

**TESTIMONY:
THE MARKET FOR ELECTRIC VEHICLES**

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**Electric/Alternative Fuel Vehicles and Mass Transportation Systems:
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First-generation electric vehicles (EVs) will offer small greenhouse benefits and large air quality benefits. But the greatest attraction of EVs is that they open a pathway toward a much more environmentally-benign transportation future. On this basis, strong government intervention is justified to initiate the introduction of EVs. But how much and for how long are we willing to subsidize the development and introduction of EVs? In part the answer depends upon how we as a society value the environmental benefits provided by EVs. But the answer also depends upon the magnitude of the incentives and subsidies that consumers will require for them to be willing to purchase and use EVs. That is the subject of my testimony. Market demand is an important topic because it tells us whether a large investment in EVs in California is a good investment.

Unfortunately, as with the most new products that are very different, it is impossible to accurately forecast the future market for EVs. EV market studies that rely on conventional research methods typically generate conservative forecasts of one percent or so of market penetration. I will explain, based on more sophisticated research at UC Davis and elsewhere, that as EV technology becomes more familiar and is improved and modest incentives are provided, much higher levels of penetration are likely. EVs do not provide large productivity gains and therefore will not overwhelm the market as did computers—but there are many reasons to believe that consumer resistance to EVs will recede over time as they reorganize their usage of vehicles and alter their expectations of vehicles in response to incentives and a growing stream of information.

A difficulty that market researchers face is that consumers have virtually no experience with EVs, and thus little evidence to extrapolate from when predicting the purchase and use of EVs. As a result, virtually all studies of EV demand are based on one of the following two methods:

- (1) Informal focus group discussions in which facilitators lead groups of ten or more people in discussing their likely future behavior.
- (2) Mail and telephone surveys that pose hypothetical questions regarding willingness to pay (or to be compensated for) particular vehicle and fuel attributes, such as less pollution, shorter driving range, lower maintenance, and higher cost.

The focus group approach can provide insights for particular individuals and groups, but the focus groups are not selected randomly, and thus the results cannot be generalized.

The results of telephone and mail surveys can be generalized, but they are probably grossly inaccurate because the respondents have probably never driven or even thought about whether they might purchase such a vehicle and under what conditions.

Many auto, oil, and electricity companies have conducted market studies recently, using the focus group and the survey approach described above. Ford Motor Company has been more forthcoming about sharing their findings than others, so I will refer to their numbers in order to illustrate the shortcomings of these conventional methods.

Ford concludes that only about one percent of consumers will purchase an EV, where an EV is defined as having the advantage of being 100 percent emission-free, but having disadvantages of a top speed of 75 mph, 50 percent less space, reduced range, and a cost of \$3000 extra.

Those estimates are probably reliable if one were to market electric vehicles now. At UC Davis, we have used an entirely different method to analyze the initial market for EVs, and arrived at a similar conclusion. We estimated that initial market as a function of the following three constraints: (1) residence is a single detached house (not apartment or condominium); (2) house has an attached garage or attached carport; and (3) the household has two or more cars. It turns out that less than 30 percent of households meet these three criteria. If only one of the 2+ cars in each of these households were to be switched to electricity, then the maximum possible penetration is down to 13 percent of cars. If user preferences such as willingness to accept less driving range, high cost, less power, and less luggage space are applied to the 13 percent penetration, then the likely market penetration drops to a very low level, approaching Ford's one percent.

But these low estimates are relevant only for the first few years of EV sales. Initially people will be reluctant to consider a vehicle that not only has attributes that are inferior to those of their current gasoline car, but costs more as well. Indeed, most people still think of an EV as being a glorified golf cart. For instance, in a test-drive clinic we held at the Rose Bowl in June of this year, we found that the great majority of drivers were surprised by the high quality and performance of the EV they drove (a converted Geo Metro and Ford Fiesta); 61 percent said their opinion of EVs increased after the test drive, versus only 16 percent who said their opinion worsened.

The one percent level estimates are likely to become quickly obsolete for another reason: electric vehicles have strong positive features that are generally ignored by conventional focus groups and surveys and perhaps by initial consumers. These positive attributes—less maintenance, ability to recharge at home without going to a fuel station, much longer engine life, and less engine noise, as well as less pollution—are ignored

because at this time neither consumers nor researchers are able to determine their importance in vehicle purchase and use decisions.

Over time, four phenomena are likely to emerge that will increase the attractiveness and market penetration of EVs: (1) consumers will learn more about EVs from the media and, more importantly, from friends, relatives and professional acquaintances; (2) EV technology will improve and costs will drop; (3) vehicle users will become sensitized to the fact that they rarely drive more than 60 miles in any one day, well with the range of future EVs; and (4) users will discard the notion that every vehicle needs to be able to serve every driving purpose and will accept the new practice of renting long-range vehicles for longer trips.

If we begin to think of EVs as a familiar and acceptable vehicle option that is endorsed and rewarded by government as the socially-approved option, then their acceptability greatly expands.

I will elaborate on consumer reaction to two inherent features of EVs: their superior environmental attributes and shorter driving range. Neither is well understood yet, but researchers have gained some important insights.

Vehicle owners in survey after survey state that they want a vehicle with a driving range similar to that of their current gasoline vehicle—about 300 to 400 miles. In practice, they do not really need this range. While it is true that a few people drive long distances on a daily basis, on average the distance traveled per vehicle per day is only about 23 miles. The reality, therefore, is that even today's pre-commercial EVs can satisfy the driving range needs of most households. Lower time, through education and greater awareness of their actual travel patterns, drivers will become comfortable with shorter-range vehicles, especially if they have the option of easily recharging at home.

Unfortunately, consumer reaction to air quality and other environmental impacts of electric vehicles has not been well analyzed. Recent studies, including the Forst Study and a mail survey of vehicle owners in California and New York done at UC Davis, have found that many consumers say they will pay a substantial premium for "clean" transportation fuels. The UC Davis survey found, for instance, that 25 percent of drivers are willing to pay 45 cents per gallon extra for cleaner-burning fuel. This premium should be more than enough to compensate for the extra lifecycle cost of EVs by the year 2000 or so.

But, as you all suspect, the reality is that very few consumers, if given a choice at a fuel pump or in a showroom, will actually select the more expensive option solely on the basis of its environmental cleanliness.

This apparent contradiction between what people say and what they do is explained by the "free rider" phenomena; that is, that consumers will not pay for something such as lower emissions if they themselves receive no more benefit than others who have not paid extra. What consumers are saying, therefore, is that they would support government initiatives that cost 10 to 50 cents per gasoline gallon or its energy equivalent if that cost is shared broadly and if that cost will truly lead to a cleaner environment.

The message with which I want to leave you is that consumer purchase behavior is fundamentally conservative—due not only to uncertainty about price and supply of energy,

as well as uncertainty regarding the resale value, reliability and maintenance requirements of electric vehicles, but also because drivers have become accustomed over the past century to the attributes of gasoline vehicles. Their behavior has become routinized and their expectations frozen. But this purchase behavior is not fixed or unchangeable—just as smoking, recycling, and seat belt use have changed dramatically in the past decade, so can vehicle use change. The most important factor in encouraging the introduction and acceptability of EVs may not be technology improvements, but actions by government and industry to reduce uncertainty and risk, and to create a positive culture for EVs.