

ELECTRIC/HYBRID VEHICLES

FOCUS GROUP RESEARCH

Prepared for

The Department of Energy

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SECTION I  
INTRODUCTION

This report presents the major conclusions and findings from the focus group discussion on electric/hybrid vehicles. The purpose of the qualitative information generated by this focus group is to provide input for the Department of Energy in two decision-making areas:

1. The evaluation of the barriers and opportunities associated with the successful commercialization of electric/hybrid vehicles.
2. The evaluation of the appropriate federal actions for promoting and facilitating commercialization.

The technology represented by electric/hybrid vehicles was selected for research and evaluation as a candidate for commercialization because of the potential opportunity to reduce American dependence on gasoline. DOE recognizes that this potential can be realized through energy conservation as well as through the development of alternative sources of energy. As a major source of energy usage in the United States, the gasoline-powered vehicle is a logical target for consideration in commercialization studies. By encouraging the use of alternative technologies, DOE can achieve its mission of energy efficiency.

This report addresses the question of whether electric/hybrid vehicles represent the appropriate alternative technology for DOE commercialization efforts. The report covers these four issues:

1. Is the commercialization of electric/hybrid vehicles feasible?
2. What is the extent and nature of the market for electric/hybrid vehicles?

3. What barriers and opportunities can be identified as critical to the commercialization and what is the relative importance of each?
4. What actions, if any, should the federal government take to promote commercialization of electric/hybrid vehicles?

These issues are discussed in terms of the perspectives of the focus group participants. The report covers the attitudes and opinions of the participants regarding the technology and commercialization. The participants' knowledge about the technology are reviewed and their ideas for successful commercialization presented.

A. BACKGROUND

Recent energy "crises" of various types, combined with growing public awareness of the depletion of natural resources and the deterioration of the environment, have led to increased efforts to discover alternative energy sources and new methods of conserving energy.

The petroleum shortage is an example of an energy crisis. The United States is increasingly dependent on uncertain foreign oil supply. This fact was underscored by the Arab oil embargo of 1973-74. Total imports of petroleum products have grown from approximately 20 percent of our requirements in 1970 to nearly 50 percent in 1977. According to long-range government projections, if present consumption trends continue, domestic and world sources combined may not be adequate to meet the expected U.S. demand for petroleum.

Faced with these and other energy problems, the Federal Government and the Department of Energy (DOE) have become increasingly involved in the area of energy consumption and conservation. The result of this involvement has been the promulgation of a growing body of regulations, on the one hand, and the active support of the research, development and implementation of energy technologies, on the other hand. These activities will ultimately have a tremendous impact on American society with strong implications for economic, physical, social and psychological issues.

In the area of energy conservation, a number of technologies have been supported. Some examples of these technologies are given to illustrate their impact. High-efficiency electric motors have already been developed in private industry. DOE is considering what actions could be taken to increase their use by the nation's industries since these motors account for a substantial proportion of the electricity we consume. The further development of electric or hybrid vehicles could reduce the amount of gasoline consumed, thus decreasing our dependence on foreign oil imports. Retrofitting home oil furnaces with the more efficient flame retention heads could reduce fuel oil consumption. In light of recent oil shortages during harsh winters, this conservation measure could have a broad impact on the economy as a whole in addition to reducing the owner's fuel bills.

There is a need to develop new sources of energy that will reduce our vulnerability to energy crises and foreign

energy supplies. The variety of sources is illustrated by the following examples. The development of shale oil resources could provide a substantial supply of domestic oil. The installation of low-head hydropower plants in existing dam sites could provide a widespread source of clean energy that would have minimal effect on the environment. The development of wind energy technology is another source of new energy that could reduce oil consumption by replacing some of the use of oil-fired generating plants.

To further these goals of energy conservation and development, the Department of Energy is conducting a program of commercialization for a number of energy related technologies. The intent of this program is to promote conservation of energy and use of new energy sources by bringing these technologies to the market place. By encouraging the widespread use of the appropriate technologies, DOE can attain the goal of energy efficiency.

