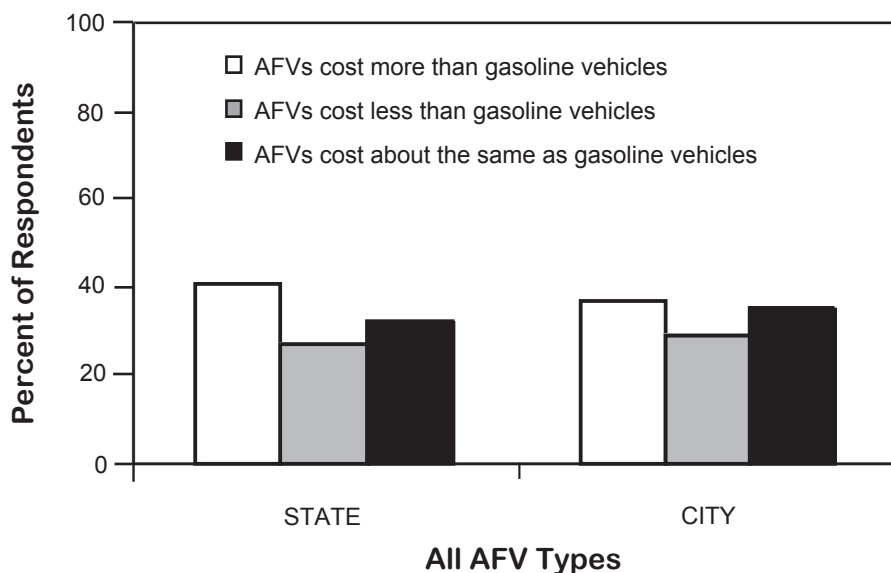


Figure 16. Responses to “how do the costs of owning and operating AFVs compare to those of similar gasoline vehicles?”

Overall Satisfaction

Fleet managers were questioned about their overall satisfaction level with the AFVs in their fleets. They were specifically asked to think about performance, convenience, and any other factors that they thought were significant to operating AFVs in their fleets. The responses are summarized in Figure 17 by state and city, and by primary AFV type.

About 63% of both state and city fleet managers reported being very satisfied or leaning toward satisfied with their AFVs (see Figure 17a). Less than 20%

