Electric Vehicle Trends and Projections

Webinar Transcript

October 24, 2019

Contents

This transcript reflects the statements made during a live webinar on October 24, 2019. The transcript has been reviewed for accuracy. Any grammatical errors or otherwise unclear passages are true to the statements of the presenters.

State and Local Energy and Environment Program

I. Electric Vehicle Trends and Projections

Slide 1. U.S. EPA's State and Local Energy and Environment Webinar Series

Operator: Ladies and gentlemen, thank you for standing by and welcome to the Electric Vehicle Trends and Current Projections Conference Call. At this time, all participants are in a listen-only mode. Please be advised that today's conference is being recorded. If you require any further assistance, please press star zero. I would like to welcome our main speaker for today, Ms. Andrea Denny. You may begin your conference.

Andrea Denny: Thank you very much and welcome everyone for joining us to hear a little bit more about what's happening with electric vehicles. Before I get into the substance of the webinar, I wanted to introduce one of our contractors, Alexis St. Juliana who is just going to do a quick software overview to make sure everyone knows how to use Adobe Connect.

Slide 2. How to Participate

Alexis St. Juliana: Thank you Andrea and thank you everyone for joining today. There are several ways to participate during today's webinar. First of all, participants can enter questions in the question and answer (Q&A) box on the right side of the screen. Please let us know who your question is for and we'll moderate all the questions at the end. Questions that we don't have time to answer will be posted on Environmental Protection Agency (EPA)'s website. Another way to participate today is through hyperlinks. All hyperlinks you see today should be active. You can click on them to explore the content.

Slide 3. How to Participate

Alexis St. Juliana: We'll also ask several poll questions during today's webinar. It should be fairly simple to participate, but users on mobile devices or tablets may need to exit full screen mode and tap on the poll icon, which looks like a slip of paper dropping into a ballot box. Please know that there is no submit button. As soon as you select your response, we receive that. The final way to participate is through the webinar feedback form. The link is posted in the Q&A box and we'll share it again at the end of today's session.

Slide 4. Today's Agenda

Andrea Denny: Great. Thanks Alexis. So, today, you're going to hear a quick introduction from myself and from Jessica Daniels with our Office of Transportation and Air Quality (OTAQ) here at EPA and then we're going to have three speakers talking about their work and some of their resources, that is Dr. Rachael Nealer from the Department of Energy (DOE), Michael Nicholas from the International Council on Clean Transportation (ICCT) and Garrett Eucalito and Matt Rogotzke from the National Governors Association (NGA). At the end of all of the speakers, we'll have a Q&A session.

II. Introduction

Slide 5. Introduction

Andrea Denny: So, this is just the names of the folks from EPA again.

Slide 6. U.S. EPA's State and Local Energy and Environment Program

Andrea Denny: I just wanted to quickly tell you a little bit about the program with EPA, the State and Local Energy and Environment program and what we do is try to support state, local and tribal governments who are interested in addressing climate change and improving their air quality and public health. We do this by offering free tools, data and technical expertise about energy strategies including energy efficiency, renewables and other emerging technologies. You can get to all of our resources through the link you see here on the slides.

Slide 7. U.S. EPA's State and Local Energy and Environment Program

Andrea Denny: Specific to electrification and electric vehicles, I just wanted to mention a few things that we have or have coming up this webinar today will hopefully be the first in a series. We are planning to do another one in late November or early December, we're still firming up the date looking at utility perspectives around vehicle electrification and then we'll have additional topics in 2020. The best way to get notified for that is to sign up for our newsletter and you can access all of our webinar materials at our state, local and tribal webinar page, which is linked here. We did a webinar earlier this year looking specifically at state and local experience with workplace charging featuring EPA's ENERGY STAR program, the Colorado Energy Office and the City of Fort Collins, Colorado talking about their experiences with workplace charging.

Then finally because not everyone is aware, I did want to mention that our ENERGY STAR program now certifies level I and level II chargers. They use up to 40% less electricity in standby mode and there are a lot of resources at the website links here including a buying guide and sample procurement language.

Slide 8. U.S. EPA's State, Local, and Tribal Transportation Resources

Andrea Denny: With that, I'm going to turn it over to Jessica to talk about some additional resources in our Office of Transportation and Air Quality.

Jessica Daniels: Thank you Andrea. My name is Jessica Daniels. OTAQ aims to reduce emissions from the transportation sector.

Slide 9. OTAQ's Voluntary Programs and Initiatives

We develop and implement mobile source regulations and conduct emissions and fuel economy testing in our National Vehicle and Fuel Emissions Lab in Ann Arbor, Michigan. We also work closely with state and local governments by offering expertise on state implementation plans, transportation conformity, the MOtor Vehicle Emission Simulator (MOVES) model and related programs. OTAC coordinates several voluntary partnerships to help reduce emissions through the Clean Diesel Program, Ports Initiative and the SmartWay Program for freight transportation and you can find information at all these links.

Slide 10. Electric Vehicle Trends

Jessica Daniels: Annually, we evaluate and publish information about new light duty vehicle greenhouse gas emissions, fuel economy data, technology data and auto manufacturers' performance and meeting the agency's greenhouse gas emissions standards.

Slide 11. EPA Resources for Consumers

Jessica Daniels: We provide resources to make it easier for the general public to understand vehicle emissions and their impact on the environment both on our fueleconomy.gov website, which is operated with the Department of Energy and on EPA's website.

Slide 12. Contact Information

Andrea Denny: Great. Thanks. Our contact information is here. Please feel free to follow up with us and links for the State and Local Energy and Environment Program's website, newsletter and LinkedIn group can be found on this slide as well.