The commercialization program requires that DOE evaluate a number of energy technologies in terms of their commercialization potential. The particular questions that need to be answered for each technology are these:

- Is the commercialization of this technology feasible?
- What is the extent and nature of the market for this technology?
- What barriers or opportunities can be identified as critical to the commercialization effort and what is the relative importance of each?
- What actions, if any, should the federal government take to promote commercialization of these technologies?

Since the technologies that are candidates for this program vary widely in their technical maturity and economic circumstances, the answers to these questions will have a substantial impact on the course of the commercialization processes.

## B. RATIONALE FOR FOCUS GROUPS

The commercialization program is now at the stage of evaluating the commercialization potential of various energy technologies. As a means of guidance in decision-making, DOE requires comprehensive input from key individuals associated with these technologies. Such individuals include representatives from government, industry, and environmental groups whose knowledge and expertise enable them to provide input to the decision-making process. The complexity of the issues and interrelationships surrounding those energy problems makes the contributions of such qualified people essential.

The focus group methodology is ideally suited to such an information gathering effort. A focus group brings together a number of individuals whose discussion of the relevant issues is led by a trained moderator. The rationale for such a group discussion is that the interaction of the respondents will produce a more thorough understanding of the topic than would interviews conducted individually. This effect is due in part to each respondent's contribution to the others as well as to the nature of the leadership exerted by the moderator.

The information needs of DOE require input to policy decisions from outside DOE. Such input is best obtained by identifying target populations of organizations and individual roles within those organizations. From these populations, qualified respondents can be selected who represent a variety of opinions about and attitudes toward the commercialization of a particular technology. Such representation helps assure

coverage of the commercialization issues from many viewpoints - developers, manufacturers, distributors, purchasers and users.

The reader should be aware that focus groups have certain critical limitations that must be kept in mind when interpreting data derived from this technique. One must be cautious in making generalizations and drawing definitive conclusions from any qualitative research data, since the information obtained is not only based on a small number of cases, but relies upon a volunteer sample. Such a sample could not be statistically representative of its assumed universe even if it were many times larger. As a result, these findings should be viewed primarily in the context of discovery, offering working hypotheses to be validated with quantitative techniques, if that is the desired goal.

Overall, this report should be read as primarily qualitative, providing insights into perceptions and knowledge of these technologies. The major questions to be answered by the research will describe WHAT, HOW and WHY participants know, think and feel about the issues, with less emphasis to be placed on HOW MANY know or think and feel in given ways. As a result, not every respondent would agree with each conclusion of the report.

Finally, the conclusions presented in this report and the findings on which they are based represent Market Facts' objective analysis of the information derived from the focus group respondents. That is, they do not represent any particular point of view held by Market Facts. Instead, the report is based on the knowledge, perceptions, attitudes and opinions of the respondents as brought forth in the focus group.

C. PROFILE OF FOCUS GROUP

The discussion from which the major findings and conclusions were drawn was held the afternoon of July 25, 1978, in Washington, D.C. Dr. James Heisler, Vice President of Market Facts, Inc., served as moderator. The three-hour discussion was informally oriented, with Dr. Heisler probing respondents where necessary and guiding the conversation so that all major issues of interest to DOE were covered. The discussion guideline which he used is provided in the appendix. Also provided in the appendix is a copy of the matrix of barriers and actions which was presented to the group for comment and evaluation.

The group consisted of 11 individuals representing public and private sector organizations. They were invited to participate based on their knowledge and experience, whether as producers, users or suppliers to the industry, with the electric/hybrid vehicle technology and market. A majority of the respondents had actual experience driving electric vehicles.

Respondents represented the following types of organizations and viewpoints:

- Public utilities
- Trade associations
- Engineering and city planning consultants
- Government agencies which use and/or are developing electric vehicles
- Manufacturers of electric vehicles and components

At the same time, one participant also spoke as a consumer. This individual regularly drives an electric vehicle between home and work.

SECTION II  
SUMMARY AND MAJOR CONCLUSIONS

In summary, the respondents feel that the following are barriers to the commercialization of electric/hybrid vehicles:

- The assumption that electric/hybrid vehicles should compete with or replace internal combustion vehicles rather than have broader opportunities for use and acceptance.
- Problems associated with government policies and standards designed for internal combustion vehicles rather than electric/hybrid vehicles.
- Unsatisfactory cost and performance experience with vehicles converted from another power source.
- Lack of experience and understanding by consumers about the benefits of electric/hybrid vehicles.
- Capital constraints, especially for smaller manufacturers and electric utilities.

