AN ANALYSIS OF THE NAFA FLEET DATA BASE: PASSENGER CARS ONLY

Deborah Shonka

September 1980

DEPARTMENT OF ENERGY AND ENVIRONMENT

BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

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BNL 51301
UC-96
(Energy Conservation—
Transportation - TIC-4500)

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ECONOMIC AND SYSTEMS ANALYSIS DIVISION
NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS
DEPARTMENT OF ENERGY AND ENVIRONMENT
BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

Under Contract No. DE-AC02-76CH00016 with the
UNITED STATES DEPARTMENT OF ENERGY

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Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price: Printed Copy $6.00; Microfiche $3.50

ABSTRACT

To assess the potential market penetration of new vehicular concepts, it is first necessary to determine the current level of demand in terms of physical capabilities and economic constraints. The survey described in this report attempts to measure these characteristics for the fleet market sector in the U.S.

The data analyzed come from a survey taken in March 1979 of members of the National Association of Fleet Administrators (NAFA). Each respondent was asked to specify a set of characteristics for electric cars that would meet his specific fleet demands and assign the maximum price he would be willing to pay for each option. From the 139 responses, it is possible to relate the physical specifications of fleet vehicles to economic utility.

Two other reports deal with the simulator (CPEN) which was designed by BNL to estimate market penetration rates of new technologies in the fleet market, using the data base described within this report: Joseph R. Wagner, A Method for Estimating Technological Penetration Rates in Commercial Automobile Fleets, BNL 51312, May 1980, and Richard Weil, Fleet Car Market Penetration Simulator (CPEN): A User's Guide, BNL 51286, August 1980.

ACKNOWLEDGMENTS

The author would like to give special recognition to Joseph Wagner, formerly of Brookhaven National Laboratory, for his contributions to this report. His valuable comments and insights on an earlier draft were instrumental in shaping the final form of this report. I am also grateful to the other persons who offered comments on this earlier draft: Gretchen Kulp of Oak Ridge National Laboratory and Jack Allentuck of Brookhaven National Laboratory.

Finally, the author would like to thank Robert Berke and the National Association of Fleet Administrations. Without their assistance in distributing the survey, this report would not have been possible.

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HIGHLIGHTS

In 1979 a survey was mailed to the members of the National Association of Fleet Administrators (NAFA). The following conclusions are based on the response of 139 members, representing 84,559 fleet automobiles.

- Typical electric vehicle (EV) design required by the fleet operators:

  4 seats
  16 cubic foot/trunk
  4 hours for battery recharge
  192-mile range
  Heater, air conditioning, power steering, and power brakes
  Interstate highway capability
  Max 13 unscheduled days in shop per year

- The operating demands and desired options varied by sector. This difference was statistically significant for the seat, trunk, range, and reliability options but not for the recharge option.

- Of the four sectors included in the survey, the police sector demands are significantly different from those of the other three sectors (government, business, utility).

- The fleet operators were on average willing to pay $52 for a heater, $303 for air conditioning, $85 for power steering, $70 for power brakes, and $278 for interstate highway capability.

- The fleet operators were on average willing to pay $179 for each additional seat, $12 for each additional cubic foot in trunk space, and $1.03 for each additional mile of range. They would add to the purchase price $13 for each hour decrease of recharge time and $11.50 for each day's decrease in unscheduled time in the shop.

- There is no single overriding factor that influences applicability rates of EVs.

1. INTRODUCTION

To assess the potential market penetration of new vehicular concepts, it is first necessary to determine the current level of demand in terms of physical capabilities and economic constraints. The survey described in this report attempts to measure these characteristics for the fleet market in the U.S.

The fleet market is here defined as consisting of light-duty highway vehicles (i.e., passenger cars and trucks) operated by corporations and government agencies. Two of the most significant reasons for choosing the fleet Sector for this survey are that the fleet market is rather large, accounting for 13.7% of new car registrations in 1978,* and that given their specific operating demands, fleets offer some special opportunities for vehicles with unusual or limited performance characteristics.**

In order to estimate market penetration rates of new technologies in the fleet market, Brookhaven National Laboratory (BNL) designed a simulator (CPEN) using the data base (NAFA data base) described in this report. A description of the simulator and a guide to its use are contained in the following two reports: Joseph R. Wagner, A Method for Estimating Technological Penetration Rates in Commercial Automobile Fleets, BNL 51312 prepared for the U.S. Department of Energy (DOE), May 1980; and Richard Weil, Fleet Car Market Penetration Simulator (CPEN): a User's Guide, BNL 51286 prepared for the U.S. Department of Energy, (DOE), August 1980.

*1,504,809 fleet cars registered in 1978 (Automotive Fleet Fact Book, April 1980, p. 26) and 10,946,104 passenger cars registered in 1978 (MVMA Motor Vehicle Facts & Figures '79, p. 24)

**See the following reports for a more detailed discussion: D.B. Shonka, Characteristics of Automotive Fleets in the United States 1966-1977, ORNL/TM-6449, September, 1978. Joseph R. Wagner, Fleet Operator Data Book (Summer 1977 Data). Vol. I: National Data, BNL 50904, September 1979.

2. DESCRIPTION OF SAMPLE AND QUESTIONNAIRE

The National Association of Fleet Administrators (NAFA) is a professional organization of fleet administrators, each operating a fleet of at least 25 cars or light trucks. In March 1979, the NAFA mailed questionnaires to its 1500 members.* Response was strictly voluntary and no follow-up letters were sent out. 139 usable responses were received, representing about 12% of the total automobiles managed by the NAFA membership (84,559 cars). Of the total cars in market sectors spanned by NAFA (i.e., business, utility, police, and government), an estimated 1.8% were actually represented by those NAFA members responding to the survey sample. The NAFA sample is not a statistically designed probability sample. The type of fleet census needed to devise such a sample is not currently available.

The majority of the NAFA members (76.5%) and the corresponding fleet survey respondents represent business fleets (see Table 1). However, three other market sectors are included: utilities (electric and gas), 1.2%; police, 6%; and government (non-police), 16.3%. Taxi fleets, rental fleets, individually leased vehicles, and the federal government fleet are not represented by the NAFA membership and thus, correspondingly, by the NAFA survey. The distribution of the NAFA data base among the market sectors is compared in Table 1 with the national distribution of fleets as published in Bobit's Automotive Fleet Magazine.** The comparison indicates that the distributions are similar, having a correlation coefficient of .99. The utility sector appears to be underrepresented, though. The business sector, because of its size, exerts considerable influence over the aggregate measures.

*The questionnaire is given in Appendix A.
**The Bobit data are by no means definitive, but they are the best source available for comparison.

Table 1

DISTRIBUTION OF NAFA RESPONDENTS AND FLEET CARS BY SECTOR

Sector	NAFA respondents	NAFA cars (No.)	NAFA cars (%)	Bobit cars[a] (%)
Police	7	5,068	6.0	7.4
Government[b]	17	13,746	16.3	16.5
Utilities	6	1,028	1.2	13.5
Business[c]	109	64,717	76.5	62.6
All sectors	139	84,559	100.0	100.0

[a]Automotive Fleet Fact Book, Bobit Publishing Co., p. 30, April 1980.
[b]State and Local.
[c]Business fleets, 25 cars or more

The intent of the survey was twofold: 1) to make a vehicle count by type (car and light truck) and by state; 2) to determine the physical demands and economic constraints for ten options selected as those most likely to affect the acceptance of a new transportation technology, e.g., electric vehicles (EVs). Options specified were as follows:

(1) seating capacity, (2) trunk space, (3) performance capability, such as speed and acceleration sufficient to use limited access roads like interstates, (4) recharge time, (5) range between refuelings, (6) heater, (7) air conditioner, (8) power steering, (9) power brakes, and (10) reliability (allowable annual number of unscheduled days in shop).

The respondent was asked to specify a set of characteristics for electric cars that would meet his specific fleet demands and assign the maximum price he would be willing to pay for each option. He was allowed to specify up to three different vehicles in addition to the base

car.* The base car was given the following options: 2 seats, 5 cubic feet trunk space, 8-hour recharge time for a range of 30 miles, a maximum of 20 unscheduled days in shop per year, and no air conditioner, heater, power brakes or performance capability (see Table 2). The fleet managers indicated that this base car was sufficient for 7.2% of their vehicle stock. That is, 7.2% of the total sample could be replaced with EVs having the base car's physical characteristics (w/o price considerations). All 139 respondents specified at least one type of EV beyond the base car, 89 specified two EVs, and 49 specified three.