III. Poll 1

Slide 13. Poll 1

Andrea Denny: With that, we're going to open up our first poll. So, for this poll, we're interested in learning which of the following is your primary interest in learning more about transportation electrification. So, please pick the most applicable answer. Leave that open for a moment, give people a chance to respond. The options we have include air quality, climate, transportation, energy and utility, land use, economic development and other and if you do enter other, please type what that option is in the Q&A box.

All right. It looks like the answers are slowing down. So, we'll give it another 10 seconds so go ahead and get your vote in if you didn't yet. We're going to go ahead and close the poll. So, it looks like the most popular choice was air quality with 52 – sorry, I can't see if that's votes or percentages - 52 votes, 44% of the vote, climate was 29%, transportation was about 16%, energy was 8.5% and land use was 2%. So, thanks very much for that and now we're going to introduce our first speaker.

IV. Overview of Department of Energy Sustainable Transportation and Trends

Slide 14. Overview of Department of Energy Sustainable Transportation and Trends

Jessica Daniels: So, Dr. Rachael Nealer is Transportation Chief of Staff at the U.S. Department of Energy. Her portfolio spans research and development and transportation systems modeling in terms of energy and emissions as well as producing publicly available transportation data and information at the Foundation for Modeling and Analysis done at DOE, the National Labs and beyond. She earned her joint Ph.D. in civil and environmental engineering and engineering and public policy from Carnegie Mellon University where she specialized in life cycle environmental impacts of transportation. Thank you Rachael.

Rachael Nealer: Thank you very much. Can you guys hear me okay?

Andrea Denny: Yup. Sounds good.

Slide 15. Overview of DOE Sustainable Transportation and Trends

Rachael Nealer: Awesome. Well, thank you Alexis and Andrea for inviting me to speak today. I'm looking forward to giving everyone on the phone here an overview of our Department of Energy Sustainable Transportation offices and some of the trends that are happening in the market today. So, I'm the Transportation Chief of Staff currently, which oversees three transportation offices here in Energy Efficiency and Renewable Energy. That is the Vehicle Technologies Office where most of the electrification work and Clean Cities work that I'll be talking about in this presentation happen. We also have the Bioenergy Technologies Office, which focuses on biofuels and bio products, and then we have the Fuel Cell Technologies Office, which will be some of what I also talk about today.

Slide 16. Market Trends: Electric Vehicle (EV) sales

Rachael Nealer: So, first, I'm going to talk about some of the market trends in electric vehicles today. So, electric vehicle sales have now reached over 1.3 million EVs on the road since 2010. This includes both battery electric vehicles and plug-in hybrid electric vehicles, but not hybrid electric vehicles. So, hybrid electric vehicles are the ones that you still have to use gasoline. They have a little bit of a bigger battery, but battery electric vehicles and plug-in hybrid electric vehicles both run at least partially on electricity if not fully in the case of batteries. So, right now today, we have about 2.61% of total new light duty vehicle sales in September, are plug-in electric vehicles, which is both the battery electric and the plug-in hybrid electric.

There were 238,000 plug-in hybrid electric vehicles and battery electric vehicles sold in 2019. That is up until about September, so this slide is a little outdated. It says through August, it should be September, my apologies. Last year we sold over 360,000 electric vehicles. Hybrid electric vehicles are about 5.2 million, but they've leveled off a little bit. So, I just wanted to provide that a little bit for context. One of the interesting things that is happening today in electric vehicle market is not only that the sales are increasing, but we're also getting into different market segments, which is really important when we consider the light duty market as a whole because light duty vehicles used to be split about 50-50 between light duty trucks and light duty cars.

Now we're at about 73% of new sales are light duty trucks or at least classified as light duty trucks. So, those are some of the larger heavier vehicles on the road and a lot of the battery electric vehicles and

plug-in hybrid vehicles have been in the kind of lighter vehicle classes and now we're seeing them get into some of the heavier models as well. As you can see from the graph, Tesla really dominates the market with the Model 3 and the Model S and the Model X. I'll note here that the Tesla sales are estimated. They report on a little bit of a different means than the other auto makers do. So, we do have to estimate it. They report on the global level and quarterly level as opposed to monthly like many of the other original equipment manufacturers (OEMs) do, but you also see big shares from General Motors and Nissan with the Chevy Volt and the Chevy Bolt and the Nissan LEAF.

Slide 17. Market Trends: Fuel cell electric vehicle (FCEV) sales

Rachael Nealer: Now looking at the fuel cell electric vehicle market, this is cumulative to today or through September. There's a total of 7,800 vehicles sold since 2014. So, note that the scale on the left is a little bit different. Not only do you have the scale on the left is less than the EV sales, but you also have fuel cell vehicles not being available for as long. So, the last graphic was started in 2010, this one is in 2014. So, we're seeing a lot of growth in the fuel cell electric vehicle market. It's mostly in California and last year we sold about 2,700 vehicles. So, we're excited about the potential, but note that it is a little bit earlier in the market for sales compared to electric vehicles.

Slide 18. Cost Trends: Batteries

Rachael Nealer: So, now we're going to talk a little bit about some of the cost trends that are going to improve both the costs for fuel cell vehicles and battery electric vehicles, but a large majority of the funding research and development that is in the Vehicle Technologies Office is actually dedicated to reducing the cost of batteries. So, we have a goal of $80 per kilowatt hour, you'll see it in a moment, at the top level, but just a couple years ago we started at $1,000 per kilowatt hour. So, we've seen a lot of improvement to today, which is around $200 per kilowatt hour with some of the chemistries that we see today like graphite, high voltage nickel manganese cobalt (NMC), which is nickel manganese cobalt chemistries, but we're still not getting to what we think will be kind of cost parity at the point of sale for electric vehicles. So, basically when you go to the sales lot, an electric vehicle costing the same amount of a gasoline vehicle without any incentive.