The respondents believe that government should take the following actions with regard to the commercialization of electric/hybrid vehicles:

- Conduct informational and educational programs about the benefits of electric/hybrid vehicles.
- Continue to support the development and use of electric/hybrid vehicles by government agencies.
- Institute a program of deregulation to remove existing institutional barriers.
- Offer economic incentives for producers and/or purchasers.
- Contribute to a positive marketing environment for electric/hybrid vehicles.

This section of the report presents the major conclusions of the research. The conclusions are drawn from the focus group discussion in which the following issues regarding the commercialization of electric/hybrid vehicles were treated: the feasibility of commercialization, the market for electric/hybrid vehicles, the barriers to commercialization, and the governmental actions that could reduce those barriers.

The conclusions are highlighted below and then followed by a more detailed description based on how the respondents view particular barriers and actions aimed at overcoming these barriers. The next section of the report provides the major findings from the research and includes verbatim quotations from respondents which serve to illustrate the nature and tone of various attitudes.

- Without exception, the focus group participants were supporters of the commercialization of electric/hybrid vehicles.
- The majority of the respondents believed that the market potential for such vehicles was largely pinned on how the vehicles were positioned -- as a replacement to vehicles driven by internal combustion engines or as an energy-saving transportation option with unique applications.
- All the respondents believed that government has a definite role in commercialization but there was no agreement on the specific actions appropriate for government to take.
- The suggestions for governmental actions were wide ranging and included economic incentives for both producers and users, public information and education, and the removal

of inhibiting standards.

- In terms of the five general categories of barriers (technological, economic, social, institutional and environmental), the participants placed major emphasis on the need to remove economic and institutional barriers such as safety standards more applicable to internal combustion engine vehicles. Social barriers in the form of perceptions of electric/hybrid vehicles by the public were also a major concern.
- Except for cost and performance considerations, there was generally congruence between DOE's and the participants' conceptions of the barriers and possible solutions.
- Finally, the participants stressed that the major thrust for successful commercialization must be directed to developing a positive marketing environment for electric/hybrid vehicles.

Feasibility of commercialization of electric/hybrid vehicles.

Although they represented different public/private, producer/user situations, the respondents were clearly advocates of the commercialization of electric/hybrid vehicles. This advocacy was even true of two respondents who had had unfavorable and unprofitable experiences in manufacturing vehicles powered by other than gasoline fuels. The group saw commercialization as providing benefits to consumers and society in the form of energy savings, cleaner environment, easier vehicle maintenance and repair, and improved urban transportation control. Although the respondents discussed a number of barriers to commercialization, they seemed to believe

that commercialization was feasible as well as desirable.

Several of the respondents distinguished between commercialization opportunities for electric/hybrid vehicles which are converted from another fuel source and those which are expressly designed for electric power. In general, they believed that conversion commercialization had not met expectations to date based on performance and cost considerations.

Market potential for electric/hybrid vehicles. The majority of the respondents believed that commercialization would be impeded if electric/hybrid vehicles were positioned as a replacement for internal combustion vehicles. Replacement was envisioned as creating a number of major problems. One was the potential threat to the significant sector of the economy involved in the manufacture and marketing of internal combustion vehicles. Resistance from the transportation industry was implied by the respondents, especially because of employment considerations.

Also associated with replacement was the problem of narrowness of the function they perceived for such vehicles. Several participants believed that electric/hybrid vehicles offered unique possibilities for mobile power sources, off-highway applications and special uses such as golf carts. To restrict the vehicles to competing with internal combustion automobiles and trucks put serious limitations on the market potential, the participants said.

The most significant problem identified by the respondents was that replacement positioning would require the vehicles to meet internal combustion standards. In their view, the standards were unnecessary and uneconomical for electric vehicles.