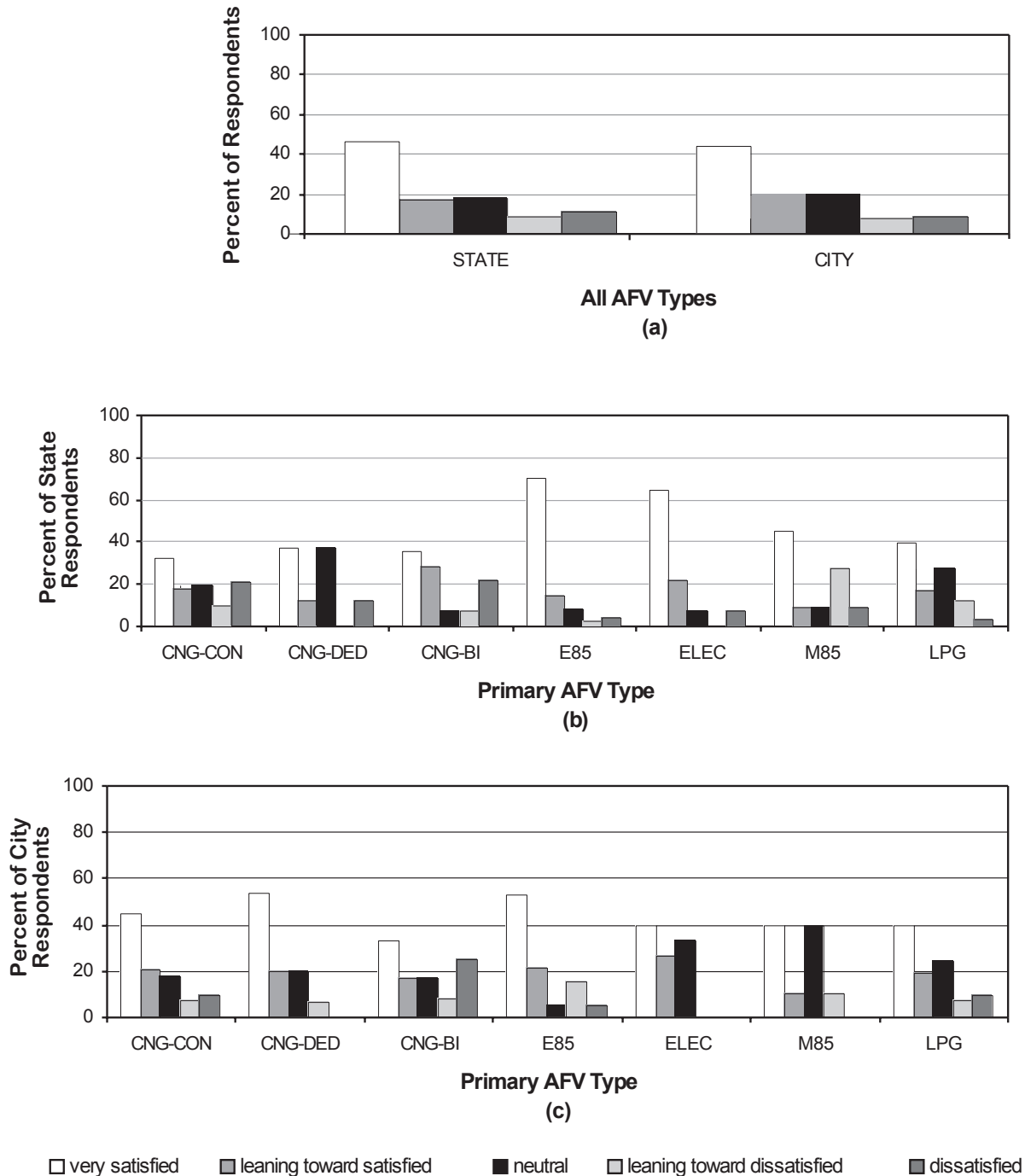


Figure 17. Fleet manager responses about overall satisfaction with AFVs in fleet—(a) all responses, state and city, (b) state responses by primary AFV type, (c) city responses by primary AFV type

of both the state and city fleet managers indicated they are dissatisfied or leaning toward dissatisfied with their AFVs. As might be expected, there were some differences in the distribution of responses by primary AFV type.

Figure 17b and 17c present a summary of the state and city fleet manager response, respectively, by primary AFV type. Analysis indicated statistically significant differences only in the distribution of state fleet manager responses by primary AFV type ($\chi^2=29.16$, d.f.=12, $\alpha<.0001$). The greatest variations were in the frequencies of the most extreme ratings of very satisfied and dissatisfied. Among the state fleet managers, those operating E85 and electric vehicles appear to be the most satisfied with their AFVs. More than 60% of the fleet managers with these AFVs types reported being very satisfied with their AFVs.

Figure 18 presents fleet manager responses grouped by region. Analysis indicated the distribution of responses by region are statistically significant ($\chi^2=24.3$, d.f.=12, $\alpha<.02$). In the Midwest, significantly more fleet managers reported leaning toward being satisfied or very satisfied overall with their fleet AFVs than in other regions (76.2% compared to 63.1% in the Northeast, 66.3% in the South, and 45.5% in the West, respectively). Fleets operating E85 vehicles as their primary AFV type dominate the participating Midwest respondents. On the other hand, fleets managers from the West reported being dissatisfied with their AFVs at a rate nearly 10% higher than fleet managers in the other regions. Approximately 20% of fleet managers in the West reported being dissatisfied compared to 8.7% in the Northeast, 3.8% in the Midwest, and 10.5% in the South, respectively. Similar analysis of city fleet manager responses grouped by Clean Cities and other cities did not reveal any differences that were statistically significant.

Following the inquiry about overall satisfaction with AFVs, fleet managers were asked what one issue influenced them most in their ratings. Fleet managers who were dissatisfied or leaning toward dissatisfied most commonly reported poor vehicle performance and limited fuel availability as influencing their responses. The most common response from fleet managers who were very satisfied or leaning toward satisfied was the good performance of their AFVs.

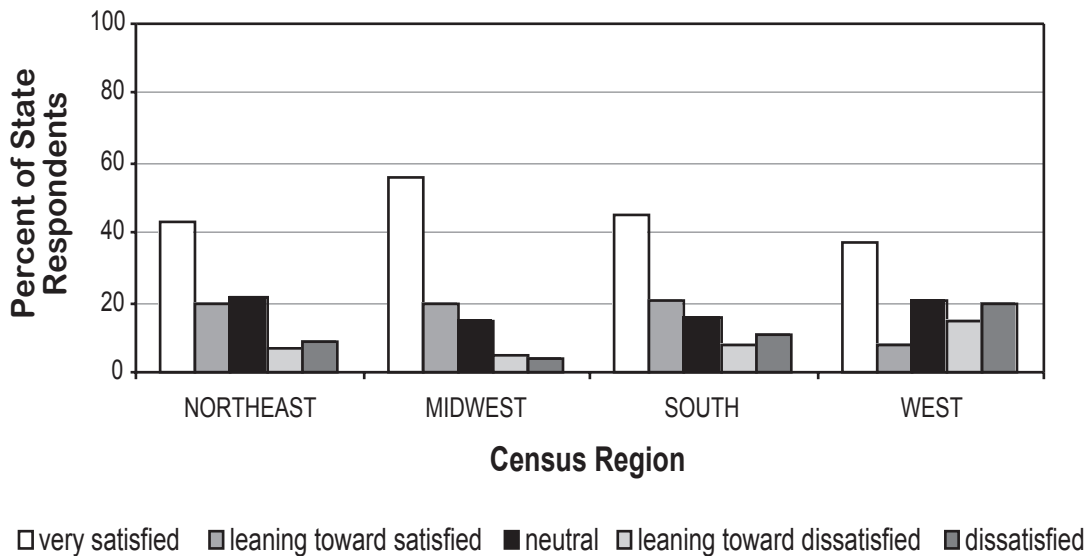


Figure 18. State fleet manager responses about overall satisfaction with AFVs in fleet by census region



Summary

As a result of improving vehicle technology, production of more vehicles by the OEMs, and changing government regulations, light-duty AFVs continue to be added to fleets—particularly federal, state, and local government fleets. Information on real-world experiences from fleets currently operating AFVs (such as that presented here) may be of value to other fleets that plan to add them, either voluntarily or in response to regulatory mandates.

