Proceedings, Methods for Understanding Travel Behavior in the 1990's. International Association for Travel Behavior, Quebec, 22-24 May 1991.

The Development of the Alternative Fueled Vehicles Market: Its Impact on Consumer Decision Processes

Turrentine, Thomas

Post-Graduate Research Assistant
Institute of Transportation Studies
University of California, Davis CA 95616

Sperling, Daniel

Director
University of California
Institute of Transportation Studies
University of California, Davis CA 95616

Funding for this research was provided by
the California Institute for Energy Efficiency (CIEE)

Title: The Development of the Alternative Fueled Vehicles Market: Its Impact on Consumer Decision Processes

Authors: Thomas Turrentine and Daniel Sperling

Abstract:

The introduction of alternative fueled vehicles (AFVs) will increase the diversity, complexity and uncertainty of the personal-use vehicle market. Several AFVs will have attributes unfamiliar to consumers, including home refueling, reduced refueling ranges, different noise levels, safety and performance characteristics. Also, the reduced emissions and greater energy security of AFVs will make personal vehicle selection and use a more prominent public issue. It is unknown what effect these differences in vehicle attributes and greater prominence of societal concerns will have on vehicle purchase and travel behavior.

Choice modeling has been the dominant method used to analyze and forecast consumer responses to transportation alternatives. These models assume stable tastes, good consumer knowledge of the alternatives, and consumer choices independent of social choices. These assumptions are unsupportable for the AFVs market. Before defensible quantitative forecasts can be made of potential demand and travel behavior for AFVs, research should be focused upon understanding consumer responses to AFVs. We review theories of consumer behavior from economics, sociology, psychology and marketing with respect three critical features of the alternative fueled vehicles market: increased market complexity, new product attributes, and social benefits. We synthesize elements of these approaches into a conceptual model that can be used to guide interdisciplinary research on purchase and travel behavior responses to alternative fueled vehicles.

Key Words: Alternative fuels, vehicle purchase, consumer theory

Introduction

Researchers and policy makers are uncertain how consumers will respond to the introduction of several new alternative fueled vehicles (AFVs) to the personal automobile market. Until now, multi-attribute choice modeling has been the dominant method used in transportation research to analyze consumer responses and forecast demand for various transportation alternatives (1,2,). Given the complexity and shifting environment of the alternative fuels market and the weak theoretical understanding of purchase behavior under its dynamic conditions in choice models, we conclude that more effort needs to be directed at understanding how consumers will respond to the changes wrought by AFVs before defensible forecasts of alternative fuel market penetration can be made, especially with respect to those fuels most dissimilar to gasoline, such as electric vehicles.

Multi-attribute choice models are based in exclusive economic theories of rational choice which assume consumers understand their choices, can make their choices independent of other consumers and that their preferences are relatively stable over the course of the study (3,4). These assumptions are not supportable in the case of the alternative fuels market. AFVs will increase the complexity of vehicle purchase decisions and will have a wide range of new technological characteristics, including fewer emissions of pollutants and greenhouse gases, shorter driving ranges, new maintenance routines and home recharging and refueling opportunities (5,6,7). These changes challenge the assumption of consumer understanding. Also, the lower emissions and fuel security benefits of alternative fuels could encourage consumers to consider maximizing their moral preferences and cooperate with other consumers, if the context of the market becomes politicized (8,9).

Our approach is to explore the strategies consumers may use under the specific conditions of the alternative fuels market to satisfy their preferences. We examine three conditions of the AFVs market in order of increasing strain they place upon the exclusive assumptions used in economic models of rational choice. For each condition we review theories from economics, psychology, sociology and marketing which suggest how consumers behave under those conditions. In Part I we examine the impact of the increased complexity of the automobile market resulting from AFVs. In Part II we examine the impact of consumer's inexperience with new characteristics of AFVs. In Part III we discuss the impact of the conflict between social and private benefits of alternatives. In the final part, we assemble the conclusions of the previous three part into a comprehensive, synthetic explanation of the development of the AFVs market.

PART I. Consumer Choice Strategies for Complex Markets

Consumers are limited in their ability to evaluate complex choices; they are forced to simplify the decision (10). A complication for personal vehicle buyers has been continuous diversification of the vehicle market; buyers may choose from a increasing array of manufacturers, models, and styles. AFVs will multiply this diversity, making auto choice even more complex.

Economists have proposed multi-attribute choice theory as a solution to complex choice situations. Multi-attribute choice theory has grown from the main trunk of economic choice theory (11). That trunk of economic thought states that each consumer possesses a set of unique preferences (also called tastes), ranked in their minds so that choices among goods are made on the basis of expected benefits and satisfaction from each good (12). It is assumed that consumers optimize a choice by comparing products. The product with the greatest benefits is chosen. This framework is called a compensatory model of choice. The value of a compensatory framework has been its parsimony, allowing economists to model choices in algebraic relations (13,14).