Related to the replacement issue was the concept of whether an electric/hybrid vehicle should be positioned as the "second car" in the family or the primary car. Although several participants pointed out that the second and third car segments of automobile ownership were large, they believed the primary position offered more potential.

Government's role in commercialization. Although all the respondents believed that government had a definite role in commercialization, they disagreed on the parameters and tasks appropriate for that role. The majority expressed negative feelings about the government being involved in manufacturing and marketing of such vehicles except through economic incentives for private development. Some of the participants believed that past government involvement had actually impeded commercialization while several others expressed positive support of the efforts by federal agencies to use electric/hybrid vehicles and thus set an example for the private sector. In general, the respondents expressed the desire that the government's role be defined in three ways: providing positive encouragement for market acceptance of the electric/hybrid vehicle, removing its own institutional barriers and stimulating demand through appropriate incentives.

In reviewing the government's role in commercialization, a number of respondents talked about state and local governments as well as the federal level. Both barriers and opportunities related to successful commercialization were mentioned.

Government actions for commercialization. Because the participants represented a variety of viewpoints and experiences with electric/hybrid vehicles, their opinions about government actions

for commercialization were equally as varied. In many cases, the opinions seemed related to the traditional outlooks of the organizations and institutions they represented. Respondents from the private sector favored minimum government involvement. Several, in fact, suggested that government's only involvement should be to remove existing barriers or to avoid instituting new ones. Although they said the free market system should be allowed to work, they wanted the government to provide economic incentives to producers and/or users.

Some respondents suggested that incentives be directed toward manufacturers in the form of tax credits, loan guarantees or other financially oriented programs. Suggestions were also offered for incentives for buyers such as reduced licensing fees, parking privileges, tax rebates and other benefits. Interestingly, consumer incentives were identified in all three governmental levels -- federal, state and local. No specific suggestions were made in terms of dollars or other measurements except that tax rebates should be much greater than now being considered in order to stimulate purchase.

In addition to incentives, the respondents agreed that the government should conduct information and education campaigns, even a massive lobbying effort, for energy conservation.

Congruence in conceptions of barriers and solutions. In general, there was congruence between the conceptions of the participants and DOE regarding the relative seriousness of barriers and the likelihood of success of the specific actions. The only apparent major disagreement was viewed as a matter of definition. If "regulatory actions" included the removal of inhibiting regula-

tions, then the respondents believed the appropriate rating on the DOE matrix should be 5, to indicate a most effective action. In other words, the participants were most interested in what they termed "positive" action -- what is also known as deregulation, a concept not included on the matrix.

Although a specific alternative was not designated, there was general agreement that the "Support Infrastructure" barrier was not as serious as indicated by DOE's rating of 4. Participants made several suggestions for infrastructure activities and agreed that no problems would develop if the marketing "pull" concept prevailed instead of a DOE "push" strategy. They generally believed that the infrastructure would follow with the availability of electric vehicles.

Lower matrix ratings were also suggested for the barriers of operating cost and performance. No specific alternatives were agreed upon, however, and one respondent indicated that the ratings would vary if an "all or nothing" approach was used in terms of replacing the internal combustion products with electric vehicles.

The respondents concurred with the ratings for actions in the area of information and suggested that DOE should educate decision-makers on the key aspects of electric vehicles such as energy conservation and environmental protection.

Several respondents mentioned the value of DOE's efforts to assess barriers and actions and to obtain input about the best approach for developing and marketing energy-related techniques. The viewpoints and areas of agreement among participants about the barriers and actions presented in the matrix were generally consistent in the general discussion of obstacles to commerciali-

zation which are addressed below.

Technological barriers. The respondents generally agreed that the technology exists today for the successful commercialization of electric/hybrid vehicles. They concurred that the vehicles do not have the range or speed of internal combustion engine vehicles but indicated that improvements were possible with further battery development. The participants seemed to agree that the millions of miles already driven by electric/hybrid vehicles constituted adequate technical demonstration of the technology.

As already mentioned, the respondents did differentiate commercialization potential for vehicles converted from gasoline fuel and vehicles originally designed for electric power.

