Electric Vehicle Trends and Projections

Webinar Questions and Answers

October 24, 2019

Question and Answer Session

All the presentations seemed to see a very bright future for electric vehicles (EVs), could you mention what you think are the top challenges to getting more electric vehicles on the road?

Rachael Nealer: We spend a lot of time and effort trying to bring the battery costs down and electric vehicle and fuel cell vehicle costs down. I think that's a big piece of it because there are a lot of folks that go to the sales lot and just can't afford upfront that couple of thousand dollars at the moment. The fuel savings are already there, but we're not seeing huge effort by people to buy EVs in the big scale. Hopefully bringing the cost down at that point of purchase would be something that could enable higher market penetrations of EVs and fuel cell electric vehicles. I think infrastructure is also a big one. We still run into the issues of people not feeling supported by the network in order to drive their vehicles around. Experts talk about the perception of needing charging when not really needing it, but I do still think that some of the investments that are being made in infrastructure now like the $2 billion by Electrify America to add infrastructure will be good. I don't think it's going to get us all the way there, so not only do we need the quantity of charging, but we also need the refueling times to go down so that people don't have to wait long periods of time in order to refuel their vehicles. I think those are two big challenges.

Michael Nicholas: Rachael brings up some of the same things I would highlight such as infrastructure. I'd say that getting infrastructure at home can be very challenging for some and whatever we can do to put upgrades into codes and regulations is a priority. If you do an upgrade or you build a building, put in access for electric vehicle charging. I think some of that problem will fix itself over time, but sometimes the upfront costs are just the difficulty of getting convenient infrastructure that people are not familiar with them - electricity as much as they might be. Assisting in any way of getting infrastructure and availability would be a key policy.

I would say also awareness is very big. Right now we see that maybe only about a quarter of the market even is aware of any model of electric vehicle out there. If they don't know of any models, they wouldn't consider them when they're buying a car. Awareness of the options is a big issue, and then I would also highlight utility policy. It's pretty confusing the way as we switch from gasoline to electricity, the way electricity is sold and the way gasoline is sold is very different, and I see a lot of confusion and I even see utilities charging more than it costs for an equivalent gasoline vehicle in a hybrid or even a regular car. High electricity prices for electric vehicle is an issue in some utilities and it doesn't need to be. I would say consistent utility policy and getting the costs right from the utility side is a big area that could be worked on.

Matt Rogotzke: I think consumer awareness is the key thing. We heard that from all 40 states and territories we talked to and they do work with the OEMs to try and raise awareness, but what we heard time and time again is that it really is the dealer that is the main point of contact with the consumer. One program that was continuously elevated was the Connecticut program, which provides a financial incentive to the dealership for each sale that is made. It's a $300 incentive for each sale, which goes to the dealership, which is a huge incentive and they have an annual award ceremony with the governor giving an award to the dealership who had the most EV sales making that connection between the dealer and the consumer is key and the charging infrastructure making people realize that they probably are okay because they generally are going to charge at home if they have a garage or someplace to charge at home. If they have a multi-unit residence or on-street parking, it makes a little more complicated. The location of charging and education about charging is key I think what we heard from states.

Related to alternative battery technologies, you could talk about other types of battery technologies the U.S. Department of Energy (DOE) might be looking at? Are other technologies that you think are promising? Participants mentioned aluminum air batteries and galvanic salt batteries, non-lithium ion batteries.

Rachael Nealer: A lot of the work that we've been doing has been focused on lithium ion, in fact some of our researchers just won the Nobel Prize in chemistry for lithium ion technology. It's very real that lithium ion has kind of revolutionized the world that we know today and so we want to build on those solid building blocks in order to capitalize on that investment. We of course continue to look for new chemistries, new technologies because each one of them has their pros and cons. When I talked about the various technologies and their challenges and opportunities you might be able to increase the specific energy of one of the chemistries to another level, but you may run into lithium plating issues. Lithium ion has its challenges as well, but it has been proven out today and so we want to build on that, especially at the lab level. We haven't gotten new technologies to quite scale up, but we are investigating new technologies as is the role of DOE we to be kind of on the cutting edge.

