



Achieving Zero-Emission Mobility: The Role of Innovative Electric Vehicle Companies

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Nissan Leaf Manufacturing were able to scale their innovative technologies. The DOE hopes to sponsor other innovative companies in the future.

Question Summary

Panelists were asked the following questions:

- How significant are large purchases of EVs by the government?
- How can new opportunities be created for startup companies in the EV market?
- Is there value in short-term EV exposure within a shared mobility setting?
- Are Light Electric Vehicles (LEVs) qualified for ATVM financing?
- What are some of the dangers of more lightweight vehicles entering the market?

With regard to large purchases of EVs, panelists assured the audience that bulk orders are fairly common and range in magnitude depending on the governmental organization issuing the order. Panelists also stated that large-scale orders bring significant benefits to both the private and public sectors. The private sector benefits from a major bump in their revenues while the public sector can leverage their size to obtain bulk discounts and purchase efficient vehicles at lower prices. The point was raised that one possible path to create new opportunities both for startup companies, as well as established players in the industry, comes from the Advanced Technology Vehicles Manufacturing (ATVM) financing program, which is managed by the DOE. The program issues sizeable loans to help eligible manufacturers develop advanced technology vehicles and associated components in the U.S. Short-term EV exposure to small EVs through the use of shared mobility systems is important since it provides a mechanism for consumers to test and become acquainted with the technology. Panelists shared multiple accounts of instances in which users of eBikes and electric scooters decided to purchase a small EV after being exposed to them through shared mobility providers. Therefore, short-term exposure to small EVs should be seen as a source of significant value for EV manufacturers.

One of the panelists explained that ATVM financing is currently limited to light-duty passenger vehicles only. This limitation excludes two-wheel LEVs at the moment. However, the panelist also expressed optimism that this limitation will eventually be relaxed to include other EV types such as two-wheeled and medium/heavy-duty vehicles.

The panelists capped off their discussion by addressing the potential dangers of introducing more lightweight vehicles in the streets. They emphasized the point that generally fatalities occur when a heavier vehicle collides with a lighter one and thus argued emphasis should be placed on reducing the overall weight of the vehicle fleets that currently use our streets and highways. In addition, panelists warned about the importance of adapting highway and street regulations to accommodate safer conditions for LEVs.

Event Summation - by Professor Emerita Elizabeth Deakin



Elizabeth Deakin, Professor Emerita, City and Regional Planning and Urban Design, UC Berkeley

Elizabeth Deakin is Professor Emerita of City and Regional Planning at UC Berkeley, where she also is an affiliated faculty member of the Energy and Resources Group and the Master of Urban Design group. Deakin's research focuses on transportation and land use policy and the environmental impacts of transportation.

Background

Some of the earliest automobiles were electric. They were pushed off the market early in the 20th century by vehicles running on gasoline and diesel fuel, power systems that made it feasible to travel long distances at high speeds. In the 1970s and 80s oil embargoes and oil cartels spurred renewed interest in EVs, but the EVs of that era still lacked range and power and did not attract much consumer interest. Today's EVs are greatly improved, but still face challenges concerning range and power. So why is there a push for EVs now?

One reason that EVs are back on the agenda is the concern about climate change. This is in addition to long-standing concerns about the adverse impacts of current transportation systems, such as congestion, safety hazards, and emissions hazards. California has legislative mandates to reduce greenhouse gases and low emissions vehicles are an important part of the state programs. Federal programs also support emissions reduction and the federal government has is sponsoring research, development and testing of new transportation technologies, systems and innovative services, including EVs. The drive towards sustainability has been increased interest in such innovations, as have smart city challenges, which offer opportunities to think about transportation anew.

Advances in technology have been an important factor in putting EVs back on the agenda, in particular the substantial improvements in batteries that have occurred over the past several decades. Innovations in materials and systems engineering also have made EVs work far better than they did two decades ago. Many of the electric vehicles being produced today are ones that mainstream consumers, and not just advocates and enthusiasts, would want to use, and that's been really important in bringing EVs back into the policy discussion in a major way.

Other supply-side pushes result from an emergence of entrepreneurial interest in transportation applications from the dot-com industry, the people who've developed software, sensors and new manufacturing processes like 3D printing. These innovators are creating new ways of putting transport products together and operating them. There's also been innovation in soft technologies that create networks of users that can share vehicles and rides. The entrepreneurs who have come up with these new products and processes are out there looking for markets and trying different things. There will be some stubbed toes and some flat-out fall-

on-your-face failures, but that's okay because there are also some successes coming along and we'll see things that actually work in the market that will take off. EVs fit well with the innovators' overall emphasis on radically improved transportation systems.

Supporting that is the demand pull is coming from new lifestyles and life cycles – in particular, urban dwellers who are just not interested in moving to the suburbs, and aging baby boomers who recognize that they are going to need a little help with their transportation in the coming years.