Table 2

ELECTRIC CAR ATTRIBUTES

	NAFA survey base car	Typical EV characteristics specified NAFA respondents	1986 Target EV
Seats	2	4	4
Trunk (cubic feet)	5	16	5
Performance	No	Yes	Yes
Recharge time (hr)	8	4	8
Range (miles)	30	192	100
Heater	No	Yes	Yes
Air conditioner	No	Yes	Yes
Power steering	No	Yes	Yes
Power brakes	No	Yes	Yes
Reliability (days)	20	13	0

In most cases, the delivered price on the base car (not including the price of the options) was fixed at $2,000. However, the business sector questionnaire recipients were arbitrarily divided into thirds. The base price for the first third was set at $2,000; the second third,

*The respondent was also asked to design electric trucks. This analysis is restricted to a discussion of the electric car designs.

$4,000; and the last third, $6,000. The final purchase price was calculated by adding the additional prices specified for each option to the base price.

After the respondent had specified characteristics for his car(s) and option prices, he was asked to designate what percentage of his total fleet could use each type of car. In order to get the number of cars involved, the respondents' total number of cars (as indicated in the vehicle census sheet filled out by the respondent) is then multiplied by each percentage. As noted above, there were 139 respondents with a combined fleet of 84,559 automobiles.

3. CHARACTERIZATION OF THE NAFA DATA BASE

As indicated in the previous section, each respondent was asked to design electric cars that would satisfy his particular fleet's demands. From these individual responses, it is possible to devise composite demands (see Table 2). That is, on the average, fleet operators indicated that they would need EVs with seating capacity for 4 people and with 16-ft^3 storage space in the trunk. The operating range should be about 200 miles with a 4-hr maximum recharge time and no more than 13 unscheduled days in the shop per year. Also, all of the options should be available: heater, air conditioner, power steering, power brakes, and sufficient speed and acceleration to use limited access roads (performance option). For this EV the fleet operators were willing to pay $5,700. The extent to which the preferences of individual respondents deviated from this average vehicle is partially revealed by Table 3, which shows the distribution of desired car sizes (i.e., seating capacities).

Table 3

BREAKDOWN OF DESIRED CAR SIZES

Size of car	%
Small (< 5 seats)	68.9
Medium (= 5 seats)	16.8
Large (> 5 seats)	14.3

The operating demands and the required or desired options varied by sector (see Table 4). The averages of the attributes for each of the four sectors (government, police, business and utility) were clustered. The results indicate that, overall, the police sector is significantly different from the other 3 sectors. Utility, business, and government sectors tend to exhibit similar characteristics. Of course, these similarities and differences varied by option.

The number of seats required varied from a low of 3 for the utility sector to a high of 4 for the other 3 sectors. Utilizing an analysis of variance test,* the difference among sectors was considered statistically significant at the 95% confidence interval (C.I.).

There was considerable variation in average trunk capacity needed. The differences among sectors was statistically significant at the 99% C.I. For example, the utility sector indicated that they needed about 7.5 cubic feet of trunk space, whereas the government sector required 27.5 cubic feet. The design of the 1986 target EV allows for 5 cubic feet.

According to the analysis of variance test, there is no significant difference among market sectors in terms of desired recharge time. In terms of absolute numbers, the police sector placed the most emphasis on limited downtime due to recharge requirements (1.7 hr) and the utility sector the least (5.6 hr). The other sectors required 4-hr recharge times. The 1986 target batteries require about 8 hours to recharge.

There was a statistically significant difference (at the 99% C.I.) in range requirements by sector. The government sector requested a range of about 100 miles while the police sector required a 436-mile range. The range on premium EVs in service today is 100 miles.

Finally, importance of the reliability of the EV varied significantly (at the 99% C.I.) among the sectors. The business sector objected most to unscheduled days in the shop (max=12 days). This is high in comparison to new ICE cars which are not expected to spend many days in the

*The Analysis of Variance (ANOVA) uses a F ratio test to determine if statistical differences exist.

Table 4

NAFA FLEET OPERATOR DEMANDS BY SECTOR

Sector	Av Seats[a]	Av trunk (ft^3)	Av recharge (hr)	Av range (mile)	Av reliability (days)	Av car price	No. respondents
Police	4.1	16.5	1.7	436	15	$6202	7
Government	4.4	27.5	4.1	101	15	3792	17
Utilities	3.0	7.5	5.6	150	16	4128	6
Business	4.0	12.6	4.2	166	12	6048	109
All sectors	4.1	16.2	4.0	192	13	5667	139

[a]Including driver.

Table 5

AVERAGE PRICE OF SELECTED OPTIONS AS DETERMINED BY NAFA FLEET OPERATORS

	OPTION					
Sector	Heater	Air conditioner	Power steering	Power brakes	Performance	No. respondents
Police	$70	$231	$152	$111	$209	7
Government	83	179	70	48	298	17
Utilities	32	238	60	36	249	6
Business	55	275	68	57	337	109
All sectors	52	303	85	70	278	139
ICE retail list price[a]	Standard	500	150	65	Standard	

[a]Based on option prices given in Automotive News 1979 Market Data book Issue, p. 78. These vary somewhat by size of car and manufacturer.

shop for repairs except for regularly scheduled maintenance. However, this seems to be a moot point as the state-of-the-art EVs are expected to be at least as reliable as ICEs.

The respondents were also asked to indicate the maximum price they would be willing to pay for each option. The prices for five options are given by sector in Table 5. On the average, the fleet operators were willing to pay $52 for a heater, which is usually standard equipment (i.e., included in the base price) on ICE cars. An air conditioner (A/C) was worth $303. The power steering option was valued at $85 and power brakes at $70. The performance option, defined as speed and acceleration sufficient to use limited access roads such as interstates and expressways, was worth $278 on the average. This option is standard on current ICE cars. The fleet operators valued the A/C and power steering options below suggested retail prices. This can be explained from the observation that fleet operators frequently obtain substantial discounts from list prices.

Using regression analysis, marginal prices were calculated for the other five options,* and are presented in Table 6. On the average, the fleet operators were willing to pay $179 for each additional seat beyond the two available in the base car. This varied from a low of $150 indicated by police administrators to a high of $855 indicated by utilities. On the average, trunk space is valued at $12 per cubic feet beyond the 5 cubic feet available in the base car. Once again utilities were willing to pay a premium $57/ft^3, whereas trunk space was valued at only $11/ft^3 by the business fleet administrators.

The fleet operators were willing to pay, on the average, $13 for each one hour reduction in recharge time from the 8-hour refueling time required by the base car. The utility sector was willing to pay the most for reductions in the 8-hour recharge time of the base car, though they required the least amount of actual recharge time reduction. Fleet operators were willing to pay about $1.00 per mile for range greater than the 30 miles offered by the base car. Business fleet operators would

*These numbers are based on the prices indicated for optional car 1 only.

Table 6

MARGINAL PRICES FOR SELECTED OPTIONS[a]

Marginal prices ($) per unit

Sector	No. seats[b] ($/seats	Trunk space ($/ft^3)	Reduction in recharge time ($hr))	Range ($/miles)	Improved reliability ($/days)	No. respondents
Police	$150	$17	$15	$1.75	$18.24	7
Government	207	20	8	1.31	7.30	17
Utilities	855	57	18	3.32	2.55	6
Business	156	11	14	.5	12.46	109
All sectors	179	12	13	1.03	11.50	139

[a]Based on the prices indicated for optional car 1 only.
[b]Including driver.

only pay 50¢/mile; utilities, $3.32/mile. Improved reliability was worth, on the average, $11.50 per one day reduction in number of unscheduled days in repair shop (base car equal to 12 days). Reliability was worth most to police ($18/day) and least to utilities ($2.55). From this analysis, it appears that the utility sector is the least constrained by economic considerations.