So, we are investing in additional chemistries and bringing those costs down. So, we think silicon high voltage NMC could get us a little bit lower in the cost per kilowatt hour, but really what we're looking for are new chemistries like lithium metal or lithium sulfur that'll get us down to that $80 per kilowatt hour technical goal that we've set for ourselves here at DOE. All these chemistries still have some research and development focuses that we are working on to bring the cost down. So, the graphite high voltage NMC we're working to increase the cathode capacity and reduce the amount of cobalt. So, cobalt is a big piece of the green and blue chemistries and it is a little bit of a volatile market.

So, we're trying to reduce the amount of cobalt and it's also an import market for us in the U.S. So, reducing that is good for energy independence, but we also have some cycling and fast charging challenges with NMC that we're trying to work on here at DOE. For the silicon high voltage NMC, we're looking to increase the anode capacity as well as the cycle life of the batteries and make sure that they are fast charge ready. I'll talk a little bit more about the fast charging when we get to the DOE goals section of the talk. Then with lithium metal and lithium sulfur, we're looking at even bigger challenges. So, solving catastrophic failure issues, reducing the excess lithium, when you get into a lot of lithium plating issues with these chemistries, we need to reduce the excess electrolyte and we need to reduce lithium metal cost. So, DOE is really focused in the Vehicle Technologies Office through the Batteries Program to reduce these costs and try to overcome many of these challenges.

Slide 19. Impacts of EVs on the Road

Rachael Nealer: Just giving a little bit of a shout out to one of the publications that my former team, the Analysis Team in the Vehicle Technologies Office did in 2018, where we looked at kind of a retroactive look of the impacts of EVs on the road today. So, you can get to the publication from the link down at the bottom, but this just gives a sample of the gasoline displacement due to the plug-in hybrid electric vehicles and battery electric vehicles by year, but it's based on a lot of behavior assumption, some of them are pretty coarse assumptions, but it does give us a kind of order of magnitude estimate of how much gasoline was reduced.

So for example, 600 million gallons have been saved through 2017, so this is a little bit of a dated study a couple years ago, but the 600 million gallons through 2017 cumulatively have been saved because of EVs on the road. They've used approximately 5 terawatt hours of electricity. There are over 23 gigawatt hours of battery capacity on the road today and electricity has powered about 16 billion miles cumulatively, which has saved us 2.6 million metric tons of carbon dioxide (CO_2).

Slide 20. DOE Technical Goals

Rachael Nealer: So, focusing a little bit more on the DOE technical goals, we've got kind of an umbrella of goals that we are interested in pursuing. So, one is like parked on already lowering the cost of EVs and fuel cell components, so that's through the battery pack where we're trying to reduce the cost per kilowatt hour. We're trying to improve the efficiency of the electric drive and we're trying to reduce the fuel self-storage system, which is a big component of the cost of fuel cell electric vehicles. We also want to focus on decreasing refueling time for EVs and fuel cell vehicles. So, I like to think of that first set of goals as kind of the cost parity for electric vehicles and fuel cell vehicles to get down to gasoline vehicles.

The second one is kind of time parity, right? We're all very used to going to the gas station and filling up in just a couple minutes to get hundreds of miles of range. So, we're trying to do that for electric vehicles and fuel cell vehicles as well. So, fuel cell vehicles were shooting for a 3-5 minute fill time and for electric vehicles although a lot of people may be able to charge at home in which they can charge overnight, some folks might not have the access to do that and so may have to rely on faster charging away from home. So, we're shooting for 10 to 15 minutes refueling for 200 to 300 miles of range for EVs, which we are calling extreme fast charging. This also has a lot of impacts to the grid as you can imagine and so we have a lot of work trying to identify challenges and opportunities to improve the efficiency between the interaction of the grid and charging system as well.

Then finally, lower the cost to produce and deliver hydrogen, hydrogen is still a pretty expensive fuel right now. It's a little bit masked by the fact that many of the automakers are selling their vehicles with incentives for the refueling, but we're shooting to get down to $4 per gallon of gasoline equivalent for production and delivery of hydrogen and one of the ways that we're hoping to reduce the cost there is by also utilizing hydrogen for other non-transport uses and we have a sort of initiative called Hydrogen at Scale, which I would encourage folks to take a look at. Lastly just to provide more information to the public, earlier EPA was talking about fueleconomy.gov, which we do run with EPA, but we also have a lot of resources through our clean city initiatives in the vehicle technologies.

Slide 21. Clean Cities Coalitions

Rachael Nealer: So, we have Clean City Coalitions that are nearly 100 coalitions covering about 80% of the U.S. population. The coalitions cover businesses, utilities, fuel providers, vehicle fleet, state and local agencies and community leaders. So, I would really encourage you to go to this website here and reach out to your local coalition for more information because they really have a platform of technology in neutral unbiased advisors.

Slide 22. Clean Cities can help you …

Rachael Nealer: So, additional information can be found on the website, but you can also get just a better sense of how we're trying to communicate not only some of the uses of electric vehicles and fuel cell vehicles, but all types of alternative fuels and you can get a lot more information for your uses and for your region.

Slide 23. Dr. Rachael Nealer

Rachael Nealer: With that, I will finish up.

Andrea Denny: Great. Thanks so much Rachael and just as a reminder to folks, we've had a number of questions come in, but if anyone else has questions, you can type them into the Q&A box at any time and now we're going to do another quick poll.