However, compensatory evaluations require consumers to have excellent knowledge of alternatives, a condition violated by the alternative fueled vehicle market. Lancaster (3) has proposed multi-attribute theory as partial solution to the knowledge demands of compensatory evaluation of complex products and diverse markets. In multi-attribute theory, consumers make cross-product comparisons based on a small set of component properties (for example color, acceleration, and interior room for automobiles) rather than the bundled properties of each product. Because consumers choose on the basis of a limited set of attributes, ranking of large sets of alternatives -- for example, the many vehicles available -- is simplified.

Daniel McFadden (15) has adapted multi-attribute choice models to consumer forecasting in transportation markets. Such models have been used to predict the sales trends of conventional vehicles using data from past purchases to predict future choice of (16,17). Train (2) and Beggs and Cardell (18) used aggregate choice models to predict market penetration for electric vehicles. Green (19,20) has analyzed choices of leaded, unleaded and premium fuels with the intention of predicting fuel switching behavior for multi-fueled vehicles. Kurani and Sperling (21) have analyzed revealed preferences for diesel cars.

However, many attributes of AFVs are not represented in conventional markets (2) such as home refueling capabilities or range. To obtain values for AFV attributes, modelers have used experimental and hypothetical choice surveys to obtain stated preference data for EVs (22) and for methanol (23). This approach is subject to numerous flaws,

depending on how realistic the hypothetical situation is constructed, who is chosen for the study and how statements are interpreted.

Psychologists and market researchers have abandoned the concept of compensatory choice in favor of theories with sequential choice processes. Tversky (24) has proposed that complex choices are made by sequential elimination of alternatives according to discrete criteria. He calls this elimination by aspect (EBA). For example, in making a choice of a car, a consumer's first step might be to eliminate all foreign made cars. Tversky proposes that the order of elimination is random and varies from consumer to consumer. Consumers faced with complexity are able to eliminate whole classes of alternatives from their choice set on the basis of a single attribute (or aspect). Recker and Golob (25) used EBA to model vehicle choice, proposing that consumers proceed with choices by eliminating alternatives according to certain threshold values of attributes.

Market researchers also note that little progress has been made towards determining which alternatives are in the set (14). For electric vehicles, Train (2) uses the manufacturer's specifications while Garrison et al (26) justify a list of five attributes based upon expert opinion. An accurate list may depend upon consumer experience and perception, not engineering specifications.

Despite the attention to cognitive and perceptive constraints on choice, the primary problem of choice models derived from psychology is inattention to budgets; people do not choose what they want but rather what they can afford. Horsky and Sen (29) note that to ignore constraints on opportunity sets or combine constraints and preferences as linear functions puts these psychology models at a great disadvantage to economic models of choice. The tension between budget and wants is basic to the choice process, and must be integrated with the evaluation of attributes.

Economic anthropologists and some marketing researchers focus upon the diversity rather than universality of decision rules. The assumption here is that consumers may have a number of choice processes, or rules of thumb, available for different choice situations (30,31). Gladwin and Murtaugh (32) ask car buyers how they made their choices. Consumers reported following a step-like process in eliminating alternatives, akin to EBA. Consumers reported first considering size of autos in respect to their family needs. The second aspect was price. The third aspect, foreign vs. domestic is not a physical component but rather a symbolic attribute of vehicles, much like brands. Buyers reported strong emotions about this aspect, suggesting categorical distinctions rather than compensatory evaluation (33).

Beyond these three aspects, no clear hierarchies were found. While Murtaugh and Gladwin draw no conclusions from this observation, one might assume that once consumers had identified a manageable set of alternatives, further attribute considerations are compensatory. For complex choices, a two-step process, sequential elimination to narrow the field of choices, followed by compensatory evaluation of a small set of alternatives is suggested by Kahneman and Tversky (34) and Beach (30).

In conclusion, these theories suggest that under situations of complexity, such as that in the alternative fueled vehicle market, consumers must deal with attributes sequentially, until a set of alternatives is found which can be managed in a compensatory framework. The first attributes in such a sequence will be the most salient in relation to budget or other primary constraints such as family size. Secondly, further sequential elimination is based upon categorical beliefs, such as brand quality. A final set of compensatory judgments is made based upon other less salient attributes.

Part II. Consumer Responses to Uncertainty and Imperfect Information

However, it is doubtful that even the modified theories of choice discussed above can describe consumer behavior in the early phases of the AFVs market. The type of choice behavior described above probably will occur later in the market after information problems, uncertainty, and social forces of choice have lessened.

For several years, the alternative fuels market will bring a wide array of changes in the attributes of automobile selection including range, refueling time, home refueling, shifts in maintenance routines, performance changes, and preferences for clean fuels. Changes in attributes make information and learning processes important variables in the development of the market; consumers must experiment, investigate, and imitate in order to make selections from the array of new alternatives. In such markets, Meyers (14) concludes that choices may be driven as much by differences in information as by differences in preferences.