Further regression analysis based on optional car 1 only was done to determine the elasticity of five options: seating, trunk space, recharge time, range, and reliability. The results indicated that all five options were relatively inelastic. That is, the price did not necessarily affect the demand.

Tables 7 through 16 present the cross tabulations for each of the ten options versus the maximum price for each option (as determined by the respondents). The cumulative frequencies calculated for each option provide guidelines for determining the eventual market penetration. For example, to penetrate at least 50% of the fleet market (as represented by NAFA) a car would need the following attributes:

TABLE 7: Seating Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of Vehicles)

No. of seats	0	$1 to $150	$151 to $250	$251 to $400	$401 to $800	$800 plus	Relative frequency	Cumulative frequency
2	15.8 (13255)	0.0 (0)	0.0 (39)	0.0 (0)	0.0 (0)	0.2 (142)	16.0 (1346)	16.0
3	0.2 (131)	0.5 (436)	0.3 (239)	0.8 (714)	0.1 (50)	0.0 (0)	1.9 (1569)	17.9
4	7.0 (5868)	5.8 (4872)	9.9 (8330)	6.0 (5029)	8.8 (7423)	13.6 (11429)	51.0 (42951)	68.9
5	3.4 (2875)	4.3 (3580)	1.2 (1047)	4.2 (3541)	0.1 (112)	3.5 (2940)	16.8 (14096)	85.7
6	0.3 (278)	0.1 (96)	1.4 (1153)	1.4 (1181)	5.8 (4879)	4.5 (3761)	13.5 (11348)	99.2
7 plus	0.1 (54)	0.0 (0)	0.0 (0)	0.0 (9)	0.2 (161)	0.6 (519)	0.8 (741)	100.0
Overall	26.7 (22459)	10.7 (8984)	12.8 (10809)	12.4 (10472)	15.0 (12625)	22.3 (18792)	100.00 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Seating Capacity desired (including driver) _____. Maximum price that you would be willing to pay for this option _____.

TABLE 8: Trunk Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of Vehicles)

ft^3	0	$1 to $75	$76 to $100	$101 to $200	$201 to $400	$401 plus	Relative frequency	Cumulative frequency
0-5	18.1 (15210)	0.8 (663)	0.4 (298)	0.0 (0)	0.2 (142)	0.0 (0)	19.4 (16312)	19.4
6-12	6.2 (5256)	1.3 (1093)	3.0 (2525)	3.3 (2773)	4.0 (3370)	2.1 (1781)	20.0 (16798)	39.4
13-20	9.8 (8237)	1.7 (1416)	17.0 (14313)	16.1 (13584)	4.9 (4139)	6.6 (5574)	56.2 (47263)	95.6
21 plus	0.3 (256)	0.0 (8)	0.0 (0)	0.2 (200)	0.1 (121)	3.8 (3182)	4.4 (3767)	100.0
Overall	34.4 (28958)	3.8 (3180)	20.4 (17136)	19.7 (16557)	9.2 (7772)	12.5 (10537)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Trunk space desired _____. Maximum price you would be willing to pay for this option _____.

TABLE 9: Performance Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of Vehicles)

	0	$1 to $150	$151 to $250	$251 to $400	$401 to $800	$801 plus	Relative frequency	Cumulative frequency
No	10.8 (9058)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	10.8 (9058)	10.8
Yes	19.4 (16331)	22.4 (18868)	15.1 (12721)	11.5 (9696)	11.7 (9849)	9.1 (7618)	89.2 (75083)	100.0
Overall	30.2 (25390)	22.4 (18867)	15.1 (12721)	11.5 (9696)	11.7 (9849)	9.1 (7618)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Speed and acceleration sufficient to use limited-access roads (i.e., interstates, expressways) (yes or no). Maximum price you would be willing to pay for this option _____.

TABLE 10: Recharge Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

Hours	0	$1 to $50	$51 to $100	$101 to $250	$251 plus	Relative frequency	Cumulative frequency
8	16.9 (14188)	0.0 (0)	2.3 (1930)	0.3 (273)	0.3 (239)	19.8 (16630)	19.8
7	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	19.8
6	1.6 (1350)	5.3 (4478)	1.4 (1143)	1.0 (809)	2.0 (1700)	11.3 (9480)	31.1
5	0.0 (0)	0.6 (525)	0.1 (104)	0.2 (154)	0.0 (0)	0.9 (783)	32.0
4	1.5 (1287)	9.1 (7688)	5.3 (4448)	11.1 (9370)	2.8 (2345)	29.9 (25139)	61.9
3	0.0 (0)	0.1 (112)	0.1 (120)	4.0 (3385)	0.4 (328)	4.7 (3945)	66.6
2	1.3 (1123)	0.1 (91)	1.7 (1445)	3.0 (2554)	3.8 (3158)	9.9 (8371)	76.5
1	6.1 (5130)	0.0 (0)	6.8 (5687)	2.7 (2245)	0.9 (731)	16.4 (13794)	92.9
0	6.7 (5625)	0.0 (0)	0.0 (0)	0.1 (120)	0.3 (254)	7.1 (5999)	100.0
Overall	34.1 (28703)	15.3 (12895)	17.7 (14878)	22.5 (18910)	10.4 (8755)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]:Form of Question: Time needed to "refuel" _____. Maximum price you would be willing to pay for this option _____.

TABLE 11: Range Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

Miles	0	$1 to $75	$76 to $150	$151 to $250	$251 to $600	$601 plus	Relative frequency	Cumulative frequency
1 to 30	8.5 (7125)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	8.5 (7125)	8.5
31 to 100	1.3 (1134)	7.8 (6543)	10.6 (8915)	3.8 (3160)	6.4 (5358)	6.7 (5621)	36.5 (30732)	45.0
101 to 180	0.8 (644)	2.0 (1719)	1.3 (1115)	0.2 (199)	1.6 (1340)	0.8 (699)	6.8 (5719)	51.8
181 to 250	4.3 (3627)	1.1 (966)	5.8 (4885)	8.2 (6904)	3.4 (2903)	4.6 (3885)	27.5 (23170)	79.3 100.0
251 plus	5.9 (4930)	0.4 (359)	1.2 (988)	8.3 (7025)	1.1 (890)	3.9 (3205)	20.7 (17398)	
Overall	20.8 (17460)	11.4 (9588)	18.9 (15903)	20.5 (17288)	12.5 (10492)	15.9 (13410)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Range desired between "refueling" _____. Maximum price you would be willing to pay for this option _____.

TABLE 12: Heater Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

	0	$1 to $40	$41 to $50	$51 to $100	$101 plus	Relative frequency	Cumulative frequency
No	12.4 (10397)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	12.4 (10397	12.4
Yes	22.4 (18851)	13.4 (11278)	20.9 (17607)	21.0 (17689)	9.9 (8319)	87.6 (73744)	100.0
Overall	34.8 (29248)	13.4 (11278)	20.9 (17607)	21.0 (17689)	9.9 (8319)	100.0 (84141)	

Note: Totals may not agree due to rounding

[a]Form of Question: Passenger Compartment Heater (yes or no). Maximum price you would be willing to pay for this option _____.

TABLE 13: Air Conditioning Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

	0	$1 to $300	$301 to $400	$401 to $475	$476 plus	Relative frequency	Cumulative frequency
No	23.7 (19947)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	23.7 (19947)	23.7
Yes	2.6 (2148)	0.0 (0)	37.5 (31594)	16.5 (13918)	19.6 (16534)	76.3 (64194)	100.0
Overall	26.3 (22095)	0.0 (0)	37.5 (31594)	16.5 (13918)	19.6 (16534)	100.0 (84141)	

Note: Totals may not agree due to rounding

[a]Form of Question: Air conditioning (yes or no). Maximum price you would be willing to pay for this option _____.

TABLE 14: Power Steering Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicle)

	0	$1 to $75	$76 to $125	$126 to $150	$151 plus	Relative frequency	Cumulative frequency
No	21.6 (18153)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	21.6 (18153)	21.6
Yes	6.4 (5423)	18.2 (15325)	26.5 (22307)	19.2 (16149)	8.1 (6785)	78.4 (65988)	100.0
Overall	28.0 (23575)	18.2 (15325)	26.5 (22307)	19.2 (16149)	8.1 (6785)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Power Steering (yes or no). Maximum price you would be willing to pay for this option _____.