V. Poll 2

Slide 24. Poll 2

Andrea Denny: For this poll, we're interested in knowing which potential impacts of transportation electrification you're interested in. You can choose more than one answer here. Your choices are greenhouse gas emissions, criteria air pollutant emissions, electricity system changes, community design, user experience and cost, and again other and if you choose other, please give us an indication what you're thinking about in the Q&A box.

All right. We'll give you about another 10 or 15 seconds to add any additional choices and then we'll go ahead and close the poll. Okay. We can go ahead and close that out. We saw the highest level of interest in greenhouse gas emissions followed by criteria air pollutant emissions and electricity system changes, but also fairly high interest in user experience and cost and community design, and we did have a few suggestions come in through the Q&A box for other topics. So, thanks very much for participating and now we're going to introduce our second speaker.

VI. Global Electric Vehicle Sales and Trends

Slide 25. Global Electric Vehicle Sales and Trends

Jessica Daniels: All right. So, Dr. Michael Nicholas is a senior researcher at the International Council on Clean Transportation. He received his Ph.D. from the University of California Davis and transportation technology and policy. His work focuses on consumer behavior and the electric vehicle market transition. He is also a standing committee member for the National Academy's Committee on Alternative Fuels and Technologies. Thank you Michael.

Michael Nicholas: All right. Thank you very much. It's a pleasure to speak with you today and share some of the work that we've been doing at ICCT on electrification. So, I'll just give a broad overview of ICCT. We do a lot of work around the world and we focused on different kinds of studies, which I'll talk about today. Some are comparing across regions and then some are looking a little bit more than one country or another country. Overall, I think this will give a good overview of what's happening around the world with electrification.

Slide 26. Global Electric Vehicle Sales and Trends

Slide 27. Terms

Michael Nicholas: So, first, I'll go through some terms and Rachael was pretty good at covering all these, but sometimes the acronyms get a little bit confusing, and so we'll talk about zero emission vehicles, which is abbreviated as ZEVs. It could be anything with zero tailpipe emissions and we have battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), which I won't go through since Rachael did a good job of covering that, but we have an overall category called EVs, which does include both the BEVs and PHEVs. Then internal combustion engine vehicles are sometimes abbreviated as ICE and those include anything that does not have a plug and is a conventional vehicle, but can include ICE as well.

Slide 28. Electric vehicles are rapidly gaining market share worldwide

Michael Nicholas: So, first of all, I'll take a broad look at just what the market is doing. So, we'll see the United States, which Rachael presented before, but we also see a lot of activity around the world especially in China. So, we see on the left axis the number of annual electric vehicle sales not cumulative and we see we're up to two million vehicles in 2018 with a lot of the growth in China, but we're focused mostly in premium markets. So, North America including United States and Canada, Europe and China and a little bit of Japan there, but so far it's been somewhat concentrated in a few areas.

Slide 29. Electric vehicle shares differ by region

Michael Nicholas: So, even though we can see these overall numbers, it's useful to look at how individual countries grow. In this case, we did a study on the United States and we've done two successive studies, one in 2017 looking at the uptake across different metros in the United States. What I'll do is I'll go to the next slide and the next slide will be 2018.

Slide 30. Electric vehicle sales are reaching more markets in 2018

Michael Nicholas: So, you can see, for example, if you could focus on the Midwest, you see that it starts in a few concentrated regions, but by 2018, we're seeing much more uptake in maybe smaller

metropolitan regions and this is quite encouraging and gives some, I guess, support to the idea that we can start small and then grow from there. Incidentally in this graph, we see in 2018, we're up to 20% of new vehicle sales in San Jose and we do see some regional differences along the coast. Especially the west coast, there's higher uptake and the east coast as well is showing increased uptake of electric vehicles.

Slide 31. The world is shifting to larger vehicles generally, but fully electric vehicles are mostly available in smaller segments

Michael Nicholas: But driving out to the world again, we see some trends that may affect how different countries are able to electrify and at what rate they might be able to transition. From 2005 to 2017, we see overall in the world that consumers are choosing larger and larger platforms, and we see especially the small truck sport utility vehicle (SUV) category, compact SUVs, that category has grown while city cars and other sedans have reduced in market share by 2017. So, this does have a little bit of a bearing on what types of vehicles are being electrified and what the potential for electrification is. On the right, we see in 2018 in Europe for example, what were the battery electric vehicle models available and we see that in the large SUV pickup category, there're no choices versus a city car, there are lots of choices, and we see again about the market share of those and it gives an idea the potential.

Slide 32. Worldwide vehicle size preference differs by country making the transition to electric easier in countries with smaller vehicles

Michael Nicholas: So, looking at this sort of metric, country by country, we see that in Italy, generally cars are smaller and then in Canada, if you're looking at the red dots, that's the average fuel consumption, which is affected by the vehicle platform. We see small cars in Italy and larger cars in Canada and United States. So, that has implications for electrification as we move forward.

Slide 33. When will EV costs reach purchase price parity with conventional gasoline vehicles?

Michael Nicholas: So, this is a very important graph, and I'm glad that Rachael presented the battery costs as very high starting in 2010. I think it was maybe a $1,000 per kilowatt hour on the pack level and now we're down to around $180-$190 dollars per kilowatt hour on the pack level. What this means is that we're getting closer and closer to price parity.

So, this is not cost parity, this price parity including all the different dealer incentives and markups, everything all into a vehicle price that we can look at, but we also look at it as a function of range because battery costs are such a large part of the vehicle. We see that for battery electric vehicle with 150 miles range indicated by the BEV-150 (green line) that will reach price parity with a conventional car, which is the dark lower line. We see the cost increases slightly for conventional cars as new technologies are added for fuel economy, but again this transition will start happening for price parity for cars around 2023 and then continue for longer range vehicles to 2027.