Wilde (31) notes that economists have overlooked information as a variable in the decision process because they are concerned with market outcomes rather than individual consumer behavior. However, some economists have shown more interest in imperfect information conditions. Nelson (35,36) finds an important distinction between the costs of search and experience goods. The utility of search goods can be derived from direct inspection while experience goods are those whose utility can only be judged after purchase and use.

Wilde (31) moves analysis from level of goods to attributes, to allow for a mix in search and experience attributes for complex goods such as automobiles. While many

attributes of cars can be designated search attributes, such as styling and some attributes can be tested on a limited basis, such as performance, many attributes of automobiles are experience attributes, such as maintenance reliability and seasonal performance. This applies more so to AFVs for which consumers have less experience.

Meyers (14) switches from analysis of the utility of goods to the utility of "inspection occasions". He distinguishes between frequently and infrequently purchased goods. Meyers proposes that each inspection occasion incurs costs which must be judged against continuing a search to another occasion. The cost of inspection occasions may be greater if distinct technologies are considered such as electric and natural gas, but more reasonable if one constrains searches to alternatives within a single class such as electric vehicles.

More extended decision models cover post-purchase evaluations as well as purchase and search activities for new products. For both expensive durables and innovations, marketers have worked on a number of more expanded decision making models (13, 37, 38), innovation adoption models (39,40) and new product adoption models (41,42). Such models break the consumer decision process into a sequence of psychological and/or behavioral steps leading to use of a new product. Below is a simplified model of the main steps in the decision process.

Figure 1

STEP 1. PROBLEM RECOGNITION

STEP 2. INFORMATION SEARCH

STEP 3. ALTERNATIVE EVALUATION

STEP 4. CHOICE

STEP 5. OUTCOMES

The strength of this model is that it breaks the decision into a sequence of events and contexts, allowing more precise analysis of consumer activities and intervening variables. While precise testing of these models is difficult, as supporting evidence marketers find that consumers use distinct information sources at different stages of the decision process, and consumers consider a purchase decision for extended time periods (37).

We interviewed compressed natural gas vehicle (CNG) consumers in New Zealand and

Canada who had pondered conversion for a year prior to a final decision. We recruited focus groups in Canada based on the decision stage of the participants, moving from initial awareness of the CNG conversion program, to a group who had applied for credit to purchase, to those who had recently purchased, to owners who had owned CNG for some time. At each stage, consumers were found to be using distinct sources and types of information, and evaluating different sets of attributes depending upon where in the decision process model they were located. Many CNG owners were still evaluating the utility of CNG technology after many months of use, so that although a purchase had been made, CNG had not become a preference (43).

Diffusion research focuses upon social processes of learning, and upon communication and imitation underlying consumer choice processes following the development of information. Diffusion research assumes that consumers are distinct in their decision processes, that early market buyers are innovators who are more experimental while later buyers are dependent upon the experiences of early buyers to make their own utility judgments. Diffusion research models the informal social processes through which a product becomes widely used or, more rarely, the processes in which a product fails to become widely used (44).

Studies of successful innovation diffusion reveal a characteristic S curve to the rate of adoption (Figure 2). This curve is explained in innovation studies as the result of a process of diffusion through systematically linked segments of the market with distinct decision making strategies. In Figure 3, the model segments the market into innovators, early adopters, early majority buyers, late majority buyers and laggards. The model states that markets for new products are initiated by "innovative" buyers who experiment with the new product, followed by "opinion leaders" who through their personal influence networks convince the majority of the market to "adopt" the product.

Formal models have been developed to predict diffusion rates and predict product growth curves of various products. Bass (45,46) predicts the S curve with a bi-segmented market. Other researchers have designed polynomial (multi-segmented) models of diffusion (47,48). These models measure the probabilities of adoption related to proportions of innovators and imitators. In a polynomial model, interdependence is measured between innovators, imitators and non-adopters.

Empirical diffusion studies have focused upon analyzing the behavior of innovators and opinion leaders, persons who act as gatekeepers for information. Opinion leaders are hubs in social networks, distributing and interpreting information about new products and ideas. In Canada, we found that innovators were individuals whose personal knowledge of vehicles allowed them to judge more easily the reliability of dual-fuel, CNG-gasoline systems and to deal effectively with auto mechanics and utility sales