This survey focused on obtaining state and local government fleet manager perspectives on the use, acceptability, and performance of AFVs. Randomly selected state and city fleet managers across the country provided candid feedback on the AFVs in their fleets. For the most part, these fleet managers provided favorable responses about AFV use and operation.

The state fleet managers and city fleet managers interviewed generally operate only a few AFVs, with most reporting 10 or fewer AFVs in their fleets. AFVs represent a relatively small proportion of the vehicles in these fleets. The 300 state fleet managers included in this survey reported having a total of 17,508 AFVs in their fleets: 6.4% of all their vehicles. The 287 city fleet managers included in this survey reported having a total of 8,128 AFVs in their fleets: 4.9% of all their vehicles. Aftermarket conversion (CNG and LPG) and flexible-fuel vehicles were the most commonly reported primary AFV types among these fleets. Currently available fueling infrastructure may be driving fleets to purchase bi- and flexible-fuel vehicles, when other dedicated fuel vehicles might have more impact on reducing energy dependence and improving air quality.

Most of the interviewees said their drivers did not indicate a preference for or against using AFVs. The exception was fleets with electric vehicles. Fleet managers whose primary AFV type is electric had higher rates of drivers wanting to drive these vehicles. Because there are few in service, we suspect that there may be more curiosity about and interest in driving an electric vehicle than there is for the other types of AFVs.

Most state fleet and city fleet managers reported that alternative fuel stations were in close proximity to their fleet locations. Access to alternative fuel was reported to be most limited by state fleets operating M85 and by city fleets operating dedicated CNG AFVs. Most fleets (55.7% of state and 51.2% of city fleets) indicated that they use public stations for fueling. Despite the fact that limited fuel availability was the most commonly cited reason that drivers do not want to drive AFVs, it appears from the fleet managers' responses that alternative fuel is reasonably available to most of these fleets.

Among fleet managers whose primary AFV types are bi-fuel or flexible-fuel vehicles, most respondents said that their AFVs are operated mostly on the alternative fuel. The alternative fuel use rate was higher than expected, and much higher than that reported in the previous federal fleet manager survey. Here, approximately 90% of state fleet managers and approximately 87% of city fleet managers reported that their AFVs use alternative fuel 50% or more of the time; approximately 63% of the federal fleet managers responded this way.

The distribution of responses to questions related to performance complaints and maintenance indicate that performance of AFVs compares reasonably well with that of similar gasoline vehicles for many of these fleets. However, it is worthwhile to note that some 34% of state and 39% of city fleet managers reported receiving more complaints about their AFVs than about their gasoline vehicles.

When asked about specific complaints, 28% percent of state and 33% of city fleet managers reported receiving at least one of the eight specific performance-related complaints, with “lacking power,” and being “hard to start” being the most common. The rate of reports of specific performance complaints was much higher than in the previous federal fleet manager survey (Whalen and Coburn, 1997), where just over 5% of fleet managers reported complaints. It is also worthwhile to note that in this survey 67% of state and 75% of city fleet managers identified their primary AFV type as an aftermarket conversion (CNG-CON or LPG); more than 80% of the complaints were from these fleet managers. This indicates that these fleets may be experiencing more problems with aftermarket conversion AFVs.

Despite more reports of complaints among these fleet managers, most (90% or more) reported no difference in the types or frequency of maintenance—scheduled or unscheduled—between AFVs and similar gasoline vehicles in the fleet. Most also reported no difference in downtime between AFVs and similar gasoline vehicles in their fleets. Responses about the costs associated with operating AFVs were closely divided between reports that AFVs cost more, AFV cost less, and AFVs cost about the same as gasoline vehicles, with slightly more reports that AFVs cost more than gasoline vehicles to operate.

About 63% of both state and city fleet managers combined reported being very satisfied overall or leaning toward being satisfied with the AFVs in their fleets. Fleets with electric and E85 vehicles as their primary AFV types tended to have higher percentages of satisfaction. Among state fleet managers, more fleet managers in the Midwest (which is dominated by E85-fueled vehicles as the primary AFV type) reported being satisfied overall with their AFVs than those in any other region.

Clearly, alternative fuel vehicles are being used in fair numbers by state and city government fleets across the country. These fleets have experience with all the types of AFVs currently available in the marketplace. Although there continue to be some fuel and performance issues associated with use of the different AFV types, these fleet managers' responses about AFV use, acceptability, and performance generally provide favorable feedback about their experiences with AFVs.



Acknowledgments

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Appreciation is extended to the numerous state and city fleet managers for their willingness to participate in this survey.