So, this could be done for cars, small SUVs and larger trucks and for those larger platforms, this cost parity is pushed out slightly, but we see that the role of incentives here can help buy down that initial cost barrier and this is what's been happening in the United States where we actually will be able to see the effects.

Slide 34. Regulatory policy can drive technology

Michael Nicholas: So, that last point about regulatory policy is an important one as these regulations provide a signal for industry to invest in these technologies, which will eventually become more useful, but there's all of the conundrum of investment now versus benefits later.

So, as industry moves forward together, we will see some of these cost reductions and lower CO_2 as a result. So, I won't speak to this study in detail, but please click the link below to look at how we look at the interplay between fuel economy regulations, which is the turquoise line and the effect it possibly could have on the share of electric vehicles in the market indicated by the dashed line at the bottom. So, by 2025, we expect to see at least 5% EV vehicle share as we move forward.

Slide 35. What is driving electric vehicle uptake in the U.S.?

Michael Nicholas: So, again I'll zoom back out to the U.S. and we see this differing electric vehicle uptake around the United States and again we'll look at these cities individually, but what is causing this difference in the uptake?

Slide 36. Metropolitan areas with more EV sales share tend to have more chargers, EV models and promotion actions

Michael Nicholas: I'd encourage you to take a look at this paper, but we did look at some of these market leaders by metropolitan area and there's not just one thing. It's not overall CO_2 regulation, but it's really all those things that are happening within the metropolitan areas themselves and even states, but this is looking just at metropolitan areas, but if you take the example of San Jose, we see high electric vehicles share in the first column. The second column looks at the charging infrastructure divided by direct current (DC) fast work place and public charging. Other important factors are models available. Consumer incentive and promotion actions. The model is available. This is driven by not everyone wants to drive the same vehicle. We don't all want a Model T, we want choice and variety and what kind of cars we would like to buy.

So, a lot of the consumer choice provides people with options and increases uptake we found in studies. Consumer incentives are important and generally the higher the consumer incentives the more we see electric vehicle uptake, but there's also things that cities and states and utilities can do as far as promotion actions to encourage or reduce the barriers for adoption of electric vehicles. So, because of all these things together, we can see differing uptake around the United States.

Slide 37. Electric vehicles and public charging have grown together globally

Michael Nicholas: So, in general, we see that electric vehicles grow with infrastructure and there is a linkage of infrastructure, but there is an important point about this graph and you'll notice that there's much more public infrastructure per car in China than the United States.

You look at the proportions of the bars and the pink bar for the cars in China on the left is smaller than the infrastructure bar on the right for China. What this says is that in the United States, home charging is much more available and so you don't need as much public charging. For a little bit closer look at -- that'll be the next slide.

Slide 38. Analytics – The charging gap varies regionally with some areas more prepared for 2025

Michael Nicholas: This is -- oh I didn't put the link in there, but this is a study we did on the charging gap. So, we can actually calculate based on uptake of how much infrastructure is needed by a metropolitan area.

Slide 39. Is there a global EV-per-public-charger benchmark?

Michael Nicholas: Back to the point about charger ratios, these are charger ratios around the world and we see the countries and cities listed along the bottom and the height of the blue bar is the electric vehicles per public charge point. If we take the example of Burgin, there is about 15 electric vehicles for every charge point and is that the right ratio? Well, we see in Shenzhen that for every vehicle, there are three public chargers and then we move over to the United States for every, about 30 vehicles, there's one public charge point.

So, some of these trends suggest that there's no global benchmark for infrastructure, but it is a combination of, home, public and DC fast, which can be put in different directions, which can be presented in different ratios to consumers to have a functioning charging ecosystem.

Slide 40. Utilities can charge more for electricity in countries with higher gasoline prices. Utilities must focus on energy cost reductions.

Michael Nicholas: So, this one maybe more a commentary on the existing conditions in a country can change. So, we see on the bottom here the gasoline price per gallon four different countries receive. The United States is about $3 per gallon, in Norway at about $7.5 per gallon or so. So, when gasoline price is high, this actually drives the market as well and some of these basic condition can make it a little bit easier in one country than the other country. So, different strategies, different business models will flourish in one place versus in others.

Just as an example, we see that the same, and I guess I should say the electricity price is along the right and these lines alongside are the equivalent prices. So, points above the line means it's cheaper to drive on gasoline; if you charge too much for electricity, gas is cheaper. If you charge too much for gas, electricity becomes cheaper or vice versa. So, these lines, they divide for two different efficiencies of vehicles where we see this break point. So, the point is that given the same electricity price, but different gas prices, we see the effect can be different, and I guess though I'll stop there because that one is a little bit of maybe a mind bender.

Slide 41. The challenge: Transition to electric drive

Michael Nicholas: We see that the transition to electric drive, there's a lot of country goals when would we like to transition to fully electric vehicle sales graph. So, the sales in any one year when do we want it to be a 100%? So, we see different country goals and we see different progress. We see Norway, we look at some of these goals of over 40% electric drive share in 2030 in California, well Norway is already there, so it is certainly possible to get to these very, very high sales percentages and we can look to some markets to show us the way.

Slide 42. Leading global EV markets keep innovating

Michael Nicholas: Again, global markets are doing their way and we see that as a top 20 markets account for 40% of electric vehicle sales, but they only account for 8% of global vehicle sales. So, 8% of gasoline sales, but 40% of global electric vehicle sales and we can look to these cities to be laboratories for the future and help expand the uptake of EVs elsewhere.