Figure 2 **S Curve of Diffusion Pattern**

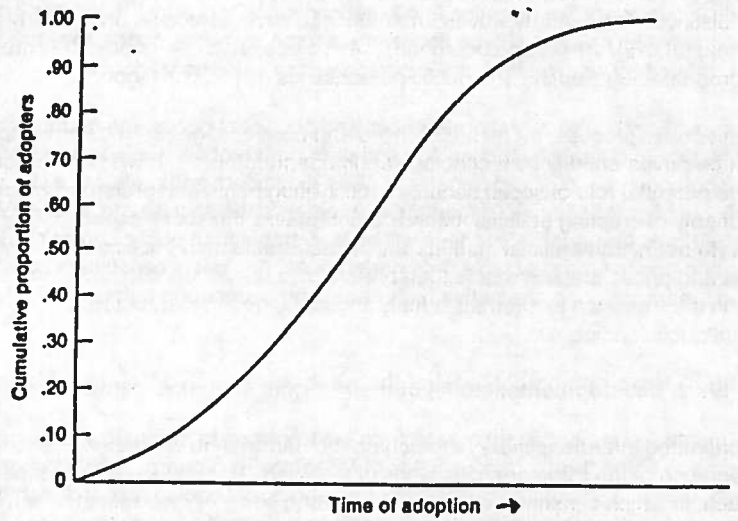
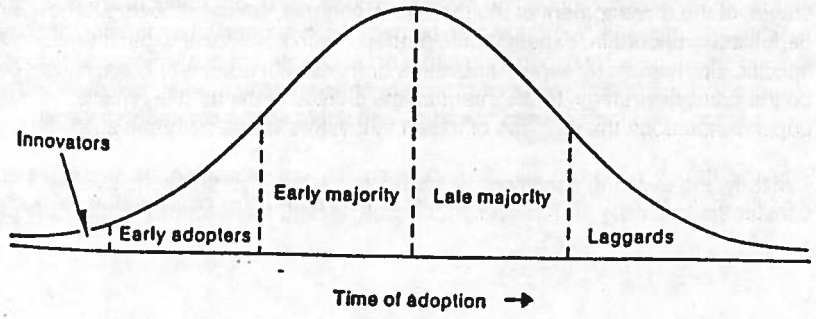


Figure 3 **Segmented Diffusion Process**



persons (43). These persons provide a wider base of experience and examples for later segments of the market to judge the reliability of dual fuel systems.

The DOI approach is designed specifically for examining purchases of new, major durables and attempts to model this process at both the micro and macro levels. It gives attention to a process of social and behavior change, a task in analysis of the AFVs market. But, the DOI scheme predicts only successful diffusions (42). By assumption, innovations are superior products, and DOI studies don't examine products as multi-attributed. Alternative fueled vehicles are not an entirely new product or superior; they are a mixture of innovative, familiar and even inferior attributes. Also, DOI studies over-emphasize the role of imitation for post-innovation segments of the market. As Sheth notes, late adopters may be more rationally motivated than innovators, waiting for products and prices to improve (44).

Still, DOI studies can lend important insights into the alternative fuels market. Some consumers will have the resources and propensity to experiment with AFVs, perhaps several AFVs in sequence. Studies of the AFVs market should identify potential adopters, their decision behavior and influence on subsequent consumer choice strategies.

Part III. The Market for Public Goods

In econometric modeling work on alternative fuels, preferences for environmentally cleaner vehicles have either been ignored because the research used conventional vehicle data (2) or assumed that social benefit is an extremely elastic attribute (19). Garrison et al (26) warn that including social benefits as a variable in choice would be an error.

Yet consumers do state a preference for clean fuels. In a hypothetical choice experiment for electric vehicles, participants showed an what experimenters referred to as an irrational preference for electric vehicles, contradicting their stated needs for range (22,26). The researchers claimed the participants were biased to the social benefits of electric vehicles even though cleanness was not a specified attribute. Surveys confirm that consumers say they are willing to pay more for clean fuels (23). Consumers in focus group interviews in Canada stated they felt the environmental benefits of CNG vehicles were valuable (43).

Indications are that consumers have a moral preference for cleaner burning cars. But consumers with preferences for less polluting autos and fuels and a willingness to pay for that preference are constrained by the social limitations of the market. Because their utility satisfaction depends upon cooperation of other consumers over whom they have

no control, they must settle for a gasoline fueled car.

The alternative fuels market is a classic case of what economists have described as the prisoner's dilemma situation (49,50,51,52). Uusitalo (8,53) and Hardin (9) have singled out environmental markets as prisoner's dilemma situations. In the prisoner's dilemma game two choice makers are given a binary choice. If they have a preference for clean air, the optimal choice would be for both to choose the alternative fuel situation. However, the goal of clean air depends upon cooperation. If they are unable to collaborate, they fear they will be the only chooser, and therefore, choose gasoline fueled vehicles -- a sub-optimal choice.