TABLE 15: Power Brakes Option vs Maximum Price quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

	0	$1 to $50	$51 to $65	$66 to $75	$76 plus	Relative frequency	Cumulative frequency
No	23.2 (19509)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	23.2 (19509)	23.2
Yes	10.6 (8916)	10.2 (8565)	13.7 (11505)	25.3 (21263)	17.1 (14383)	76.8 (64632)	100.0
Overall	33.8 (28425)	10.2 (8565)	13.7 (11505)	25.3 (21263)	17.1 (14383)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Power Brakes (yes or no). Maximum price you would be willing to pay for this option _____.

TABLE 16: Reliability Option vs Maximum Price Quoted by Respondent[a]
Percent of Vehicles (No. of vehicles)

Days	0	$1 to $100	$101 to $200	$201 plus	Relative frequency	Cumulative frequency
18-20	39.5 (33258)	0.8 (706)	0.9 (725)	2.7 (2300)	44.0 (36989)	44.0
15-17	0.0 (0)	1.7 (1427)	0.2 (149)	0.0 (0)	1.9 (1576)	45.9
12-14	2.3 (1947)	1.9 (1607)	1.6 (1328)	0.0 (0)	5.8 (4882)	51.7
9-11	5.3 (4473)	10.3 (8700)	5.2 (4359)	1.0 (802)	21.8 (18333)	73.5
6-8	1.4 (1146)	2.8 (2377)	0.2 (136)	2.5 (2105)	6.9 (5764)	80.4
3-5	1.8 (1527)	1.6 (1383)	2.2 (1859)	2.6 (2218)	8.3 (6988)	88.7
0-2	3.1 (2614)	0.0 (0)	0.6 (546)	7.7 (6450)	11.4 (9610)	100.0
Overall	53.4 (44965)	19.3 (16199)	10.8 (9101)	16.5 (13875)	100.0 (84141)	

Note: Totals may not agree due to rounding.

[a]Form of Question: Allowable annual number of unscheduled days in shop _____. Maximum price you would be willing to pay for this option _____.

4 seats (69%)
13 to 20 cubic feet (96%)
performance capability (89%)
4-hr max recharge (62%)
101 to 180-mile range (52%)
heater (88%)
air conditioner (76%)
power steering (78%)
power brakes (77%).
maximum of 12 to 14
unscheduled repair days (52%)

The numbers in parentheses represent the percent of NAFA survey that would be captured if that option were available. These are in absolute terms. No allowance is made for tradeoffs. That is, in reality, the respondent may be willing to "trade off" a few cubic feet of trunk space for an air conditioner.

4. BASE CASE RUNS ON CPEN SIMULATOR

As indicated in the introduction to this report, a simulator (CPEN) has been designed to use the NAFA data base to estimate the market penetration rates of new technologies in the fleet market. This section discusses some of the curves that have been generated using CPEN.

CPEN produces two types of rates: applicability rates and market penetration rates. The applicability rates are generated by comparing the physical attributes of the input vehicle (in our case, the 1986 target EV) to the required physical capabilities specified for cars operated by the individul NAFA respondents. The market penetration rates are calculated on the basis of both physical and economic considerations. That is, for all EVs that are physically applicable to a particular respondent, life-cycle costs including purchase price are calculated for both the EV and a comparable ICE. The respondent is assumed to purchase the vehicle whose purchase price is lower. If purchase prices are comparable, then the choice depends on the total life-cycle cost. Finally, if the purchase price exceeds certain limits set by the respondent, he is said to defer purchasing altogether.

The simulator was initially run with a vehicle corresponding to the 1986 Target EV (see Table 1), with a base price of $6500, battery price of $1355, and no subsidy. Based on the NAFA survey data results, this EV design had an applicability rate of 12% but a zero penetration rate and thus no actual retail sales.

A series of curves were generated to indicate the sensitivity of these rates to changes in both physical characteristics and economic considerations. They are presented in Figures 1 through 7. Each figure deals with changes in one specific variable, while all others are held constant.

Figure 1 shows the market penetration rate versus the base price of the car. As indicated above, this car offered at $6500 would have zero buyers. If the price was decreased by $2500, the penetration rate would increase to 3%. If the vehicle was virtually free, the vehicle would be selected by only 9% of the NAFA respondents. Changes in battery price have even less effect (see Figure 2). Going from a battery price of $1355 to 0 would only increase the market penetration to 2%. Increasing the subsidy from 0 to $2000, with all else held constant, would increase market penetration by 3% (see Figure 3). Of course, this has the same effect as reducing the vehicle price by $2000. Note though that a given dollar reduction in battery price has a different effect than an equivalent reduction in vehicle price because of the differential way in which these alternatives affect life-cycle costs (See BNL 51312).

Changes in the physical characteristics of the EV generally did not result in changes in the market penetration rate, which remained at or near zero. Figures 4 to 7 display changes in applicability rates based on changes in physical characteristics. Figure 4 indicates that a reduction in the required recharge time from 8 to 0 hours would result in an increase of 5% in terms of applicability (12 to 17%). The applicability rate peaks at about 17% for a maximum 30 ft^3 in terms of trunk capacity (see Figure 5). Increases in seat capacity have little effect on applicability rates (see Figure 6), while an increase in range from 50 to 300 miles would result in about 3% increase in applicability (10 to 13%, see Figure 7).

It is clear from this limited analysis that there is no single overriding factor that influences applicability rates of EVs. Dramatic increase in specific capabilities result in only minimal increases in applicability rates. For example, while omission of AC would result in substantial reduction of user markets, inclusion does not guarantee a good acceptance rate. The fleet administrators are looking at the whole package - options, performance, and price.

5. CAVEATS

The data base described in this report has many drawbacks. The survey did not represent a statistically designed probability sample. Nor were the data weighted to correct for potential sampling errors.* The response rate was very low. From the responses, it appears that the maximum acceptable option prices specified by many of the fleet administrators were unrealistically low. Also, some of the responses indicated prejudgments about EV capabilities, which theoretically should not have been taken into consideration. The survey probably would have been more successful if the questionnaire had avoided reference to any particular technology. However, the NAFA data base is the only known data base that relates the physical specifications of fleet vehicles to economic utility. Moreover, the CPEN simulator, despite its need for further refinement, embodies functional relationships and independently derived coefficients that are useful for understanding how variations in vehicle characteristics affect life-cycle costs when EVs are used in fleets.

Given the potential importance of fleet activities to the introduction of new vehicular technologies, it is important to utilize the best available resources in order to understand the current needs of fleet operators. It is for this goal that this report has been generated.

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*There is currently no fleet census available from which to weight the sample.