You talked about the displacement of gasoline and some of the associated greenhouse gas savings, what are the assumptions you made about plug-in hybrid electric vehicles and typical gasoline consumption to come up with those numbers? Do the greenhouse gas estimates include offsets from increased electricity?

Rachael Nealer: I would point folks to the link at the bottom of that slide: Impacts of electrification of light-duty vehicles in the United States, 2010–2017. That report covers cumulative impacts up to 2017, it was published in 2018 based off some of our work which is also updated on a monthly basis. Maybe that's also a plug for folks that are interested in these impacts and the increase in sales that Argonne National Lab tracks in monthly sales reporting. You can get some of those statistics updated monthly, but all the assumptions are kind of laid out in that paper. There are a number of very coarse assumptions like I mentioned in the talk, coarse assumptions that we need to make about driving behavior in the utilization especially for a plug-in hybrid electric vehicles how much is driven on electricity versus how much is driven on gasoline. It is a net gasoline displacement.

It takes into consideration the gas that is used in the plug-in hybrid electric vehicles and subtracts that from the total gasoline offset, but I would just point folks to the link at the bottom just because it will do a much more comprehensive job of explaining the assumption and the authors Dave Gohlke and Joanne Zhou are great people to reach out to at Argonne National Lab. If you have any questions or you can ask

me if you have any questions as well, but I won't take up too much of the time with all of the nitty gritty assumptions.

Do you have any comparative information about the EV uptake in section 177 zero-emission vehicle (ZEV) states versus non-ZEV states?

Michael Nicholas: I don't think we have a report focused on that. One place I would look would be our Quantifying the electric vehicle charging infrastructure gap across U.S. markets report where we look at the state by state or metro by metro the uptake in those specific regions and then you would have to do a little bit of work to see which states that are in it if they're ZEV states and total up the cumulative effect, but I don't think we have a report that is directly answering that specific question.

How does demand for public charging change as vehicle range increases?

Michael Nicholas: As the vehicle range increases, they need to go to the charging station less. Your utilization increases because convenience increases. Not going as far has a lot of benefits to the charging infrastructure. One effect is that you can potentially charge faster. Another effect is that if you didn't have home charging, it would be more feasible to have a long range electric vehicle and fast charge, maybe once a week, then it would be to have a short range vehicle with no home charging. I think we'll see a broadening of the market based on the convenience of charging not having to go to the charging station as much.

We'll provide some options for people with marginal charging situations either if it's Level I low power or no home charging, I think it'll broaden up that market. Faster charging can be more possible with larger batteries.

If my state doesn't participate in the National Governors Association (NGA) transportation electrification work, how they get connected?

Garrett Eucalito: I don't know the full list top of my head. Like we said, 40 states and territories attended one of the workshops, but that questioner can certainly reach out to me and let me know where they're from and I can tell them for sure, and we love to have that conversation. Sometimes since we are there for the governors' offices, a lot of governors' offices are small and often times they may not pass it on to their agencies, but always willing to talk with those state agencies and learn more about what's going on in those states.

What could states or utilities do to help lower costs of demand charges for fast charging and make fast charging more accessible?

Michael Nicholas: There are thousands of utilities each with their own policy on high power charging, which can either include demand chargers or not - there's no uniform method, but what we see now which has been a very effective, that is to provide energy only rates for low utilization stations. In exchange for a higher cost per kilowatt hour on a low use station, you can get reasonable amounts of, at a reasonable cost. The problem is with a very low utilization station and high demand charge, the cost per kilowatt hour is prohibitive and it ruins the business model for a nascent network. Having two different rate structures, one is an energy only rate in the beginning and then you can switch to demand charges later would be a good strategy and it's being pursued in California utilities.

Matt Rogotzke: This is definitely an ongoing concern that we have with NGA. We are hosting a number of grid modernization retreats and one state that we're working on identified this is one of its priorities.

These events we bring together some other experts and pretty much everyone in the relevant agencies to come together meeting of minds and talk about potential solutions that they could overcome. We will certainly be looking more and sharing some of these solutions, but that's one of the opportunities that NGA provides for it states. It's just tackling some of these topics because sometimes it's not the greatest solution as funding might be limited for agencies as these are really extensive challenges in states.