Hardin (9) takes issue with a strict rationalist interpretation of the prisoner's dilemma (49,54), claiming that if prisoner's dilemma games are iterated, that cooperation becomes rational. Applying this logic to clean air markets, he finds that if the inevitability of the need for alternatives continues to present itself, the choice becomes rational for all players, if the preferences are understood. He suggests that under iterated conditions, tacit agreements are likely to develop. While he notes that such agreements are difficult in large or heterogeneous groups, he suggest that groups of like-minded consumers, who belong to environmental-political groups may achieve tacit agreements on public goods like alternative fuels choices.

Uusitalo (8) proposes that given a supportive political context, consumers may achieve contracts and consensus in rational discourse. He draws upon the work of Jurgen Habermas, a political scientist who has promoted the development of rational discourse for the solution of political problems in industrial societies. Habermas' theory is that in rational discourse, the "rules" of public discussion sanction individual utility judgments; the public good is sought; consensus on that good is achieved and the behavior of individuals is changed. Elster (50) while reserving criticisms of the idealism of such an approach, nevertheless finds it a superior political process to aggregated choice mechanisms, or artificial markets.

Working in a less collective sense of social process, economist Hirschman (55) suggests that public goods choices are generated from dissatisfaction with private consumption (56). Hirschman proposes that consumers may shift from personal utility generated preferences ranking to meta-preferences, or ideal preference rankings if they become sufficiently dissatisfied with private consumption. Consumer dissatisfaction with automobiles has been discussed in several social histories of the automobile (57,58,59). Uusitalo suggests that "green" markets may develop from the social conditions of dissatisfaction Hirschman discusses (8).

In addition to moral preferences, AFVs may become valuable as prestige goods (9). Automobiles have been clearly identified as positional goods by economists and social scientists (60,61,62). Gartman (63) discusses in depth how automotive design and model distinctions are firmly woven into American social structure. In the early phases of the market, AFVs will be scarce goods. As scarce, symbolic goods, they are likely to be appropriated by wealthy and public personalities as positional goods.

Between public process, moral preferences and positional goods, the market for AFVs will not be driven entirely by technology and prior preferences. It will be an error to pass over the potential role of social benefits in utility judgments and preference changes in favor of only of creating artificial markets to internalize the social aspects of AFVs. Hardin (9) notes that artificial markets will be less stable than public choice markets; policies and prices are less stable than preferences. Any costs consumers consider to be fair in the transition to alternative fuels should be understood before artificial prices supplant public choice.

PART IV: A Developmental Model of the Alternative Fueled Vehicles Market

To coordinated interdisciplinary research on the transition to alternative fuels requires an integration of the three previous fields of research. To organize a comprehensive approach, in which consumer choice, diffusion and social choice research can be coordinated, the AFVs market must be viewed as a diversified and dynamic process, so that different approaches apply to distinct choice contexts, consumers and phases in the overall development of the AFVs market.

Our assumption is that consumers choose decision processes according to the conditions of choice and their own resources. As the AFVs market moves through various development phases, and the conditions of choice change, market segments and decision strategies will change. Compensatory evaluation, in which consumers compare utility of alternatives, relies upon stable tastes, good information and criteria for limiting choice sets. During the first phases of the market, few consumers will have the resources to make compensatory or even hierarchical judgments between different AFVs. Combination hierarchical-compensatory judgments will be more common in late stages of the development of the market. In contrast, when products are new, and benefits are uncertain, experimental, perhaps even sequential experimentation with specific alternatives by expert innovators or those with adequate financial resources will be the primary strategy. In the intermediate phases of the market, imitation and dependence upon the opinions of expert innovators will be common strategies.

Similarly, the evolving conditions of social choice will determine the strategies of consumers to satisfy preferences for clean fuels and fuel security. In the early phases of

the AFVs market, when few vehicles are on the road, consumers must be highly autonomous. AFVs will be most scarce, thus most valuable as positional goods. In addition, only green consumers who have shifted their preference structure to social goods, or meta-preferences as Hirschman (55) describes, will be able to make autonomous decisions about AFVs. In intermediate phases of the market, as more AFVs are on the roads, "green" consumers with strong affiliations will be able to coordinate their preferences and purchases through rational discourse with their peers. Finally, as the market develops further, less affiliated "green" consumers in a region such as Los Angeles, where the social value of AFVs may be publicized, can achieve tacit agreements to coordinate preferences and purchases.

Certain aspects of this process can be represented in a Ven diagram. In figure 4, circle A represents consumers for whom the attributes of AFVs fit previous vehicle purchases, who are predicted from consumer choice theory; circle B represent consumers who chose to experiment with the new attributes of AFVs and are predicted by information search theories; and circle C represents consumers who have a moral preference for AFVs and are predicted by public choice theories.

1. First, the intersection of A,B and C contains a set of consumers who are highly motivated, oriented towards experimentation and pre-adapted to the attributes of alternative fueled vehicles. These consumers are the core consumers; they will be the earliest, most satisfied and vocal of all consumers in the early market.