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Appendix A:

Results Summarized by Census Region
(State Responses) and by City Type
(City Responses)

Table A-1. Number of responses by state fleet managers by census region and primary AFV type

Census Region	Primary AFV Type							TOTAL
	CNG-CON	CNG-DED	CNG-BI	E85	ELEC	M85	PROPANE	
Northeast	14	3	3	0	4	2	20	46
Midwest	16	0	0	58	0	0	6	80
South	36	1	8	10	6	1	34	96
West	30	4	3	6	4	8	23	78

Table A-2. Number of responses by city fleet managers by city type (Clean Cities participants and other cities)

City Type	Primary AFV Type							TOTAL
	CNG-CON	CNG-DED	CNG-BI	E85	ELEC	M85	PROPANE	
Clean Cities	85	8	7	6	9	8	25	148
Other Cities	77	7	5	14	6	2	28	139

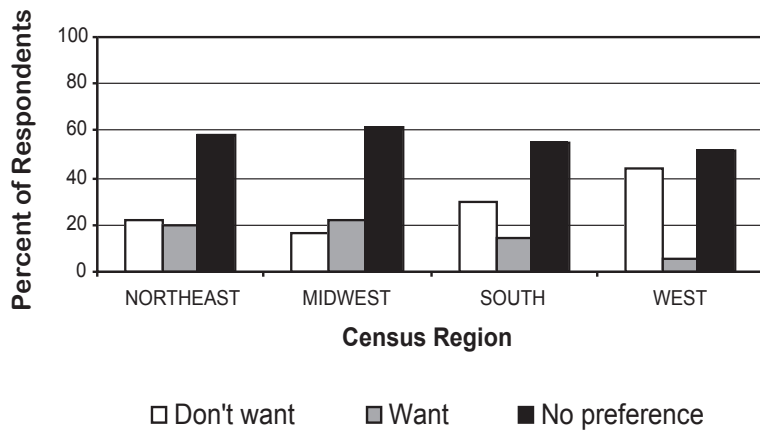


Figure A-1. State fleet manager responses to "how acceptable are AFVs to drivers?" by census region

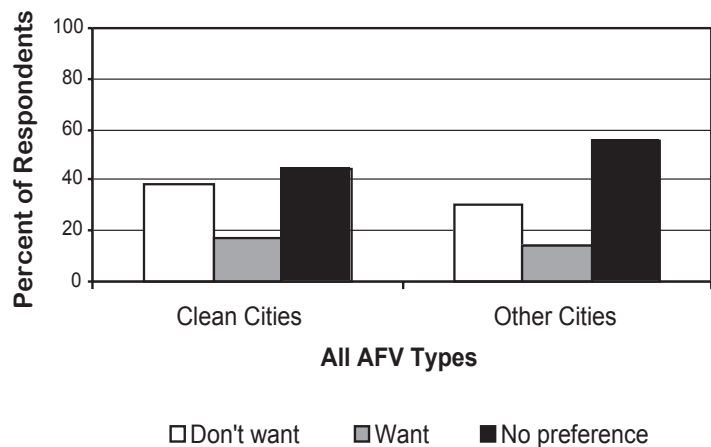


Figure A-2. City fleet manager responses to "how acceptable are AFVs to drivers?" by city type

Perspectives on AFVs

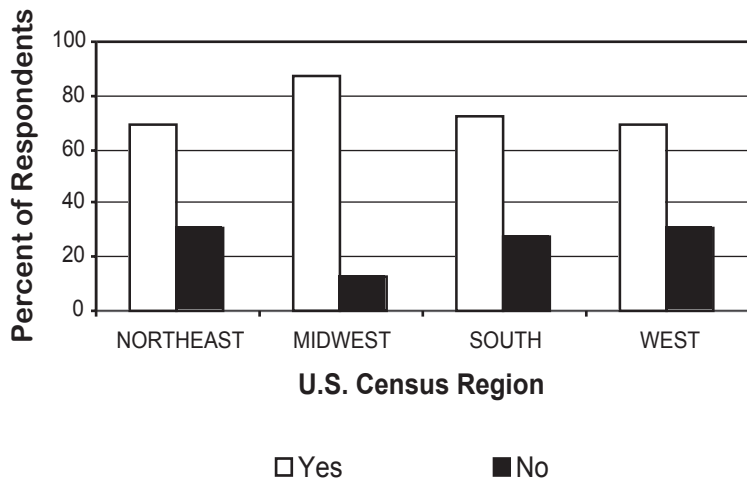


Figure A-3. State fleet manager responses to "is there an alternative fuel station nearby?" by census region

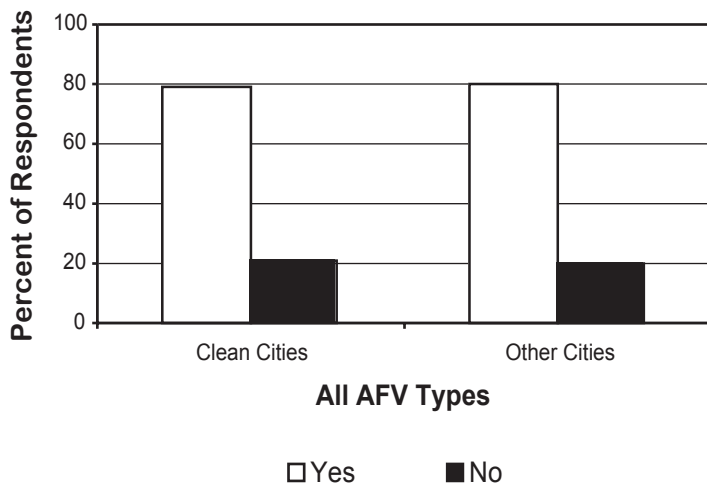


Figure A-4. City fleet manager responses to "is there an alternative fuel station nearby?" by city type