Economic barriers. A number of major economic barriers were cited by the participants. Standards which forced electric/hybrid vehicles to operate under the same conditions as internal combustion engine vehicles were viewed as the major economic barrier, both in terms of the manufacturer being able to produce profitably and the consumer being able to purchase and operate at reasonable costs. Participants from the private sector repeatedly stressed that the current market was not large enough for producers and consumers to benefit from mass production techniques and cost savings advantages. Several participants referred to the use of electric commercial vehicles in England and suggested that greater demand would result in the United States if free market pricing of fuel oil were permitted.

Another economic barrier receiving mention was the potential role of electric utility companies. Because of rate pressures and capital restrictions, respondents believed that utilities could not

participate in commercialization at the desirable level. Several respondents, including the trade association representative, pointed out the logic of having utilities involved in commercialization because of their established precedence and experience in appliance marketing and the opportunity to use low demand level periods for recharging of vehicle batteries.

The need for adequate capital was also mentioned during a discussion of how small manufacturing firms cannot sustain the early losses associated with developing a new product or technology. Major corporate sponsors with sufficient equity were needed, the participants said. As an incentive for development, one respondent suggested that major automobile manufacturers be allowed to use the electric vehicle in obtaining weighted mileage averages.

Social barriers. Although respondents did not provide great detail about the social barriers associated with commercialization, they mentioned the problems of negative perceptions and experiences consumers might have, especially if the vehicles are positioned as replacements for their current automobiles.

Some comments were directed to the type of lifestyle most conducive to electric/hybrid vehicle use. While respondents agreed that urban lifestyle would benefit from such vehicles, they were not certain whether the existence of vehicles would improve urban living or vice versa.

Institutional barriers. The discussion of institutional barriers centered on problems associated with policies and standards forcing the electric/hybrid vehicle to compare equally with the internal combustion engine vehicle. The respondents believed this situation was resulting in less demand for electric/hybrid vehicles.

The pros and cons from the standards point of view were wide ranging. Several participants talked about the marketing and manufacturing advantages enjoyed by the Moped although some predicted that standards would be developed which could inhibit future growth of that product's market. The opposite problem, making a new product comply with an existing product's standards, created substantial barriers, in the view of the respondents.

Environmental barriers. Electric/hybrid vehicles were mentioned as a positive force in the control of air pollution in high traffic urban areas. There was little discussion of actual environmental barriers other than those associated with societal change and the transportation system, including roads and standards, which is designed for internal combustion engines.

Positive marketing thrust. Underlying the entire focus group discussion, primarily because an advocacy for the commercialization of electric/hybrid vehicles prevailed, was the support for creating a positive marketing environment. The comments covered the full arena for developing such an environment -- from encouraging the establishment of manufacturing capacity, to providing the buyer with information and purchase incentives. The government was viewed as potentially a facilitator and an inhibiting force in the process.

SECTION III  
MAJOR FINDINGS

This section of the report presents the detailed findings of the research. The findings are categorized according to the five major barriers of commercialization which were discussed and evaluated by the focus group: technological, economic, social, institutional and environmental. Verbatim quotations are used to illustrate how respondents describe the issues and to indicate the intensity of their feelings on a particular subject.

#### Technological Barriers

Without exception, the focus group participants indicated that they believe the technology exists today for commercialization of electric/hybrid vehicles. One respondent said that the some 12 million miles already driven by electric vehicles constituted "a previous demonstration" of the technology and proves "that this mode (of transportation) makes sense."

The participants also agreed, however, that improved battery technology would increase the range and speed available with electric/hybrid cars and, potentially, market acceptance. One respondent estimated that the existing battery technology was adequate to meet the needs, on a replacement basis, of approximately 10 percent of the automobiles now on the road, or about 10 million vehicles. Although 10 percent seemed like a rather low number, the respondents indicated, the share of total mileage would be considerably higher and contribute accordingly to more substantial energy savings.

In the technological barrier area, there was some discussion of the problems associated with conversion versus original design. Two respondents said converting commercial vehicles is easier because of the greater interior room and carrying capacity. As a result, the cost and performance of converted passenger vehicles

"has not met up to expectations," said one respondent.