Young people are taking their time forming their own households, and when they do, many of them rent city apartments. They are not rushing to buy a house in the suburbs. Whether this is an effect of a shaky economy or a permanent change in values remains to be seen, but even if it is a transitional phase it is one that is creating a sizeable market for urban transport alternatives ranging from better walking and biking options to carsharing.

In this group are people who don't want to buy a new car because it seems too expensive for the amount of use they'll get from it. They also don't want to buy an old clunker that they can't be sure of. They don't need a car on a daily basis, though they might like to have a car available now and then. That's a lot of my students. They tell me, "I don't want to spend \$30,000 to \$40,000 to have something that's gonna sit in my driveway most of the time, because I walk or bike when I can. And I don't want to spend \$10,000 on something that's gonna break down on the freeway and put my life at risk." These are people for whom the new vehicle sharing options are well-matched.

At the same time we're experiencing an aging population. People like me, baby boomers, are getting to retirement age, and for many of us, age is beginning to dull our vision and take away some of the flexibility of our necks and shoulders. Driving is going to become a little more difficult. We all grew up driving, and increasingly we are scared that we could end up unable to drive, because for many of us that would mean that we can't stay in our homes. If we don't have the ability to drive any more, we won't have access to the grocery store or the doctor or our children and our friends. That's a strong motivation to think about new technologies, in particular automated vehicles.

There's also a bunch of people we didn't hear very much about today. One big group are people who don't have driver licenses. We don't let them drive. They're just kids! It's possible that new vehicle technologies could open up mobility freedoms for people at the young end of the age spectrum as well as the old end of the age spectrum.

Then there are people who can't afford a car, but need one, because they have to have a car to get to work and take care of their household. They'd prefer to buy a reliable used car but they end up with a \$2000 clunker that is not very reliable and not very safe. Finding a way to make a safe, reliable vehicle available to them would be good for them and good for us as a society.

And finally, there are the people who want a car and will drive it a lot, but also want to be green. Some on this group will be looking for an EV. Others will like the idea that they can buy a membership that will let them have the use of a car when they need it, but can let other people use it when they don't - seeing sharing a vehicle as an action that will let them do something that's good for society and good for the environment and for the community.

All these situations and individual motivations are creating demand pull for new technologies.

Cities are amplifying this demand pull by looking for additional and more creative ways of dealing with long-standing problems such as congestion, pollution, and parking, and newer concerns such as resiliency in the face of global warming. They are looking for transport solutions that will make the city more efficient and cost-effective while providing a high quality of life for residents and supporting thriving commercial districts. Fast, safe, efficient transportation for them means well utilized transport systems, transit or cars – getting a lot of mobility for the number of vehicles on the road and the amount of urban land consumed.

Key Themes from the Presentations

Let me turn now to some key themes from the presentations. One thing that kept coming up was there are a lot of specialized markets, large and small, for electric vehicles, and a lot of different vehicle types that can be matched to those markets. New manufacturing processes open up possibilities for even better matching of vehicles, technologies, and markets. That raises the question of whether there should be an EV for every market, not just sedans and small personal vehicles but also electric SUVs and perhaps electric pickup trucks. The question here is whether designers should be matching vehicle performance to serve “most” travel patterns (that is, urban travel, relatively short trips with only a few people in the vehicle) vs. trying to build a vehicle or set of vehicles that can replace existing ones in all respects including carrying capacity and range. And on the range issue, there is the question of whether the vehicle needs to have the range or it can be provided by roadside infrastructure, for example, by installing electric charging facilities on the interstates.

Quite a bit of the discussion was about vehicles that are fun, which is certainly a positive thing. However, I think we need to have more women in the room discussing this because a lot of those people who are having fun seem to be guys. If you’re interested in large markets, you have to consider what women would think about the vehicles, the features they need and want. You may have kids in the vehicle, for example, along with groceries and a briefcase. Thinking about women’s interest in EVs is something that needs more attention.

We’ve heard that the electric vehicles can be buses as well as personal vehicles. Especially if this is combined with automation, it could transform transit services, for example by allowing services to be provided in thin markets at an affordable cost and minimal environmental impact.

Ten Items for Further Study

To conclude, I would like to list the 10 things we didn’t hear very much about, all of which deserve further study.

1) **Market barriers:** We mentioned price issues; if you have to be rich to own an EV or an automated vehicle, that’s a market barrier. Weather could be an issue for some of the

vehicles we heard about - there's a question of whether it is going to work in snowy New Hampshire or in California in January when that cold rain is pouring down. We need to have more discussion about who and how many would pay a premium for vehicles with limited performance, or whether we need a price point that's much lower. Another possibility is that many EVs could be second or third vehicles used for special purposes, much the way that some households have boats or jet skis or all-terrain vehicles.