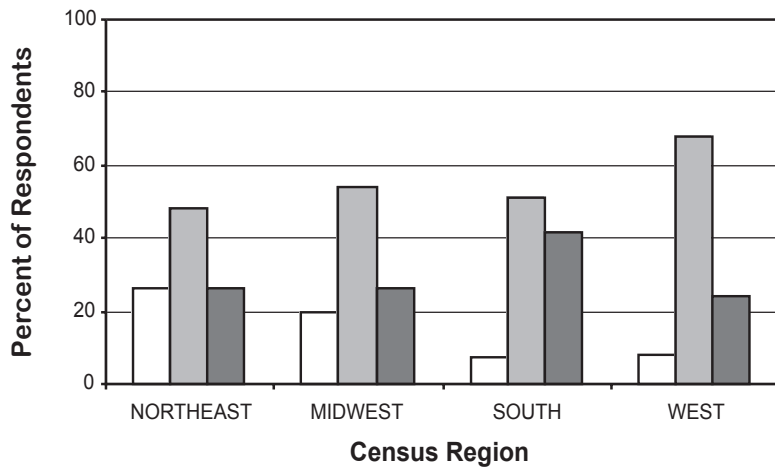


Figure A-5. State fleet manager responses on type of refueling station used by fleet by census region

Legend: On-site station (white), Public station (light gray), Local private station (dark gray)

State and City Government Fleet Manager Survey

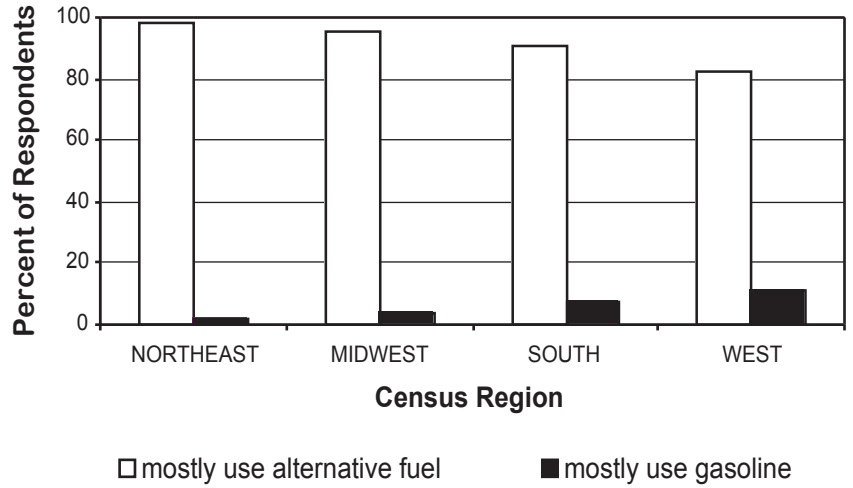


Figure A-7. State fleet manager responses to "what fuel are your AFVs usually operated on?" by census region

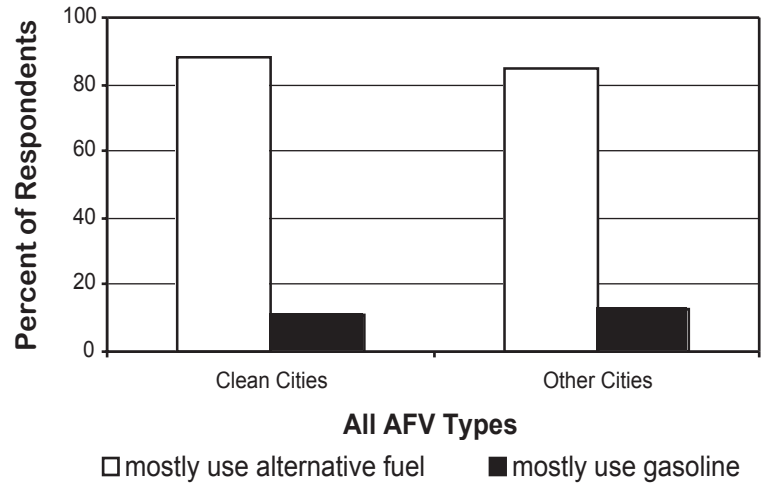


Figure A-8. City fleet manager responses to "what fuel are your AFVs usually operated on?" by city type