Classified somewhat as a technological barrier is the concept of the electric/hybrid vehicle's transportation role. If viewed in the most "unfettered" sense, said one respondent, all types of possibilities could be explored. As the respondent commented:

"One of the things I think that's inhibiting the development of electric vehicles for any purpose whatever is the notion that they oughta replace the internal combustion engine and internal combustion automobile, and this may be a false assumption to start with."

In fact, the respondent believed there might be many applications unique to the electric vehicle and not at all suitable for the internal combustion engine. Another respondent agreed and suggested there might be a "horizon of specialty vehicles"; focusing on replacement was to "waste time," he said.

Perhaps because the respondents seemed to consider the state-of-the-art adequate for commercialization, they did not discuss in detail the disadvantages associated with speed and range. One respondent did, however, point out that "the electric car doesn't have to be slow" and cited a recent test of an electric vehicle at 72 miles per hour.

Two of the participants, in support of "the technology is here now" argument, described their personal experiences with electric vehicles. They contended that their having driven over 50,000 miles was a good measure of the feasibility of and pleasure derived from owning an electric vehicle.

A final comment associated with the technological barrier category was made about the advantage of dual fuel system vehicles. This was the only time hybrid vehicles were mentioned specifically. These vehicles permit an owner to take advantage of the reduced

air pollution and energy efficiency features offered by using electric power in town and of the increased fuel efficiency of gasoline power when driving on super highways, a respondent pointed out.

#### Economic Barriers

Economic barriers were discussed at length by the respondents. Of principal concern was the fact that the current market was not large enough to provide the cost-saving advantages of mass production techniques. Respondents from the private sector again and again emphasized that the vehicles must be economically feasible although they did not offer specifics on how this state could be achieved.

The need for substantial equity during a time of severe capital restraints was a barrier, they agreed. In the words of one respondent:

"What is needed is a corporate sponsor with the financial resources to penetrate the market, with enough equity to sustain losses in the early years (of development)."

Even the suggestion that electric utilities might be appropriate leaders in commercialization carried the caution that utilities face rate pressures and capital constraints.

One respondent thought the economic barrier really only existed in time, that others were not seeing into the future. "Electric vehicles are only too expensive now....ultimately the electric car won't cost as much." The respondent attributed part of his opinion to the fact that electric vehicles have far fewer moving parts and are thus easier to maintain.

Although also a matter of institutional barrier, the respondents frequently cited this effect of applying internal combustion standards to electric vehicles--inhibiting costs. One respondent, who often was critical of the government's past activities related

to electric vehicles, said that standards demanded by the Departments of Energy and Transportation do not permit energy efficiency. Like others, he believed the pattern of seeing the electric vehicle in the same light as an internal combustion one was the source of the problem.

"If the electric vehicle cannot be energy efficient, it cannot be economical."

Several respondents talked about the fact that electric vehicles were once considered cost effective in the United States and said commercial units are still used in England. A private sector participant suggested that free market pricing of oil would provide the electric vehicle with an advantage.

A sense of optimism was revealed by at least one participant who believed that "electric vehicles will be a good business someday."

#### Social Barriers

The relationship of lifestyle to vehicle ownership was the subject of a lengthy discussion characterized by one respondent as "a chicken or the egg" problem.

One respondent said "our cities are dying" and suggested a revitalization effort involving a ban on internal combustion engines. The ban, he believed, would encourage urban living. The same respondent called Americans "myopic" in their thinking and thought planning for the days when gasoline would not be available should begin now.

"You're not in the real world" was how one participant responded when another talked about an upward trend in urban living. He contended that the suburbs "are still growing" and said that only a change in lifestyle would create a place for electric cars.

A social barrier in terms of market acceptance of electric vehicles was identified for the consumer who purchases such a vehicle for in-town use. The participant expressed concern about the one-car family's problem when a long distance trip was needed. "The owner must make special considerations, such as renting a car, that are not associated with internal combustion cars," he said.

The major social barrier appeared to be the positioning of the electric vehicle as a replacement to the passenger car rather than a transportation option with countless uses. Negative words like "stepchild" and "Cinderella" were used to describe the unfortunate position of electric vehicles if they are considered "no. 2."