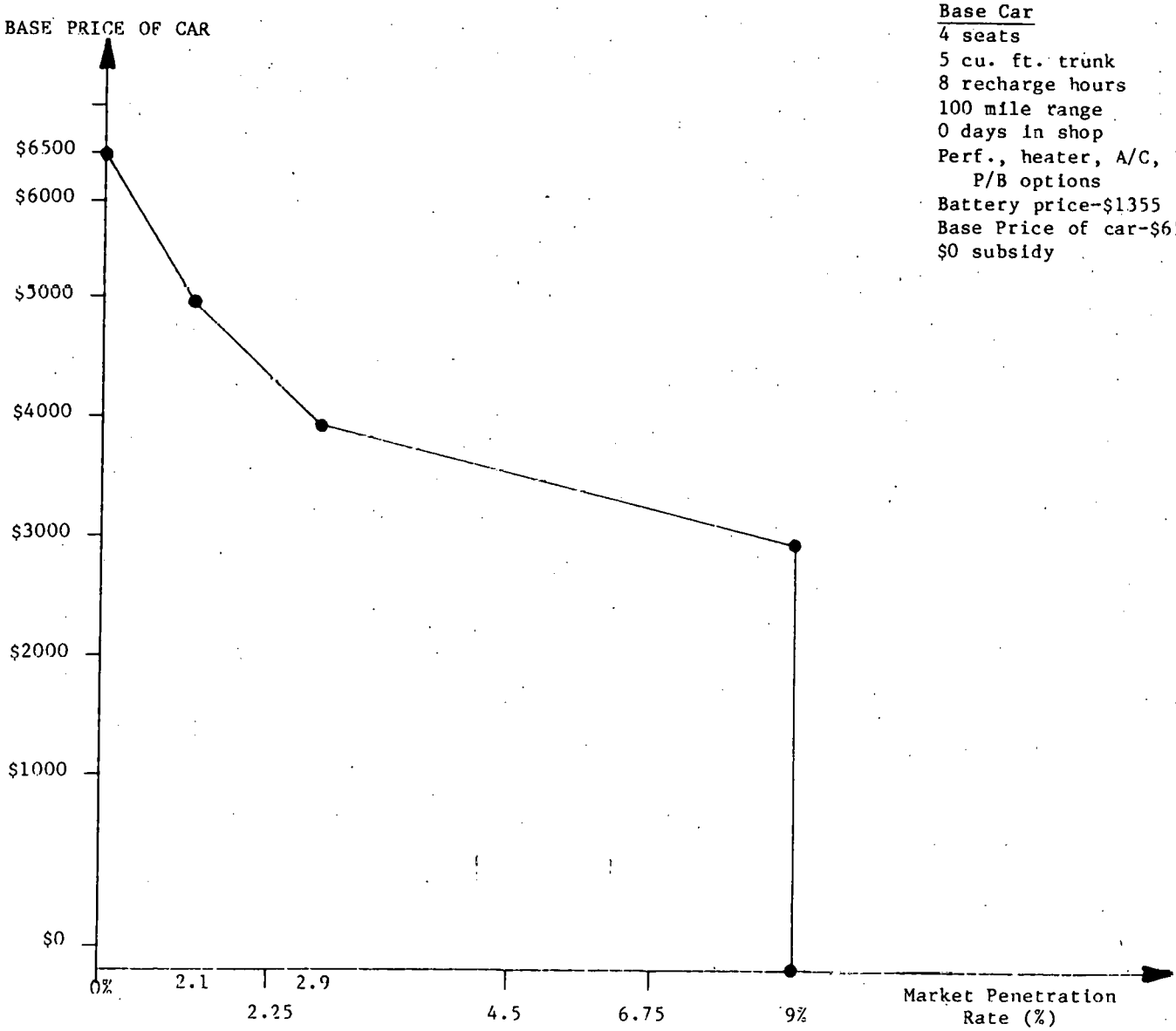

Figure 1
Base Price of Car (Ex Battery) Versus Market Penetration Rate

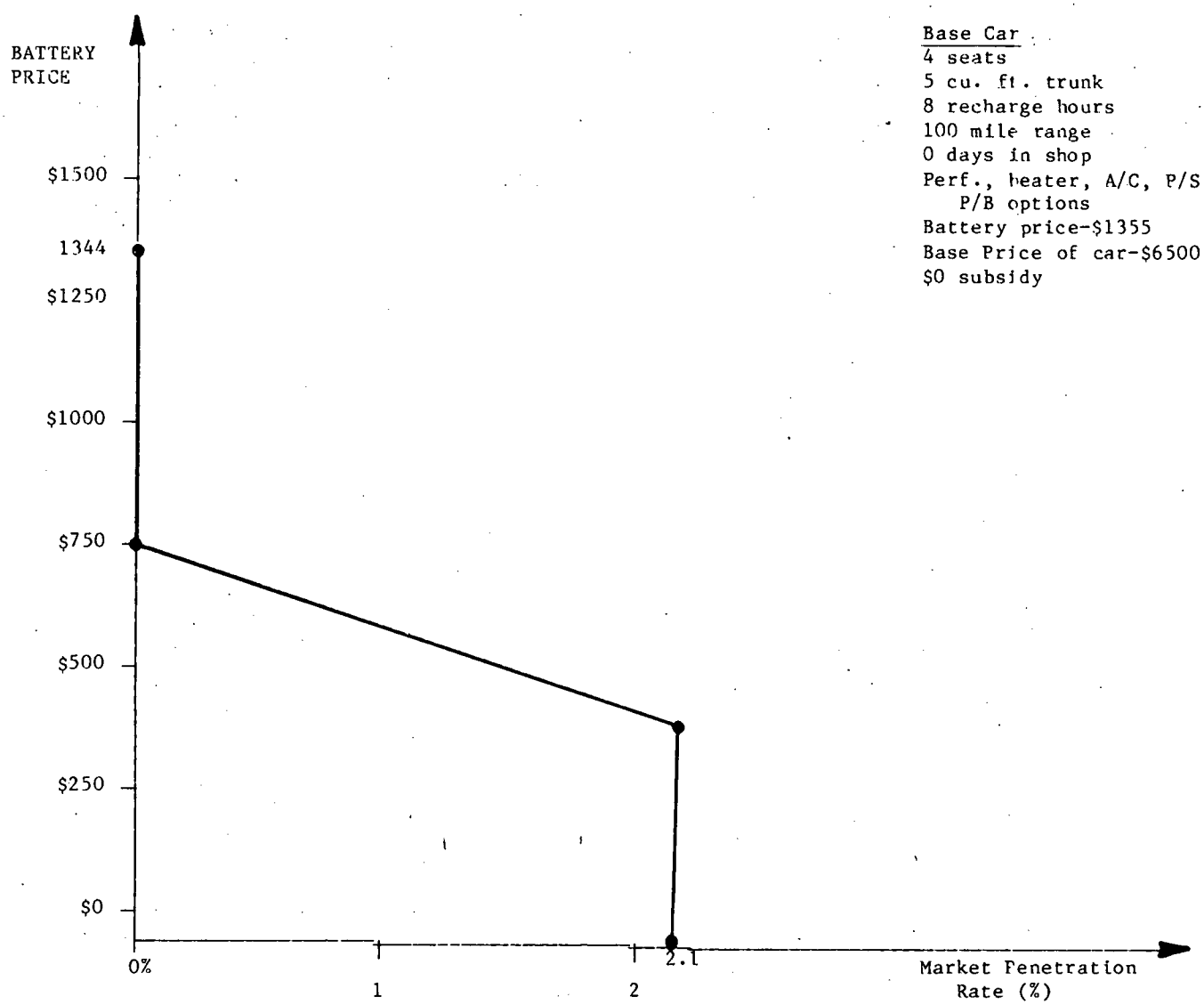

Figure 2
Battery Price Versus Market Penetration Rate

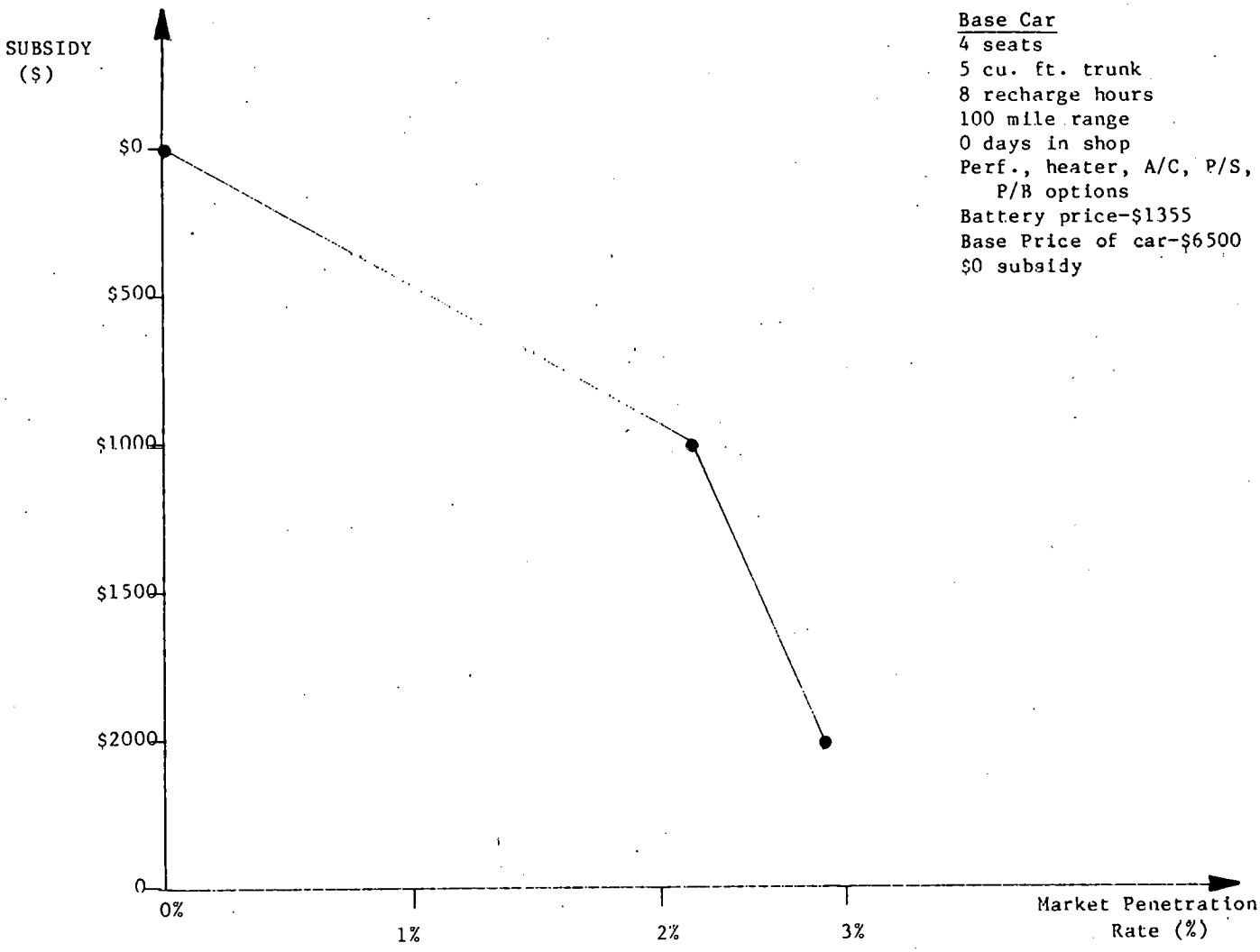

Figure 3
Vehicle Purchase Subsidy Versus Market Penetration Rate

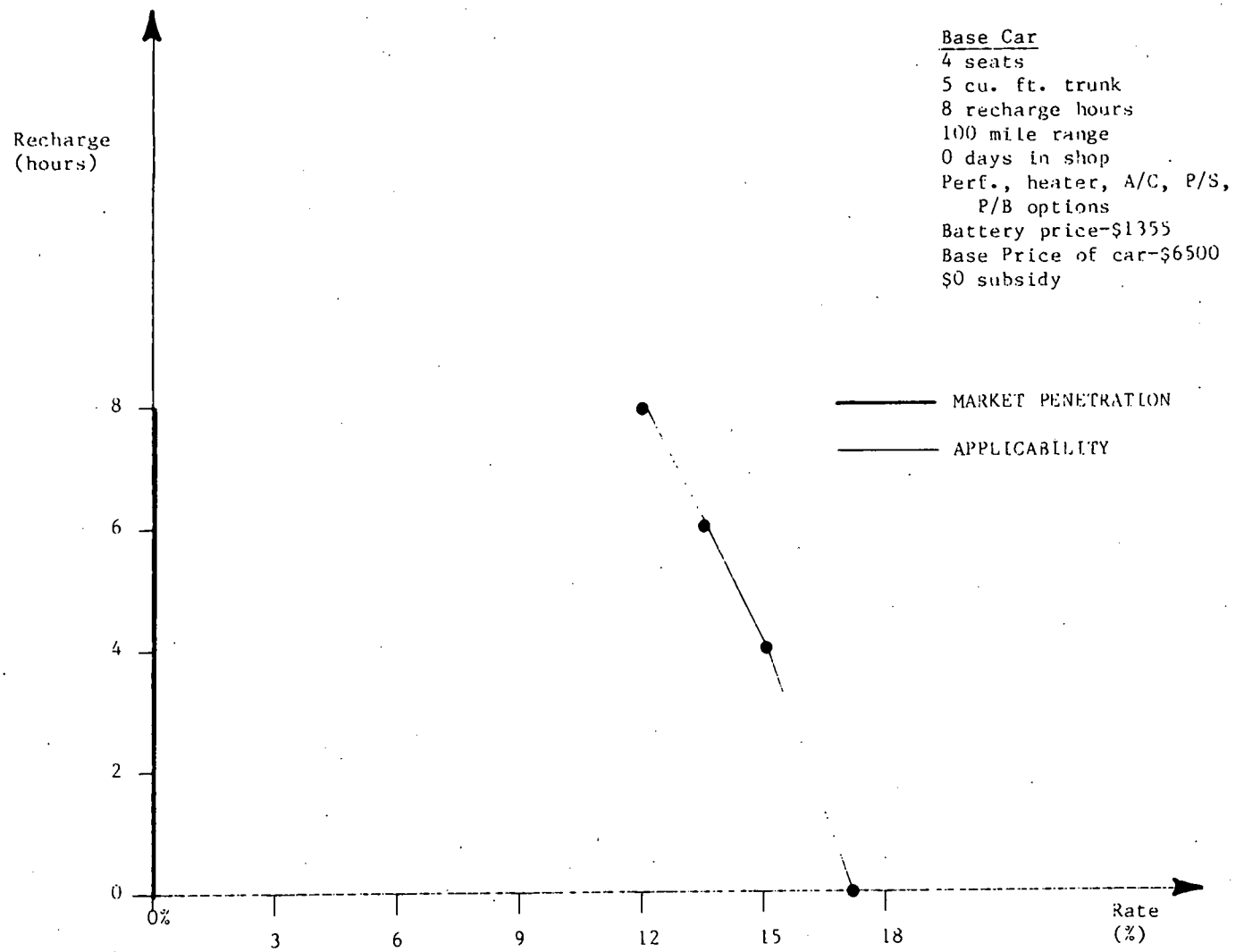

Figure 4
Recharge Time Versus Applicability Rates & Market Penetration Rates

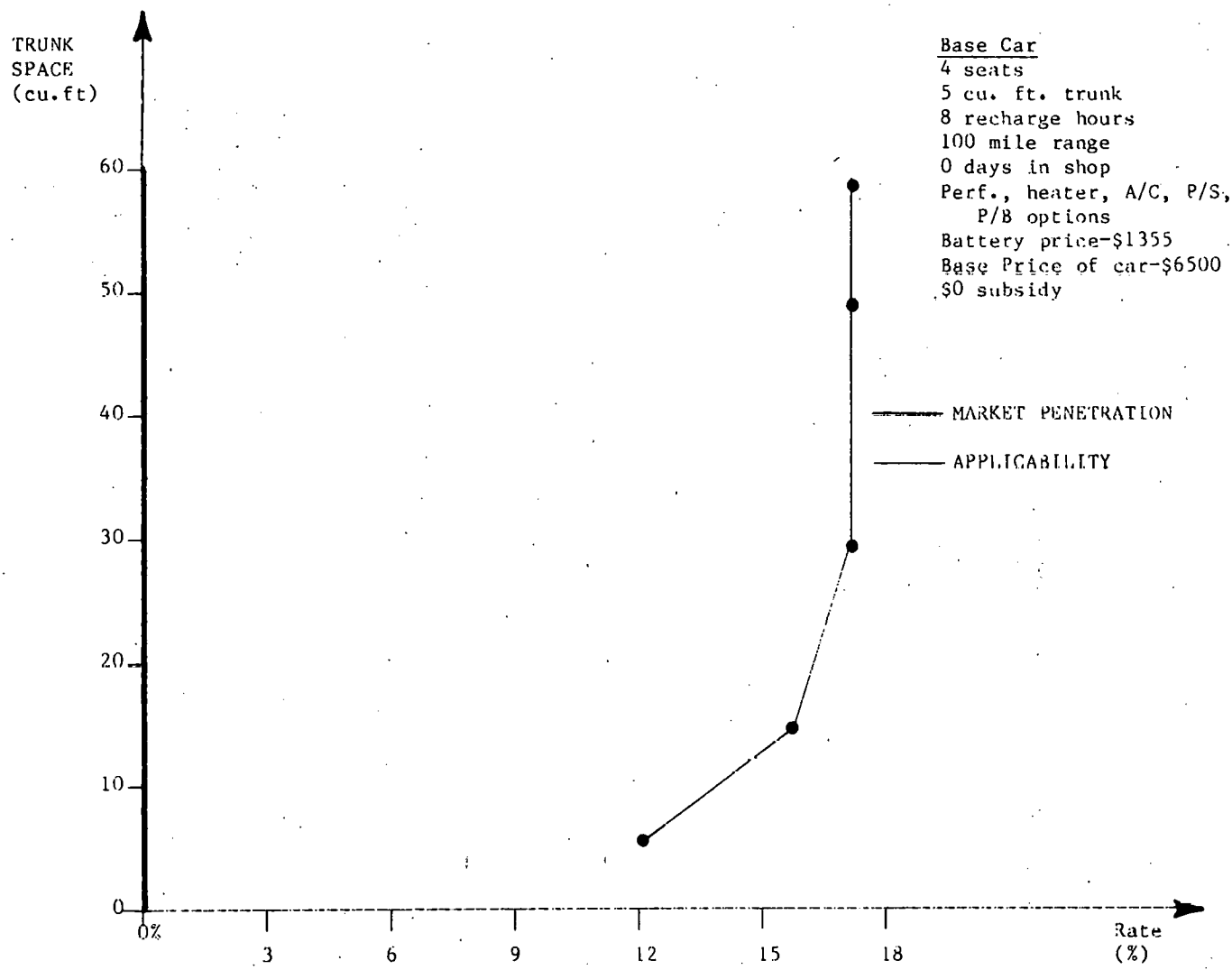

Figure 5
Trunk Space Versus Applicability Rates & Market Penetration Rates

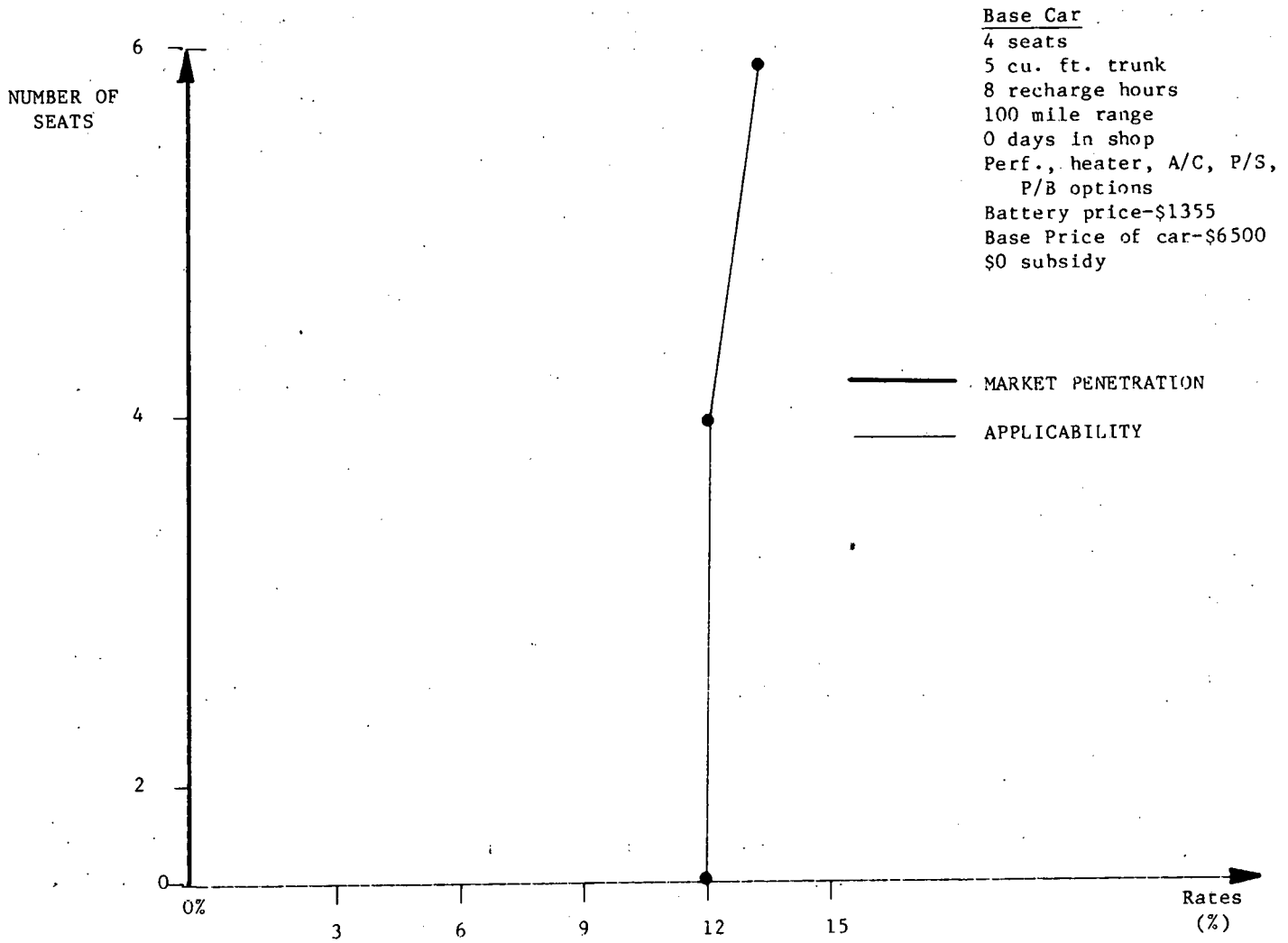

Figure 6
Number of Seats Versus Applicability Rates and Market Penetration Rates

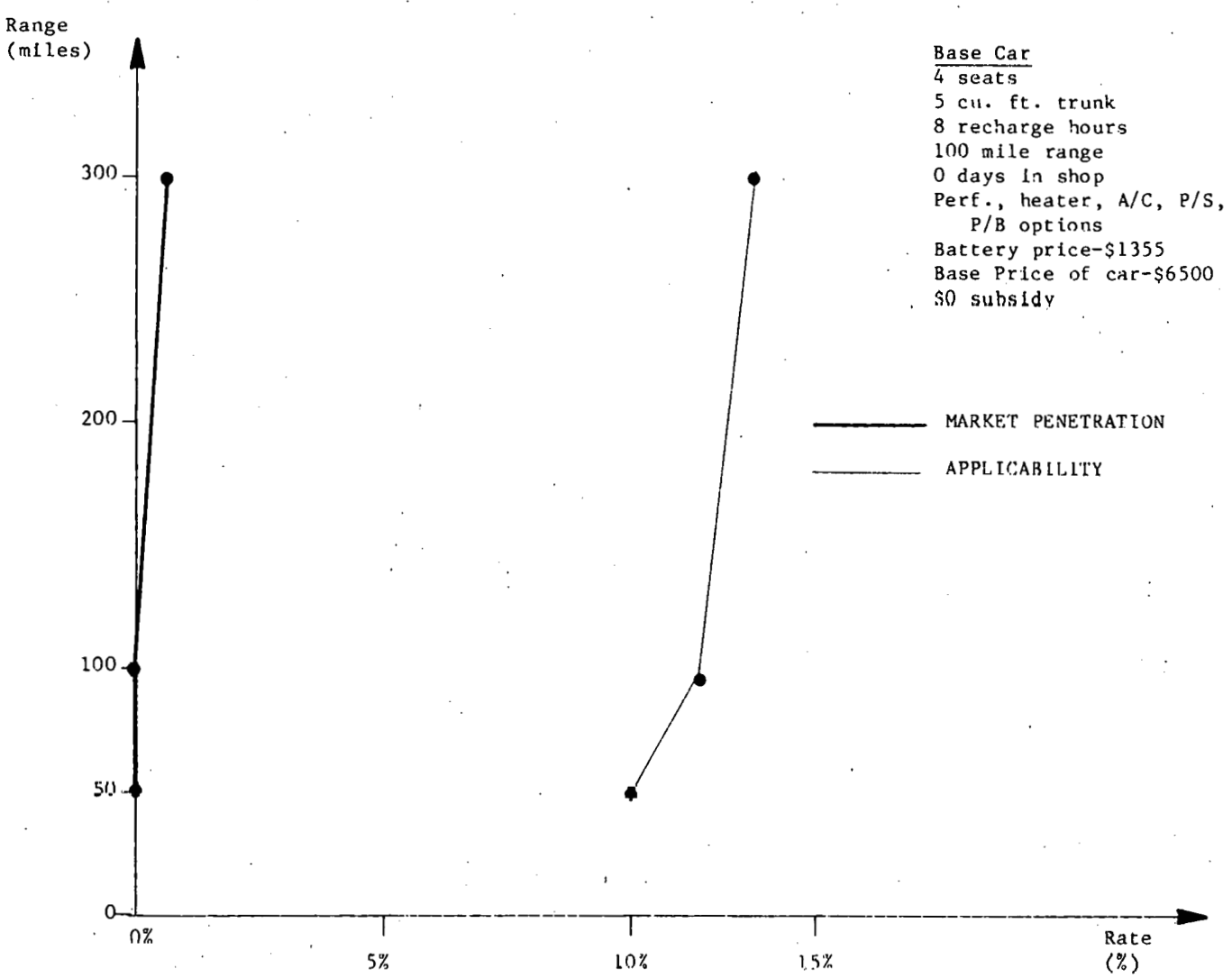

Figure 7
Range Versus Applicability Rates and Market Penetration Rates

APPENDIX A

NATIONAL ASSOCIATION OF Fleet Administrators, Inc.

295 Madison Avenue, New York, New York 10017 / Telephone (212) 689-3200

To: All NAFA Members

From: R.L. Breault, President

Re: ELECTRIC VEHICLE SURVEY

Once popular, now scorned, will electric cars return to the American highway?

In view of the ever-rising price of gasoline, the unreliability of imported supplies, the impact of emission controls, a great deal of research is being devoted to a possible rebirth of the electric car and light truck as a potential vehicle of the future.

NAFA Members -- as professional, rational car and truck buyers and lessees -- can make an important contribution to this research in one very specific area:

HOW LARGE IS THE POTENTIAL MARKET FOR ELECTRIC VEHICLES?

The enclosed survey is designed to develop answers to that question. We urge your cooperation in carefully studying the options offered, comparing them with your transportation needs and then completing the questionnaire.

In addition, we are taking this opportunity to gather information about NAFA members in a previously unknown area -- where your cars and light trucks are located. The first sheet of the survey asks you to specify the state in which your vehicles are registered.

This information will be of great help to us in developing additional data about the impact of fleets on the total vehicle market, an area much overlooked by many research organizations.