Slide 43. Transformation is a combination of monetary and non-monetary actions across sectors and jurisdictions

Michael Nicholas: So, I'll skip that in the interest of time, but to the lessons learned is that long term regulations ensure investment and model availability.

Slide 44. Reflections and lessons learned

Michael Nicholas: Incentives are important in the short term, charging infrastructure is very important, but will differ by country, utilities they can provide charging infrastructure, home, workplace and public at low cost. Again, these cities, they have a big role to play in promoting electric vehicles locally. Really, boots on the grounds and local action makes a big difference in vehicle uptake. Some final lessons, just one of the actions above is insufficient and really takes more than just price, it takes infrastructure investment, it takes a lot of different things to grow the market. Stable regulatory policy is key and infrastructure is key.

Slide 45. Contact

Michael Nicholas: So, I'll stop there and thanks everyone for listening to all the research we have done.

Andrea Denny: Thanks so much Mike. That was great.

VII. Poll 3

Slide 46. Poll 3

Andrea Denny: We're going to pull up our last poll. So, we are just doing a little bit of market research here. As I mentioned, we are hoping to do an ongoing series of webinars related to electrification topics and so we would love it if you would just let us know what your top three webinar topics would be that you would like us to cover in the coming months. So, some of the choices we have include EV infrastructure and electric vehicle supply equipment, policies and planning to support vehicle electrification, public education and outreach, public or private fleet electrification, bus electrification, non-passenger vehicles, automated vehicles, shared mobility or any other topics and again if you could enter those into the Q&A box, that would be helpful. All right. If people could take another 10 or 15 seconds or so to get their last answers in, we'll get the poll closed and move on. Okay. We can go ahead and close that poll.

Thank you very much. That's extremely helpful information to us. It looks like there is a very high level of interest in policies and planning to support vehicle electrification followed by EV infrastructure and electric vehicle supply equipment (EVSE). I think next on the list was non-passenger vehicles, but we also saw high levels of interest in many of the other topics. So, we will definitely keep these in mind and thanks for the other topic suggestions that you typed in through the Q&A box. All right. We're going to introduce our last two speakers.

VIII. Transportation Electrification: States Rev Up

Slide 47. Transportation Electrification: States Rev Up

Jessica Daniels: All right. Garrett Eucalito serves as a program director for the National Governors Association Center for Best Practices, Energy and Infrastructure and Environment Division where he supports governors' staff and state policy makers on issues related to transportation and infrastructure. His areas of focus include transportation funding and innovative infrastructure financing and delivery methods, the impact of new technologies such as autonomous vehicles, drones, ride hailing and electrification as well as infrastructure and housing resilience.

Matt Rogotzke also works in the Energy, Infrastructure and Environment Division as a policy analyst. At NGA, Matt supports state decision makers in developing sustainable strategies towards their long term energy goals to accomplish this. He's focusing on the benefits of energy efficiency, grid modernization and transportation electrification. So, welcome. Thank you Garrett and Matt.

Garrett Eucalito: Thank you very much. First, this is Garrett Eucalito with NGA. I want to first thank EPA for allowing us to present on this webinar. It's great to hear from the other panelists and see what the attendees are interested in through the polling. Our presentation is definitely going to cover some of those issues that came up and talk about how states are addressing some of these concerns and ways to move forward in electrification. So, like I said my name's Garrett Eucalito, and I'm here with my colleague Matt Rogotzke. We're with the National Governors Association.

Slide 48. Transportation Electrification: States Rev Up

Slide 49. What is NGA?

Garrett Eucalito: For those of you who do not know the National Governors Association, I'll give you a brief background. I always assume most people don't know about us, we were founded in 1908 serving the nation's governors. We represent all 55 governors; that is the 50 states and the five territories and commonwealths here in Washington, D.C.

We work with their federal affairs folks many of whom are based here in the Hall of States with us. We also work with the governors offices directly back home in their state capitals and with their state agencies. Matt and I are based in the Center for Best Practices, which is the 501(C)(3) portion of NGA. We exist to serve governors offices directly on policy development, help them determine what is working well what's not working well across the country, see what's happening across the border and across the country and across the world.

Slide 50. Energy, Infrastructure and Environment (EIE) Division

Garrett Eucalito: So, our division is Energy Infrastructure and Environment. There is a link there that can take you to our home page where we have a lot of our resources that we have already pulled together over the past several years. In addition to doing research and policy analysis, we do specific technical assistance requests that come in and a large amount of our work is doing convenings and workshops for governors, staff and state agency staff to get together with peers from across the country and dive deep into a new topic.

Slide 51. Transportation Technologies of Focus

Garrett Eucalito: So, for us in my Transportation Team, we have four main technologies of focus: ride-hailing, and car sharing, electric vehicles, connected and autonomous vehicles and unmanned aerial vehicles and drones.

Slide 52. Why Governors Are Interested

Garrett Eucalito: So, here for EVs falls right in line with one of our topics that we're really focused on. Briefly, why are governors interested? It's fairly obvious, but just touch on a few of the reasons. Obviously, they care about the reducing petroleum independence, they care about issues like lowering and shifting emissions, electricity market benefits, minimizing household expenses and like I said reducing petroleum dependence. Those are just some of the many reasons why governors came to us and asked us to start getting involved in doing more in the electrification space to help their states prepare.

Slide 53. Benefits from Electrified Transportation

Slide 54. What We Did

Garrett Eucalito: So over the past year, this is what we did and we pulled together.

Slide 55. Regional Transportation Electrification Workshops

Garrett Eucalito: After hearing from governors, we decided to expand our assistance in this space leading a series of four regional transportation electrification workshops over the periods of six months. This was only possible with the support of the Department of Energy as well as foundations across the U.S.