2) **Infrastructure:** We need more discussion about the infrastructure that new transportation technologies might require. We heard a little about charging stations, but if we get automation on some vehicles and not others, will we need separate lanes? If so, which of the vehicles would need their own lane? At the extreme I can imagine roads that will look like rainbows, with lanes painted different colors for different kinds of vehicles. It's not necessarily a matter of separating the Escalade from the mini EV, it's also the garbage truck and the dump truck and the semi that's delivering to the grocery store we that have to think about. And it's not just transportation infrastructure; we have some very serious issues about where we are going to get the electric power to support a whole fleet of EVs. What fuels will produce the electricity and what are the environmental consequences of those choices? We have some serious issues about electricity transmission systems problems to go along with that.

3) **Financing:** Going along with the infrastructure questions are questions about how to pay for transport infrastructure, an issue that is already arising with increasingly fuel-efficient vehicles of all types, and the federal highway trust fund bankrupt or very close to it. Just as infrastructure issues aren't limited to streets and highways, neither financing issues; if demand for electric power surges with the growth of EVs new strategies to pay for electric power infrastructure will likely be needed.

4) **Automation:** Some cities are already thinking about automated vehicles as a way to make transit and paratransit work better, to handle urban goods deliveries, and perhaps to handle curbside refuse and recycling collection. But we'll have to have a bigger discussion of this. For one thing, there could be very serious labor repercussions from some of the moves being contemplated.

5) **Regulatory issues:** Regulatory issues will come up with as EVs make use of new materials, present new vehicle designs, and offer different operating capabilities. Infrastructure design standards will raise regulatory issues as well. Safety and emissions rules will need to be established. Licensing and taxation issues also will arise. The questions will be the extent to which existing rules are adequate or should be modified, or new rules will have to be formulated. We are seeing some of this now with the emergence of ride-matching services and the debates over whether they should be regulated as taxis or as something different.

6) **Transitions:** More investigation is needed into the ways that the vehicle fleet might transition to EVs and automation. This includes questions about how fast the turnover in the vehicle fleet will be. Currently it takes something like 15 years for the personal vehicle fleet to turn over, so even if all new cars were equipped with particular technologies by a certain

date, we can expect a long period when we have a mix of vehicle technologies on the road. If only some vehicles offer the new technologies, or if the technologies are high priced options initially, it will take even longer for the innovation to diffuse. Of course, it is possible that regulations or incentives could result in a faster automotive transition. These are issues worth studying – looking into alternative implementation pathways and their implications for market penetration.

7) **Early adopters:** There is a tendency to look to early adopters to investigate potential markets, but I would recommend caution here. Early adopters are often enthusiasts and their behavior may not be at all like that of the mass market that needs to accept the product if it is going to fill more than a market niche. For example, it was suggested that we could learn about EV markets by looking at ho's buying e-bikes and how they're using them. Maybe we can, but maybe E-bike purchasers are not very representative of the larger population. The problem with trying to do research on consumer reactions to proposed new technologies is that its potential users aren't familiar with those new technologies. Researchers draw analogies from other experiences and create scenarios `can help attain some insights, but also have limitations, notably the difficulty in communicating a realistic understanding of what the real-world, day-to-day operating conditions for the new technology would be like. In addition, when studies are conducted by advocates for the technologies, they often are marred by optimism bias, stressing benefits and downplaying problems and the sheer inertia of the existing system.

8) **Serving the whole population:** There has been some attention recently to getting EVs and other innovative transportation systems such as carsharing into low income communities. That's important, but there are a lot of middle-income communities who also think about what these new vehicles would cost and could be put off by how much money they'd have to spend on them, so that's an issue too. Also, are we designing these vehicles so that they will be usable by people who have vision disabilities, who have mobility disabilities, who have mental or emotional disabilities? As noted earlier, the elderly are often beset with physical decline that makes driving difficult, but there are plenty of younger people who also are mobility impaired. At the Shanghai Exhibition a few years ago, General Motors presented their vision of a car of the future that could serve this population, combining automation and electric power in a small, affordable, flexible vehicle designed to operate on a separate guideway, at least for starts. We can imagine such a vehicle that would greatly expand the mobility of populations that might not now be able to drive safely. This could extend to kids, who are a big share of the population and today are heavily dependent on adults for their transportation.

9) **Freight applications:** If buses can be electric, why not delivery vehicles? Could we have urban freight being delivered by electric vehicles? Is there a possibility for other urban service vehicles to be replaced by EVs, e.g., garbage trucks? Are there scenarios in which long distance freight trucking could be electric?

10) **Labor impacts:** The labor impacts of electrification of a portion of the vehicle fleet, along with other technology advances, have already been significant; automation could

result in even greater changes. New technologies for the vehicle create not only demand for new products but also demand new skills for designers, construction and maintenance workers, regulators and inspectors. Automated pickup and delivery services, automated taxis, transit and paratransit, automated intercity trucking. All of these are changes that could have significant impacts on the number of jobs available in the transportation sector. Labor impacts could pose challenges to technological change unless they are dealt with creatively and sensitively.