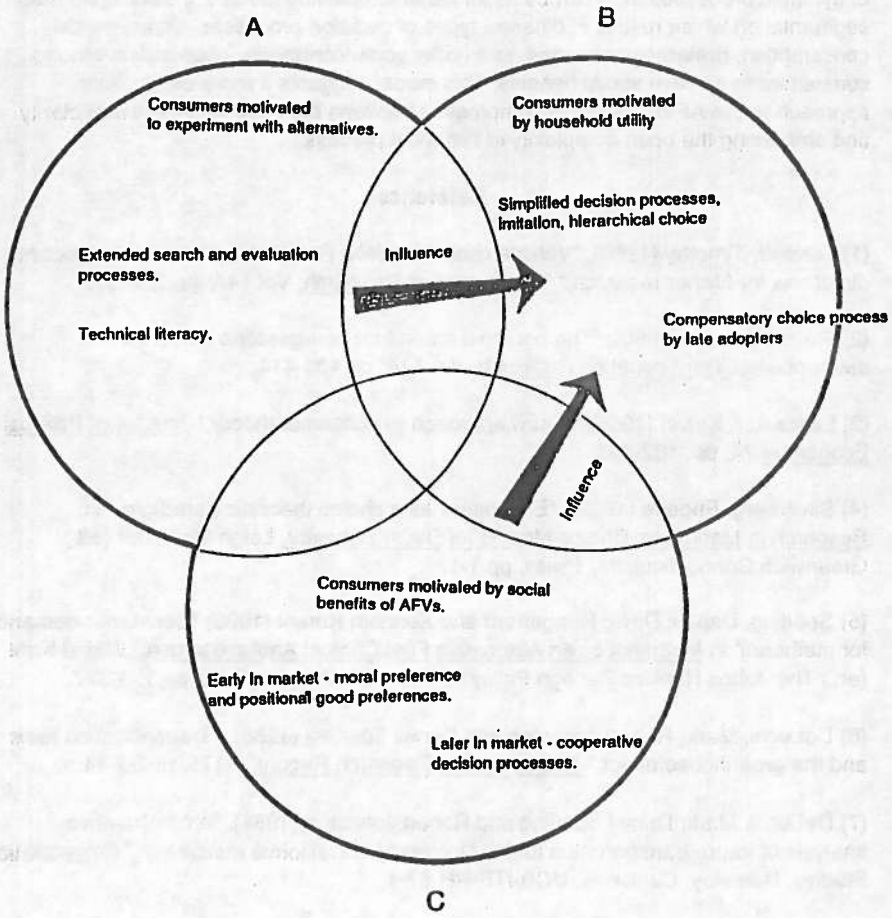
2. Innovative consumers in segment A (not counting overlaps with B and C) are likely to enter the market early, but because the alternatives don't fit their use patterns are likely to discontinue and not adopt. Only incentives and changes in lifestyles will retain these buyers.

3. Consumers in segment B (minus overlap with A and C) may have use patterns (or potential use patterns) which fit certain AFVs but are reluctant to invest without the demonstrated utility of new attributes, quality and potential improvement in air pollution. These consumers will comprise the majority consumers described in diffusion research.

4. Consumers in segment C (minus overlap of A and B) are highly motivated by the public benefits of alternative fueled vehicles but need assurances on the quality of products. While alternatives may not fit previous vehicle use patterns, if the consumers in this segment are convinced alternatives will have a positive effect on air quality, they may be motivated to lifestyle changes.

5. There are three locations of overlap between the three segments. Like the intersection of A, B and C, these segments are more motivated than consumers in #s

Figure 4



2,3 and 4.

Examining the intersections and contingent relationships between these market segments and their potential decision processes is a more complex model of the market than can be used in forecasting. But the transition to AFVs will involve a broader range of dynamic processes than can be assumed in forecasting models, including market segmentation which results in different types of decision processes, experimental consumption, preference changes, and under some conditions, cooperation among consumers to achieve social benefits. This model suggests a more exploratory approach to the AFVs market, a compromise between the need for theoretical clarity and embracing the open complexity of historical process.

References

(1) Tardieff, Timothy (1980), "Vehicle choice models: Review Of previous studies and directions for further research," Transportation Research, Vol.14A: pp.327-335.

(2) Train, Kenneth (1980), "The potential market for non-gasoline powered automobiles," Transportation Research, Vol.14A: pp.405-414.

(3) Lancaster, Kelvin (1966) "A new approach to consumer theory," Journal of Political Economy< 74: pp. 132-157.

(4) Silverberg, Eugene (1982), "Economics as a choice theoretic paradigm," in Research in Marketing: Choice Models for Buyer Behavior, Leigh McAlister (ed.) Greenwich Connecticut: JAI Press, pp.1-12.