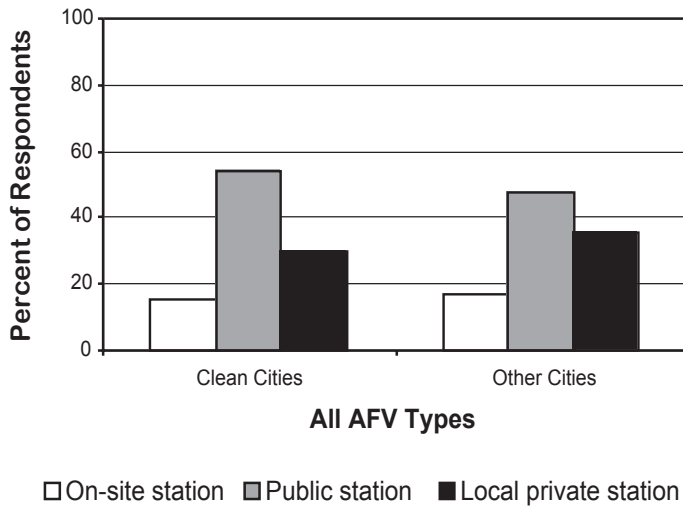


Figure A-6. City fleet manager responses on type of refueling station used by fleet by city type

Perspectives on AFVs

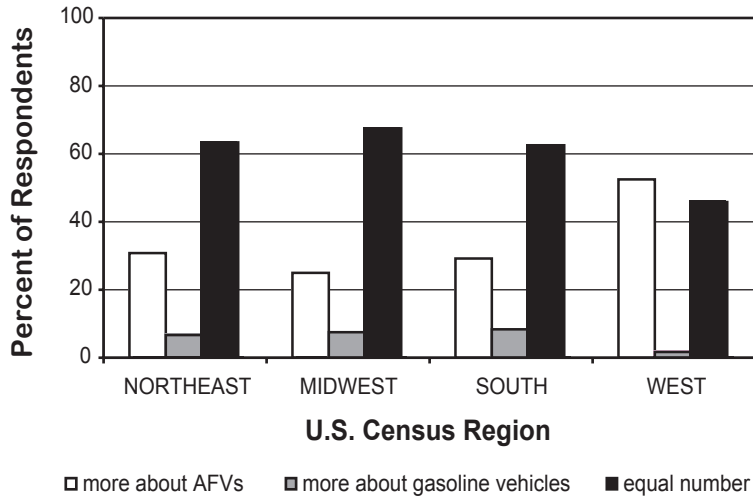


Figure A-9. State fleet manager responses to "which vehicle type do you receive more complaints about?" by census region

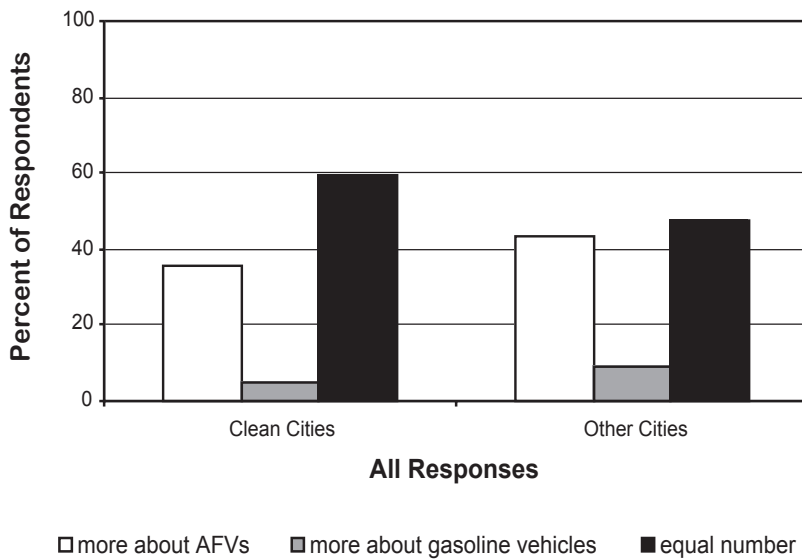


Figure A-10. City fleet manager responses to "which vehicle type do you receive more complaints about?" by city type

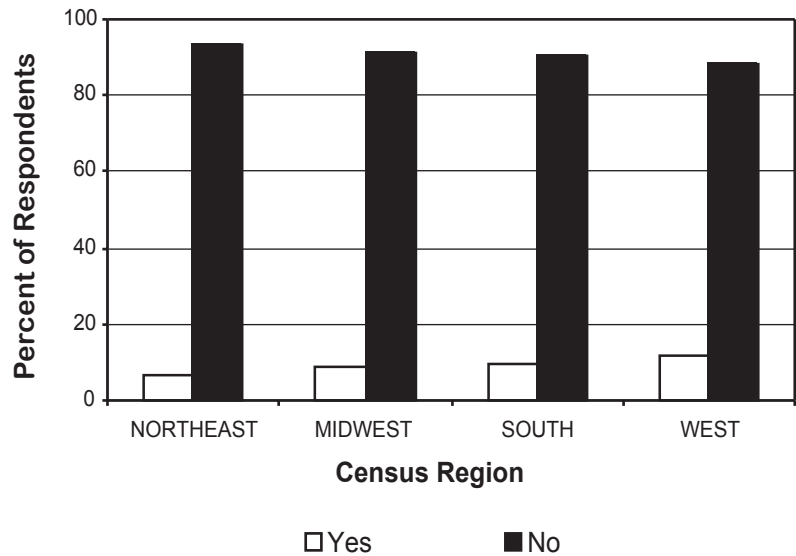


Figure A-11. State fleet manager responses to "do your AFVs require more or different scheduled maintenance than similar gasoline vehicles?" by census region