For the state, local and tribal governments on today's webinar, what would be the one thing you recommend to support electric vehicles and electric vehicle infrastructure in their state or community?

Rachael Nealer: I think there's a lot of power in (our) community here (on today's webinar). Making sure that we're sharing valuable information about some of the challenges and solutions that we come up with to get EV markets to kind of the mass market level is a great first step. Connecting to your Clean Cities Coalition, talking with each other, I think that's something really powerful that can rise all those experts.

Michael Nicholas: I would say consumer awareness. There's a lot of great cars out there and if only people knew about them, we would multiply the market by several times.

Garrett Eucalito: One thing people can do within state government and within local government is to talk to your colleagues in other agencies. When we convene these large groups of individuals from 40 states and territories, we got lots of people from each state in the room and some of them had never met their colleagues that worked a block away and we're working on same programs doing similar things and sometimes we're being duplicative and then after the event, they went back and reconfigured some programs to make it more efficient and utilize the funds better.

Questions Not Answered during the Webinar

Can you repeat what you said about last year's light-duty sales? Did you say more than 70% were light truck? Is this in general (without regard to fuel type)?

Rachael Nealer: Yes, we are trending towards higher light truck sales based on vehicle classification. Larger, heavier cars/trucks are being purchased at higher rates than smaller, lighter cars.

Why isn't DOE coordinating with cold fusion research which has been progressing for decades. Even the Massachusetts Institute of Technology has had annual conferences in cold fusion (also known as low-energy nuclear reaction or lattice assisted nuclear reaction).

Rachael Nealer: DOE does have research in fusion through the Office of Science. The transportation offices are in the applied sciences within Energy Efficiency and Renewable Energy. You can find more information on DOE research and development efforts here: Fusion Energy Sciences.

As EV population increases doesn't that add additional load on the electric grid? Do the greenhouse gas emissions reduction estimates account for impact of this additional electric generation and load?

Rachael Nealer: Yes, there is an increased load with EVs. Stay tuned for a new report by our U.S. Driving Research and Innovation for Vehicle efficiency and Energy sustainability (DRIVE) partnership that are wrapping up some research and soon releasing a paper on the possible grid impacts of EVs in larger amounts in the future. It's definitely something we're looking into, but for now, the grid capacity is enough to accommodate EVs.

Is DOE aware of Brown's Gas - energetic plasma state of water, also termed HHO?

Rachael Nealer: Yes, DOE is doing research in electrolyzers and using hydrogen as an energy carrier. You can find more information on our efforts here: H2@Scale.

How do you expect proposed changes in fuel economy standards to impact the EV trends you've discussed?

Michael Nicholas: Changes in fuel economy standards will slow the uptake generally. Although we expect EVs to reach cost parity by mid to late decade, this estimate is partially due to economies of scale driven by policy. This slowing has trickle-down effects of slowing infrastructure installation, customer engagement, and utility transformation to leverage EVs. There are many benefits to electrification, and we'll miss out on them for a bit longer.

Does anyone know the effect that Chinese subsidies have on battery costs? Are those effects separated out of the cost per unit of energy estimates?

Michael Nicholas: I don't know that specifically. Batteries are generally a global commodity with regional variation in price. Lower prices in China will be reflected in the global battery price average.

How do you explain the different forecast in battery costs [e.g., Annual Energy Outlook, International Council on Clean Transportation (ICCT), and Bloomberg?]

Michael Nicholas: ICCT based theirs on Bloomberg and other studies. Some differences arise based on chemistries included in one's analysis and which studies they depend on for the reduction in cost.

What about the complete life-cycle carbon foot-print for battery electric vehicles (BEVs) and their cost to environment?

Michael Nicholas: This is a common question and analyses vary widely based on assumptions. We estimate that the "carbon debt" created by increased energy of manufacture takes about two years of operation before the carbon debt is erased today due to lower emissions during operation. There is an opportunity to reduce the time the carbon debt is erased by increased renewable use during operation. Many analyses that show less promising timelines use higher carbon dioxide values for extraction of materials and battery manufacture in addition to high values for carbon dioxide for energy generation. This report contains more information: Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions.