Through this series of four workshops, we worked with over 230 participants from 40 states and territories, and we had nonprofits, automobile OEMs, charging companies, folks from academia and other industry leaders in the room at the series of workshops. It really did help us frame our learning for our Transportation Learning Network at large as well as feed into the white paper that we recently released and which Matt is going to go into in more detail.

Slide 56. State Policies to Encourage Electric Vehicles

Garrett Eucalito: So, just touching briefly on a few ways states are encouraging the adoption of electric vehicles and then I will turn it over to Matt to talk about what we publish in our white paper that looked at some of the trends in electrification at the state level.

Slide 57. Terms

Garrett Eucalito: So, one of the key ways that states looked at helping is do incentive programs.

Slide 58. State EV Incentives

Garrett Eucalito: I think most people on the call know about this. A couple of these numbers are out of date.

Slide 59. California

Garrett Eucalito: I just want to highlight three of the states specifically, California probably the best known and the largest percentage of EVs on the road.

Slide 60. Colorado

Garrett Eucalito: Colorado, we definitely have been highlighting Colorado a lot largely because Governor Polis who's the new governor, just took office in 2019, his first Executive Order (EO) actually focused on ways to advance EV adoption. So, that was by singling using his first EO, it really signals a priority for the administration.

Slide 61. Connecticut

Garrett Eucalito: Then Connecticut, small but really interesting program. The number has changed here a little bit. They offer $5,000 for hydrogen vehicles, $1,500 for EVs and it drops down based on the battery range. They also, this legislative session, just passed a new registration fee for all vehicles on the roadways.

So, every time you register your vehicle, you will pay a fee and that goes to help pay for what they call the Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) Program, which is the rebate program for incentives. So, all vehicle owners are now paying into a fund, which is going to go help pay for the incentive programs out there for EV adoption.

Slide 62. EV White Paper

Garrett Eucalito: So with that, I want to turn over to Matt. My colleague, Matt Rogotzke here who's going to talk a little bit about our EV white paper that we recently released, which kind of summarizes all of the four workshops we did looking at the trends across the country on incentives, on issues that states are facing and where they need some of the assistance and where the choke points are. So, Matt?

Matt Rogotzke: Thanks Garrett and thanks EPA for the opportunity to share about our learnings from the regional workshops. We framed the lessons that we learned into eight sections, and I'll cover those on the following slides. I won't be able to cover all the topics that we heard in our meetings, but please read more into our white paper. If you're interested, there is a link on the screen or there's contact info at the end of our presentation, and I can make sure to pass on the link to you.

Slide 63. Crafting Incentives and Policies

Matt Rogotzke: So, first topic that we cover at each of our meetings is crafting incentives and policies. So, states face many barriers to EV adoption. Those include limited consumer awareness, concerns over where to charge vehicles that contributes to the topic of range anxiety or how to make incentives equitable across all income levels among other barriers.

So, states are overcoming some of these through policies such as setting EV procurement targets, formalizing consumer engagement campaigns or planning for EV charging corridors. So, Garrett showed earlier that many states offer EV purchase rebates, but there's more than just purchase rebates that states can offer. So, it's important to consider when setting a rebate the level: is it attached to a consumer's income or is it based on vehicle retail price? So, a few states like Connecticut, Delaware and Pennsylvania all here their rebates are based on vehicle price capping, the amount capping the rebate that you can receive if your car is retailed at a certain price level.

In some cases, their rebate is tiered on the type of vehicle or battery range. In California and Oregon, they incentivize based on income, so the rebate will rise for lower- income individuals. In Connecticut, they offer dealers at $300 incentive for an EV sold or leased. States mention that automakers and dealers could do more in terms of consumer awareness and this incentive is meant to overcome this barrier.

Slide 64. Enhancing State Fleet Electrification

Matt Rogotzke: Next, we talked about state fleet electrification. So, many of our states are intent on making their fleets more efficient as it's an opportunity to lead by example. Every state owns large numbers of light duty vehicles, but states typically do not own transit fleets. Those are more often controlled by local transit authorities. So, while there's a lack of ownership among states, they have a role to play in assisting local transit agencies to convert to things such as electric buses. Each state received a portion of Volkswagen (VW) funding that's commensurate with affected vehicles in their state. Many states acknowledge that they would be much worse off in terms of EV progress without the settlement. So, some states are using that settlement money like Hawaii and Rhode Island to overcome high cost. They purchased electric buses as part of their fleet. In Washington, they are using funding to purchase electric ferries. Vermont is taking a bit of a different approach. They set action plan that requires 25% of its data on fleet to be zero emissions by 2025 and this may work better because it's going to be aligned with battery cost decreases.

Slide 65. Siting Charging Infrastructure

Matt Rogotzke: Next topic that we cover siting charging infrastructure. So, common reason consumer cite for not purchasing an EV is range anxiety. This includes fears that batteries don't have long ranges, charges are not available or convenient along routes or charging times are too long. One company that is working on this is Electrify America. They are a subsidiary of Volkswagen and Tesla to build out of chargers across the country. They have $2 billion to spend through various cycles and their end goal is to have chargers 70 miles apart on all roadways. We have them at our workshops and they engage with many states and we heard frequently that states were interested in engaging more with them and finding ways to increase build out of charges in their corridors. Then some other states are using the VW settlement to address their major charging needs. The settlement allows states to use up to 15% of their allocation on charging equipment and 34 states are taking advantage of this carve out.