#### Institutional Barriers

If economic barriers generated the most discussion, institutional barriers provided the most intense and generally negative reactions. Although several participants were admittedly biased and perhaps bitter because of previously unfavorable experiences, the majority believed that government presented an inhibiting force to commercialization. As one industrial representative responded when asked his view of why the government is concerned about the commercialization of electric vehicles:

"I don't think they should be; I don't think they trust the marketplace and I think they're concerned about something that isn't any of their business. I've never yet seen the government market anything successfully. The more they dabble, the less apt it's (commercialization) going to be to come."

The same respondent said firmly that he believed government involvement in electric vehicle commercialization thus far had actually set the industry back "three and a half years." Murmurs of agreement were evident although no specific inhibiting actions on the part of the government were cited.

As mentioned several times already, the issue of the electric vehicle replacing or competing directly with internal combustion vehicles was seen as the biggest institutional barrier, with implications for the economic and technological barriers as well. As one respondent said, "Government has the attitude that the electric vehicle is unacceptable to the American people and that we need instead to develop a battery so the electric vehicle can be like the internal combustion car. The government should not decide at what point technology is practical. The marketplace should decide." The same respondent appeared bitter in further stating that a few bureaucrats have been the real barriers to commercialization; remove them and commercialization will result, he declared.

Whereas participants had been rather general in discussing aspects of other barrier categories, they provided specific examples of situations where institutional barriers have caused problems for electric vehicle commercialization. One respondent described the fire laws in one community which require the owner of an electric vehicle to make modifications to the garage before battery charging is permitted. Another respondent described the problems of licensing a vehicle without a muffler. He ultimately installed an unnecessary muffler just to pacify licensing officials. Later he had to cut off the visible part of the muffler when frequent inquiries from the news media became embarrassing.

The Moped was cited time and time again as a technology which has prospered in the marketplace simply because few restrictions exist. Although some respondents predicted regulations would evolve on Mopeds, all seemed to desire the same "unfettered" conditions for electric vehicles.

The attitude toward the barriers created by standards was succinctly put by one electric vehicle advocate: "If standards had been put on the Wright brothers, there would have been no flight by airplane."

In the institutional sense of the infrastructure required for electric vehicle production and maintenance, the respondents generally believed the internal mechanisms would be developed as demand grew. They cautioned, however, that continuing to view electric vehicles as direct competitors with internal combustion vehicles hampered a creative approach. For example, the vehicle owners would not need gasoline station services but might benefit from a credit-card operated or even free recharging unit at, say, the retail mall where they shop.

#### Environmental Barriers

Most of the brief discussion of environmental matters focused on the positive features of electric vehicles such as reduced air pollution. If viewed as the environment in which society exists, the major barrier identified by the city planner was the level of understanding people have about limited energy resources. He believed government could facilitate the process of helping society "come to understand." A "coherent government program" is needed, he said.

Another society-oriented barrier was described by a government respondent who pointed out the problems in introducing change. As an example he talked about the initial resistance to having park police ride electric vehicles rather than horses. Contrary to expectations, the result was quite positive, with one benefit being the police officers' ability to stop instantly and to communicate on an eye-to-eye level with citizens.

## APPENDIX

SUMMARY PROFILE: PERSONAL USE  
SPECIFIC MISSION EV

Barrier Importance	TECHNICAL AND ECONOMIC					INITIAL DEPLOYMENT			INSTITUTIONAL	
	Performance	Range	Purchase Cost	Operating Cost	ROI Risk	Markets/Users	Support Infrastructure	Public Acceptance	Production Capacity	GSA Purchase Restrictions
Categories and Specific Actions										
INFORMATION										
Near Term R&D	5	5	4	4	4	2	3	4	3	1
Longer-Term R&D	4	4	3	3	3	2	2	3	2	1
Engineering Demonstrations	4	4	2	2	2	3	2	4	2	1
Market Demonstrations	4	4	2	3	4	4	3	4	2	2
Information Dissemination	3	3	3	3	4	4	2	3	3	1
REGULATION										
Regulatory Actions	2	2	2	2	2	2	3	2	4	4
INCENTIVES										
Incentives for Industry	3	3	3	3	4	2	4	3	4	1
Incentives for Consumers	1	1	4	4	3	2	3	4	2	2
TAXES/PENALTIES										
User Taxes	1	1	3	2	2	2	2	2	2	1
COORDINATION										
Intergovernment Coordination	2	2	2	2	3	2	2	3	3	4
Private Sector Coordination	2	2	2	2	4	4	2	3	3	1
Consumer Coordination	1	1	1	1	3	3	3	4	3	1
International Organizations	3	3	3	3	2	2	2	2	2	1