State and City Government Fleet Manager Survey

Figure A-13. State fleet manager responses to “do your AFVs require more or different unscheduled maintenance than similar gasoline vehicles?” by census region

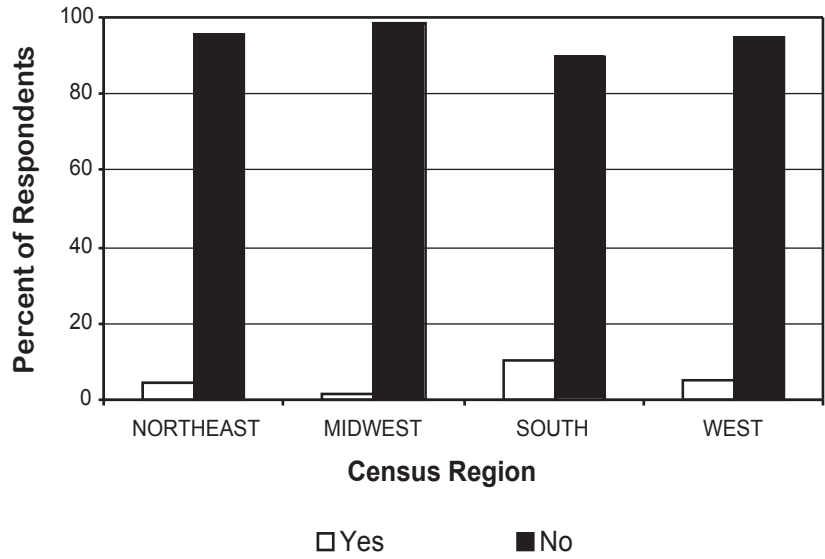


Figure A-14. City fleet manager responses to “do your AFVs require more or different unscheduled maintenance than similar gasoline vehicles?” by city type

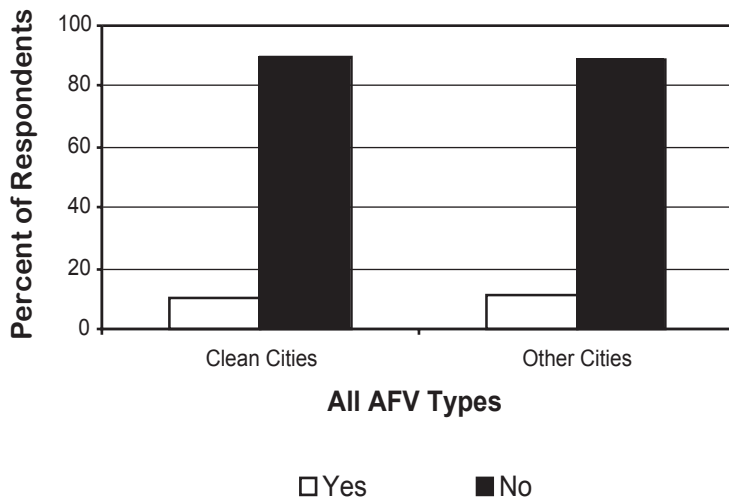
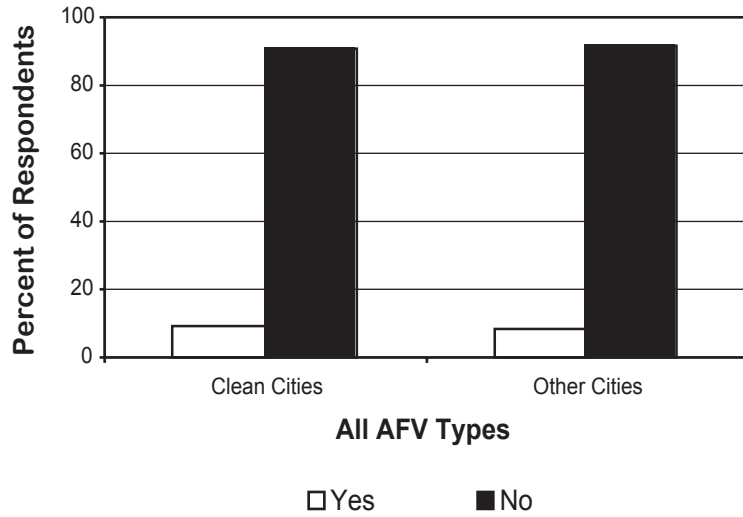


Figure A-12. City fleet manager responses to “do your AFVs require more or different scheduled maintenance than similar gasoline vehicles?” by city type