(5) Sperling, Daniel; David Hungerford and Kenneth Kurani (1990) "Consumer demand for methanol" in Methanol as an Alternative Fuel Choice: An Assessment, Wilfrid Kohl (ed.) The Johns Hopkins Foriegn Policy Institute: Washington D.C., pp.359-377.

(6) DeLuchi, Mark; Robert Johnston and Daniel Sperling (1988), "Transportation fuels and the greenhouse effect," Transportation Research Record,, 1175: pp.33-44.

(7) DeLuchi, Mark; Daniel Sperling and Robert Johnston (1987), "A comparative analysis of future transportation fuels," University of California Institute of Transportation Studies, Berkeley, California, UCB-ITS-RR-87-4.

(8) Uusitalo, Liisa (1986), Environmental Impacts of Consumption Patterns, Aldershot, England: Gower Publishing company.

(9) Hardin, Rusell (1982), Collective Action, Baltimore: Johns Hopkins Press.

(10) Wright, Peter (1975), "Consumer choice strategies: Simplifying vs. optimizing," Journal of Marketing Research, Vol. XII: pp.60-7.

(11) Hauser, John (1980), "Comments on "Econometric models for probabilistic choice among products"," Journal of Business, Vol. 53, no. 3: pp 31-34.

(12) Sen, Amartya (1973), "Behavior and the concept of preference," Econometrica, 40: pp.241-59.

(13) Nicosia, Fransico (1966), Consumer Decision Processes: Marketing and Advertising Implications, Englewood Cliffs, N.J.: Prentiss-Hall.

(14) Meyer, Robert (1982) "Consumer information search and choice behavior: Two models and an initial empirical test" in Choice Models for Buyer Behavior Leigh McAlister (ed.), Greenwich, Conn.:JAI Press, pp. 259-279.

(15) McFadden, Daniel (1974), "The measurement of urban travel demand," Journal of Public Economics, 3: pp.303-328.

(16) Train , Kenneth and Mannering, Fred (1985), "Recent directions in automobile demand modeling," Transportation Research, Vol.19B, no.4: pp.265-274.

(17) Hensher, David and Vicki Le Plastrier (1985), "Toward a dynamic discrete choice model of household automobile fleet size and composition," Transportation Research. Vol.18b, No. 6.

(18) Beggs, Steven and Scott Cardell (1980), "Choice of smallest car by multi-vehicle households and the demand for electric vehicles," Transportation Research-A, Vol. 14A: pp.389-404.

(19) Greene. David (1989), "Motor fuel choice: An econometric analysis," Transportation Research, Vol. 23A, no.3: pp.243-254.

(20)Greene, David (1990), "Consumer choice for multi-fuel vehicles," Contemporary Policy Issues.

(21) Kurani, Kenneth and Daniel Sperling (1988), "The rise and fall of diesel cars: Consumer choice analysis," Transportation Research Record, 1175.

(22) Calfee, John E. (1985), "Estimating the demand for electric auto using fully disaggregated choice analysis," in Transportation Research, Vol. 19B, no. 4: pp. 287-302.

(23) Sperling, Daniel; Winardi Setiawan and David Hungerford (1991), "Is premium gasoline the target market for methanol?," Proceedings, International Alcohol Fuel Symposium,Florence, Italy.

(24) Tversky, Amos (1972) "Elimination by aspects: A theory of choice," Psychological Review, Vol.79, no.4: pp.281-299.

(25) Recker, Wilfred and Thomas Golob (1979), "A non-compensatory model of transportation behavior based on sequential consideration of attributes," Transportation Research, Vol.13B: pp.269-280.

(26) Garrison, Louis; John Calfee and Harry Bruck (1986), Consumer Preferences for Electric Vehicles, Palo Alto: Electric Power Research Institute.

(27) Stefflre, Volney. (1965), "Simulation of people's behavior towards new objects and events, American Behavioral Scientist, Vol. 9.

(28) Tversky, Amos and Schmuel Sattath (1982) "Preference trees",in Choice Models for Buyer Behavior, Leigh McAlister (ed.), Greenwich, Conn.: JAI Press, pp.185-200.

(29) Horsky, Dan and Subrata Sen (1982), "Models of choice: Perspectives from psychology, social psychology, economics and marketing," In Choice Models for Buyer Behavior, Leigh McAlister (ed.), Greenwich, Conn.: JAI Press, pp.335-349.

(30) Beach, Lee Roy (1982), "Decision making: Diagnosis, action selection and implementation," In Choice Models for Buyer Behavior, Leigh McAlister (ed.), Greenwich, Connecticut: JAI Press, pp. 185-200.

(31) Wilde, Louis (1980), "The economics of consumer information acquisition," Journal of Business, Vol. 53, No.3: pp.143-158.

(32) Murtaugh, Micheal and Hugh Gladwin (1980), "A hierarchical decision-process model for forecasting automobile type-choice," Transportation Research, Vol. 14A: pp.337-348.