Working Paper  
July 6, 1978SUMMARY PROFILE: COMMERCIAL USE  
SPECIFIC MISSION EV

Barrier Importance	TECHNICAL			INSTITUTIONAL
	Performance	Range	Reliability/ Maintainability/ Durability	GSA Purchase Restrictions
Categories and Specific Actions				
INFORMATION				
Near Term R&D	5	5	5	1
Longer-Term R&D	4	4	4	1
Engineering Demonstrations	4	4	4	1
Market Demonstrations	4	4	4	2
Information Dissemination	3	3	3	1
REGULATION				
Regulatory Actions	2	2	2	4
INCENTIVES				
Incentives for Industry	3	3	3	1
Incentives for Consumers	1	1	2	2
TAXES/PENALTIES				
User Taxes	1	1	1	1
COORDINATION				
Intergovernment Coordination	2	2	2	4
Private Sector Coordination	2	2	2	1
Consumer Coordination	1	1	1	1
International Organizations	3	3	3	1

## DISCUSSION GUIDE

## I. Introduction

- A. Topic and Purpose of discussion
- B. Discussion format
- C. Background of participants
  - 1. Organization identity
  - 2. Role of organization in technology
  - 3. Individual's role

## II. Current State of the Energy Technology

- A. What is the current state of the art?
- B. To what extent has the technology advanced over the years?
- C. What have been the characteristics of this advancement?
- D. What will be the net effect on energy output in short-term? Long-term?

## III. Commercialization

- A. Is the technology understood and far enough along in its development that it can be commercially implemented?
- B. Is industry physically and psychologically ready to accept and implement the technology?
- C. What are the likely markets for the technology: Consumer? Governmental? Industrial?
- D. Are these markets physically and psychologically ready to accept and utilize the technology?
- E. Are any of the following barriers to commercialization? What are they? How are they barriers? How important are they?
  - 1. Technological barriers
  - 2. Economic barriers
  - 3. Social barriers
  - 4. Political barriers
  - 5. Environmental barriers

F. Do any of the following present themselves as opportunities or facilitators of commercialization? What are they? How are they opportunities? How important are they?

1. Technological factors
2. Economic factors
3. Social factors
4. Political factors
5. Environmental factors

G. What, if any, information should be provided to industry and the public to enhance the acceptability of the technology? In what form should it be conveyed? Who should provide the information?

H. Financial considerations

1. What are the estimated costs associated with the commercialization of the technology?
2. What are the sources for these funds? Why these sources?

#### IV. Impacts

A. What if any, impact will there be on the following as a result of commercialization?

1. Physical environment
2. Social structures
3. Political structures
4. Economic structures
5. Labor market

B. How important are these impacts?

#### V. Role of the Federal Government in commercialization of the Technology?

A. Should the government exercise a role?

B. What role is desired or necessary?

1. Provide findings?
2. Favorable legislation?
3. Provide knowledge?
4. Provide equipment, materials and facilities?
5. Other?

C. What departments and agencies should be involved?

VI. Presentation of and Reaction to DOE Thinking

A. (Present concept statements to participants)

B. General reactions

C. Are these plans realistic/feasible given the:

1. Current state of technology

2. Realities of the market place

3. Realities of social, economic, political structures?

D. (Focus on specific aspects of the concept statement.  
Included here:)

1. Has DOE realized all of the opportunities and  
barriers? Are there others? How important is  
each?

2. Has DOE presented all of the possible solutions to  
the barriers? Are there others? What is the  
relative likelihood of success of each solution?

3. Is DOE's time schedule realistic/feasible?

VII. Summary

(The discussion will be reviewed with the participants  
in order to develop "bottom line" statements about each  
critical issue).