What kind of cost premium would be on plug-in hybrid electric vehicles (PHEVs)?

Michael Nicholas: It depends on how big the battery is, but the upfront cost premium versus a conventional vehicle will be higher than a BEV in the future because of the need to integrate an internal combustion engine, battery, and large electric motors whereas a BEV does not a need an engine. The cost premium over a conventional car is on the order of $3,000-$6,000. More details are in this resource: Update on electric vehicle costs in the United States through 2030.

Please clarify if there is a difference between price parity and purchase parity in slide 33. Are they the same thing? How do either compare to overall cost of ownership parity (e.g., maintenance and fuel costs)?

Michael Nicholas: They are the same in this slide. In our paper we look at cost, price, and total cost of ownership parity: Update on electric vehicle costs in the United States through 2030.

Do you have estimates on when the non-battery costs of BEVs/PHEVs will reach price parity with internal combustion engine vehicles?

Michael Nicholas: That's a tough question to answer. In an internal combustion engine, you have an engine. In a BEV you have a battery and electric motor and controllers. What are you suggesting to subtract out? A detailed breakdown is in this paper where you might be able to selectively subtract out what you'd like: Update on electric vehicle costs in the United States through 2030.

What did the different shades of green signify for the promotion actions in metro areas?

Michael Nicholas: For more information on state, local, and utility actions read The Surge of Electric Vehicles in United States Cities.

Demand charges are a real problem for faster chargers. Other than time of us rates to try to equalize the high demand charges from electric utilities, what can be done to lower the costs? Currently we are hearing the demand charges for a 150kW station are upwards of $25,000 per year.

Michael Nicholas: Demand charges vary widely. Some are up to $30-$40 per kW. The solution some utilities have implemented is a demand charge holiday for five years in which time they offer a higher energy-only (per kWh instead of per kW) rate that varies by time of day and have no per kW demand charge. This is in recognition of the fact that early stations are lightly used and have no business case. When utilization increases, then demand charges are actually good if reasonably priced, not $30 per kW.

On slide 36, if you added a graph of per capita income to the set of variables, what might it show? I note that San Jose has a lot of people with high income.

Michael Nicholas: It would show that there are a lot of high income places that don't have high uptake. It's definitely a factor in the early market and can amplify trends, but there are more and more middle and lower income people in these areas who are buying EVs now too. As with many new products, higher income people buy down the cost of new technology.

On slide 58, can you talk a bit about the levels of income required to receive the full state income tax credit?

Garrett Eucalito: Information on California's income guidelines can be found here: Income Eligibility. A summary of the program, including brief information on income eligibility, can be found here: California Vehicle Rebate Program.

The State-imposed EV fees seem counterproductive to consumer incentives for adoption. What about imposing fees upon the gas vehicle side instead to promote EV adoption?

Garrett Eucalito: Debate is ongoing about the impact of EV fees on adoption. The fees are intended to raise revenue to support the infrastructure, but many do point out it may be in conflict with other state policies to reduce greenhouse gas emissions. Several academics are looking at this, including the team at the University of California, Davis: How to Fund Roads and Ensure Electric Vehicles Pay Their Share. NGA will continue to work on this topic.

Do you think there might be an increase of greenhouse gases due to the combination of a loose federal regulation on EV and the encouragement of getting more EV on the road?

Garrett Eucalito: I do not see a way that greenhouse gases would increase due to that combination of factors, but others may have another opinion.

Larger sport utility vehicles (SUVs) and pickups are so popular now. What are the prospects for electrification in that segment?

Garrett Eucalito: Auto manufacturers are planning to release EV SUVs in the next couple of years; Ford will be releasing an EV SUV next year, as will Volvo. Audi already has released its electric SUV, and we have been told most manufacturers are planning to pursue this market.

Are there any resources to better understand how to address equity concerns?

Garrett Eucalito: This is a topic that continues to develop, but The Greenlining Institute and EV Hybrid Noire are both organizations NGA has worked with on this subject. The National Consumer Law Center does work in this space: Principles for Fair and Equitable Investment in Electric Vehicles and Transportation Electrification.