Perspectives on AFVs

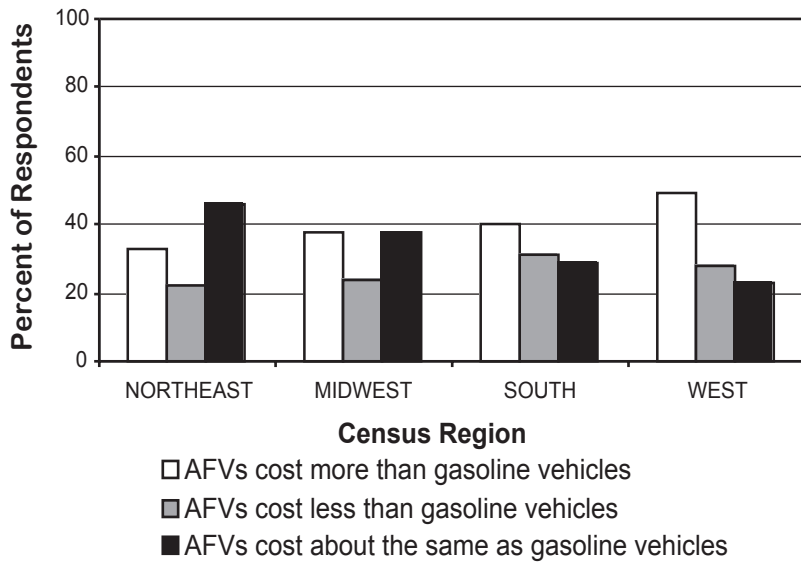


Figure A-15. State fleet manager responses to “how do the costs of owning and operating AFVs compare to those of similar gasoline vehicles?” by census region

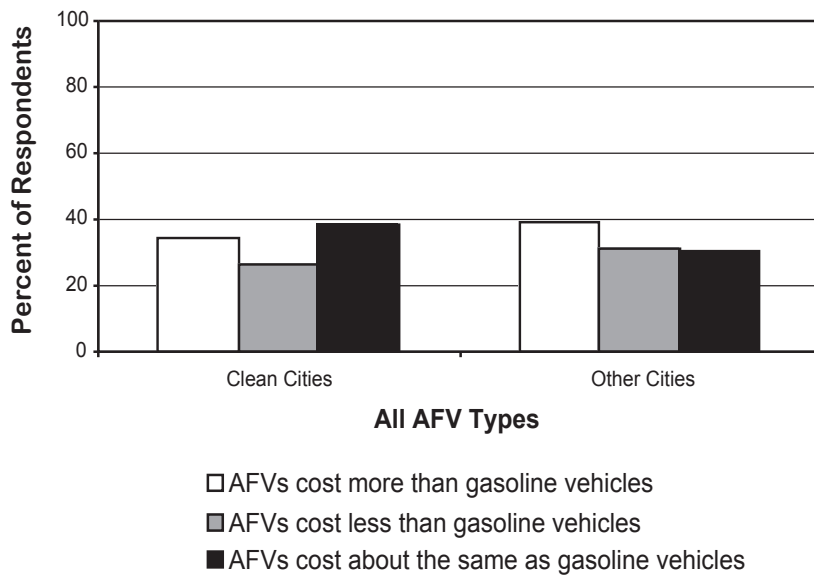


Figure A-16. City fleet manager responses to “how do the costs of owning and operating AFVs compare to those of similar gasoline vehicles?” by city type

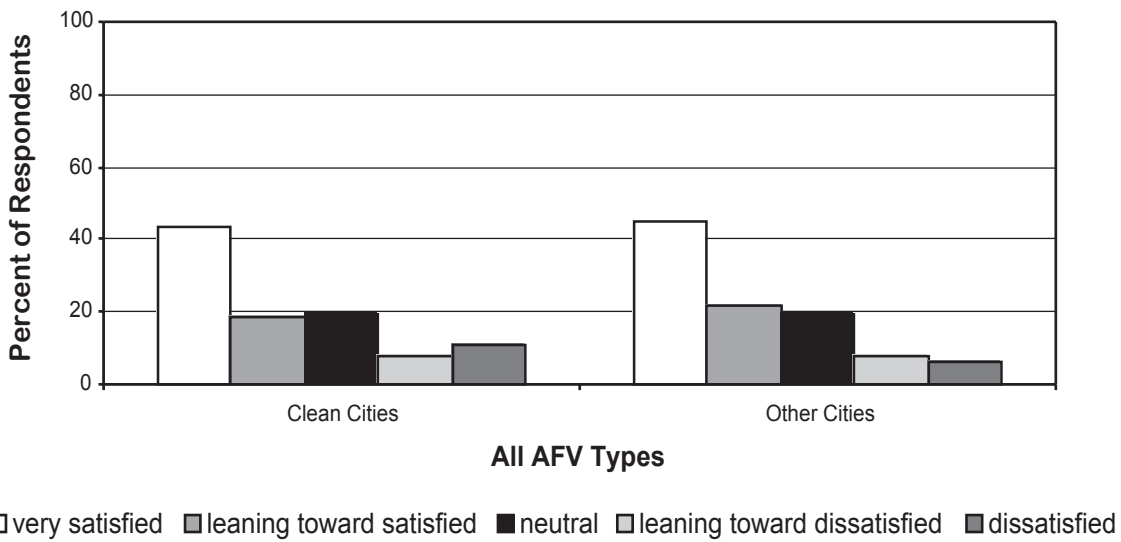


Figure A-17. City fleet manager responses about overall satisfaction with AFVs in fleet by city type

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