(33) McCarthy, Patrick and Richard Jay (1989), "Consumer valuation of new car attributes: An econometric analysis of the demand for domestic and Japanese/Western

European imports," Transportation Research, Vol. 23A, no.5: pp. 367-376.

(34) Kahneman, Daniel and Amos Tversky (1979), "Prospect Theory: An analysis of decision under risk," Econometrica, Vol. 47: no.2: pp. 263-291

(35) Nelson, Philip (1970), "Information and consumer behavior", Journal of Political Economy, 78: pp.311-329.

(36) Nelson, Philip (1974), "Advertising as information," Journal of Political Economy, 81: pp. 729-54.

(37) Hansen, Flemming (1972), Consumer Choice Behavior: A Cognitive Theory, New York: The Free Press.

(38) Engel, Blackwell and Kollat (1978), Consumer Behavior, 3rd Ed., Hinsdale, Illinois: The Dryden Press.

(39) Rogers, Everett (1962) The Diffusion of Innovations, The Free Press.

(40) Rogers, Everett (1983), Diffusion of Innovations, 3rd ed., The Free Press.

(41) Robertson, Thomas (1970), Consumer Behavior, Glenview, Illinois: Scott, Foresman and Co..

(42) Rogers, Everett (1976), "New product adoption and diffusion" Journal of Consumer Research, 2: pp.290-301

(43) Turrentine, Thomas and Daniel Sperling (1989), "A decision process model for analyzing consumer purchases of alternative-fueled vehicles: The case of CNG vehicle conversions in British Columbia", Institute of Transportation Studies, University of California at Davis.

(44) Sheth, Jagdish (1981), "Psychology of innovation resistance: The less developed concept (LDC) in diffusion research," in Research In Marketing Vol. 4, Jagdish Sheth (ed.), Greenwich, Connecticut: JAI Press Inc., pp.273-282.

(45) Bass, Frank (1969), "A new product growth model of consumer durables," Management Science Vol.15: pp. 215-27.

(46) Bass, Frank (1980), "The relationship between diffusion rates, experience curves and demand elasticities for consumer durable innovations," Journal of Business, Vol.53,

no.3: pp.50-67.

(47) Mahajan Vijay and Yoram Wind (1986), Innovation Models of New Product Acceptance, Cambridge: Ballinger.

(48) Sharif M.N. and K Ramanathin (1982),"Polynomial innovation diffusion models," Technological Forecasting and Social Change, 21: pp.301-23.

(49) von Nueman, John and Oskar Morgenstern (1953), The Theory of Games and Economic Behavior, (3rd ed.) Princeton: Princeton University Press.

(50) Elster, Jon (1986), "The Market and The Forum: three varieties of political theory," in Foundations of Social Choice Theory,Jon Elster and Aanund Hylland (eds.) Cambridge: Cambridge Univ. Press, pp.103-132.

(51) Sen, Amartya (1977), "Rational Fools: A critique of the behavioral foundations of economic theory," Philosophy and Public Affairs, 6 (Summer 1977): pp.317-44.

(52) Arrow, Kenneth (1963), Social Choice and Individual Values, New York: Wiley.

(53) Uusitalo, Liisa (1990), "Economic man or social man: Exploring Free Riding in the production of collective goods", in Understanding economic behavior, Grunert, K. and Olander F.(eds.), Boston: Kluwer Academic Publishers, pp. 267-283.

(54) Hechter, Micheal (1982), "A theory of group solidarity," in Choice Models for Buyer Behavior, Leigh McAlister (ed.), Greenwich, Connecticut: JAI Press, pp.281-284.

(55) Hirschman, Albert (1982), Shifting Involvements: Private Interest and Public Action, Princeton: Princeton Univ. Press.

(56) Scitowsky, Tibor (1976) The Joyless Economy: An Inquiry into Human Dissatisfaction,New York; Oxford University Press.

(57) Flink, James (1975) The Car Culture, Cambridge: The M.I.T. Press.

(58) Brownwell, Blaine (1972), "A symbol of modernity: Attitudes toward the automobile in southern cities in the 1920s," American Quarterly, 24, 23.

(59) Jerome, John (1972) The Death of the Automobile, Norton.

(60) Hirsch, Fred (1977), Social Limits to Growth, London: Routledge and Kegan Paul.

(61) Sachs, Wolfgang. (1984), "Are energy-intensive lifestyles fading? The cultural meaning of the auto in transition," in Consumer Behavior and Energy Policy, Ester et al (ed.), Amsterdam; North-Holland, pp.259-277.

(62) Earl, Peter (1986), Lifestyle Economics: Consumer Behavior in a Turbulent World, Sussex: Wheatsheaf Books..

(63) Gartman, David (1986), "Reification of consumer products: A general history illustrated by the case of the American Automobile," Sociological Theory '86, Vol 4, no. 2 (Fall): pp. 167-185.