As always, your cooperation and assistance are greatly appreciated.

NUMBER OF VEHICLES PER STATE

(If a given vehicle operates in more than one state, assign it only to the state which serves as the vehicle's base of operations.)

	Cars	Light Trucks (GVW of 10,000 lbs. or less)	
		Vans	Other
Alabama			
Alaska			
Arizona			
Arkansas			
California			
Colorado			
Connecticut			
Delaware			
District of Columbia			
Florida			
Georgia			
Hawaii			
Idaho			
Illinois			
Indiana			
Iowa			
Kansas			
Kentucky			
Louisiana			
Maine			
Maryland			
Massachusetts			
Michigan			
Minnesota			
Mississippi			
Missouri			
Montana			
Nebraska			
Nevada			
New Hampshire			
New Jersey			
New Mexico			
New York			
North Carolina			
North Dakota			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Rhode Island			
South Carolina			
South Dakota			
Tennessee			
Texas			
Utah			
Vermont			
Virginia			
Washington			
West Virginia			
Wisconsin			
Wyoming			
Total			

Form 81

NATIONAL ASSOCIATION OF FLEET ADMINISTRATORS, INC.
295 Madison Avenue, New York, NY 10017

Name _____

Title _____

Company _____

ELECTRIC CAR SURVEY

Suppose that you must replace your cars and that the only replacements you can obtain are electric cars. The basic electric car available to you has a delivered price of $6000. Options are available to increase the capabilities of this vehicle. All of the cars ordered do not have to have the same options. In fact, you may order as many as three different types of optional vehicles. In the table below please specify the type(s) of optional car(s) you would order and the price you would be willing to pay for each option. Aside from the optional characteristics shown in the table, assume that the electric car is identical to the average car you now operate. In the event that you prefer to lease vehicles, fill out the form with purchase price data and assume that your lease payments would reflect selling prices in the same manner as at present.

	Base Car	Optional Car #1	Optional Car #2	Optional Car #3
1. Seating Option: Seating capacity desired (fill in number, including driver)	2 adults	_____adults	_____adults	_____adults
Maximum price you would be willing to pay for this option.		$	$	$
2. Trunk Options Trunk space desired	5 cubic feet	_____cubic feet	_____cubic feet	_____cubic feet
Maximum price you would be willing to pay for this option.		$	$	$
3. Performance Option: Speed & acceleration sufficient to use limited-access roads (i.e., interstates, expressways) (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$

	Base Car	Optional Car #1	Optional Car #2	Optional Car #3
4. Fast Recharge Option: Time needed to "refuel"	8 hours	_____hours	_____hours	_____hours
Maximum price you would be willing to pay for this option.		$	$	$
5. Range Option: Range desired between "refuelings"	30 miles	_____miles	_____miles	_____miles
Maximum price you would be willing to pay for this option.		$	$	$
6. Passenger Compartment Heater: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
7. Air Conditioning: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
8. Power Steering: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
9. Power Brakes: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
10. Reliability Option: Allowable annual number of unscheduled days in shop	20 days	_____days	_____days	_____days
Maximum price you would be willing to pay for this option.		$	$	$
11. What percentage of your car fleet would use each type of car? (Total of this line must equal 100%)	_____ %	_____%	_____%	_____%

NATIONAL ASSOCIATION OF FLEET ADMINISTRATORS, INC.
295 Madison Avenue, New York, NY 10017

Name _____

Title _____

Company _____

ELECTRIC TRUCK SURVEY

Suppose that you must replace your light trucks (GVW of 10,000 lbs. or less) and that the only replacements you can obtain are electric trucks. The basic electric truck available to you has a delivered price of $6000. Options are available to increase the capabilities of this vehicle. All of the trucks ordered do not have to have the same options. In fact, you may order as many as three different types of optional vehicles. In the table below please specify the type(s) of optional truck(s) you would order and the price you would be willing to pay for each option. Aside from the optional characteristics shown in the table, assume that the electric truck is identical to the average truck you now operate. In the event that you prefer to lease vehicles, fill out the form with purchase price data and assume that your lease payments would reflect selling prices in the same manner as at present.

	Base Truck	Optional Truck #1	Optional Truck #2	Optional Truck #3
1. Seating Option: Seating capacity desired (fill in number, including driver)	2 adults	_____adults	_____adults	_____adults
Maximum price you would be willing to pay for this option.		$	$	$
2. Cargo Space Option: Desired full-enclosed cargo space capacity	5 cubic feet	_____cubic feet	_____cubic feet	_____cubic feet
Maximum price you would be willing to pay for this option.		$	$	$
3. Payload Option: Desired cargo weight capacity (including driver & passengers)	500 Lbs.	_____Lbs.	_____Lbs.	_____Lbs.
Maximum price you would be willing to pay for this option.		$	$	$

	Base Truck	Optional Truck #1	Optional Truck #2	Optional Truck #3
4. Performance Option: Speed and acceleration sufficient to use limited-access roads (i.e., interstates, expressways) (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
5. Fast Recharge Option: Time needed to "refuel"	8 hours	_____ hours	_____ hours	_____ hours
Maximum price you would be willing to pay for this option.		$	$	$
6. Range Option: Range desired between "refuelings"	30 miles	_____ miles	_____ miles	_____ miles
Maximum price you would be willing to pay for this option.		$	$	$
7. Passenger Compartment Heater: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
8. Air Conditioning: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
9. Power Steering: (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
10. Power Brakes (Yes or No)	No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Maximum price you would be willing to pay for this option.		$	$	$
11. Reliability Option: Allowable annual number of unscheduled days in shop	20 days	_____ days	_____ days	_____ days
Maximum price you would be willing to pay for this option.		$	$	$
12. What percentage of your truck fleet would use each type of truck? (Total of this line must equal 100%)	_____ %	_____ %	_____ %	_____ %