Slide 66. Improving Regional Coordination

Matt Rogotzke: Next, we talked a lot about improving regional coordination. One speaker we would have frequently is the Federal Highway Administration and how they're designating alternative fuel corridors. There's now 79 corridors that cover 135,000 miles and are tackling signage installation in states like Louisiana, Minnesota, Rhode island and South Carolina and if you drive through those states, you might find that it's a little easier to identify where to charge your car. States themselves are taking on the task of forming regional collaboratives like West Coast Electric Highway, Regional Electric Vehicle (REV) West or the Transportation and Climate Initiative.

Then finally one topic that we covered is commercial activity in interstate highway rest areas. So, there's a federal prohibition on this activity because originally 1960 had set that cars should stop at local businesses and towns instead of that commercial road stops, although this could be a convenient opportunity for drivers that they're passing through interstates or roadsides and having a charge there.

Slide 67. Who Owns, Operates and Pays for EVSE

Slide 68. Managing the Grid

Matt Rogotzke: Next, we looked at who owns, operates and pays for the charging equipment. There are various ownership models when it comes to charging infrastructure. It's an important component to states, mainly they're regulated as well as utilities. So, it's important to have both energy and transportation folks in the room when we're talking as sometimes they don't always meet up, but in this case state regulators have the opportunity to prove make-ready EV infrastructure, which means utilities can install the electrical equipment that enables charging, but just not the charger itself. Some other possibilities that states can look at it including utilities to become the owner and operator of the charger, although some states were wary of this or they can provide financial incentives for the charges. Panelists discussed how they see charging stations potentially being unsustainable funding structures because electric vehicle adoption is still in a limited stage. This could be an opportunity for utilities to become more involved.

Slide 69. Electrification for All

Matt Rogotzke: Next, we talk about managing the grid and how electric vehicles impact electricity. So, more EVs constrained the electric grid in various ways such as increased peak demand, more load growth, heavy duty vehicles and DC fast chargers are significant challenges to the grid as well. So, one solution that states turn to is time abuse rates. Drivers can set their charger to start during off peak hours. This one is demand charges that they accrue and smooths demand that fluctuations across the grid.

So, this is good for both the consumer and the grid, although some utilities are experiencing a demand spike as soon as off peak hours kick in. So, policy makers need to ensure that they're smoothing the transition from the period that off peak hours begin. In one topic, we covered a little bit with vehicle to grid benefits. They're seen as very beneficial to pathway of applications for resilience. They charge during low demand periods and they can operate as energy storage applications, but they're not fully explored to those issues with warranty and battery challenges themselves.

Slide 70. Addressing Impacts to State Revenue

Matt Rogotzke: Last two topics we covered was electrification for all. We have many substantive discussions in each workshop on this issue. It's clear states are eager to make sure that there's more equitable design and policies for electric vehicle incentives. Traditionally, EV owners have been higher income individuals, 70% of EV owners make more than $75,000 a year. So, tiering rebates to be based off consumer income is maybe a solution for covering this. It's also important to remember that rural communities have challenges in finding convenient chargers, so prioritizing charging corridors in those regions are helpful as well.

Slide 71. State-Imposed Electric Vehicle Fees

Matt Rogotzke: Then finally, we looked at addressing impacts to state revenue. EVs are changing transportation funding change because they don't pay gas tax. Twenty eight (28) states are implementing additional registration fees to account for some of the lost revenue, but they're doing it in different ways and in different amounts themselves.

So, some states charge up to $200 for registration fees and consumer reports put out an article talking about how this can be in excess of what drivers would pay in gas taxes, sometimes double or triple the amount. States such as Maryland and Vermont are waiting to assess these until EVs reach a more

significant adoption rate. This is a topic that NGA is covering a little bit more upcoming, so Garrett will talk about what we're working on in the future on electric vehicle fees.

Garrett Eucalito: Thanks, Matt. So, just really briefly to wrap up. So, where NGA is going from here is after all the workshops, there's a lot of things around the energy side that states have told us they need more assistance with when it comes to EVs including vehicle to grid and grid modernization efforts and integration. On the policy side, there's a lot of questions at the state level on fees that are being imposed.

Slide 72. Punitive Fees Map

Garrett Eucalito: So, this map here shows you what fees are currently in place or taking effect. So, we going forward NGA, we are going to be convening some folks from the state level and some academia to have a discussion about the future of transportation funding in light of growth in electrification, look at what some alternatives are out there and try to do a deep dive on what the impacts of these fees really are on the revenue as well as on adoption levels.

Then going to 2020, we're going to hope to continue to grow this program because we've heard loud and clear from governors and their staff that no matter what part of the country they're in, they want to talk about EVs. So, with that we will wrap up and we'll turn it back to EPA.

Slide 73. Thank You

Andrea Denny: Great. Thank you so much Matt and Garrett. That was really helpful.

IX. Question and Answer Session

Slide 74. Question and Answer Session

Andrea Denny: So, we've had a number of questions and comments come in. I'm not sure we're going to have a chance to get to all of them. If there are things that we don't have a chance to answer on the phone today, we will reach out to the speakers and see if we're able to get those answered offline and posted along with the webcast materials on our website in the next few weeks. A number of people have also suggested resources, web links or other comments for the speakers, and I just want to let everyone know we will share those comments with the speakers. You can continue to answer or to ask questions as we start our Q&A session, but I'm going to go from -- before we get into specific questions on the presentations, I just wanted to throw out a question for all the speakers. So, maybe we'll go back and give Rachael a chance to answer first and then just go in order of the presentations, but all the presentations seemed to see a very bright future for electric vehicles, and I wondered if you could just quickly mention what you think are the top challenges to getting more electric vehicles on the road.

Rachael Nealer: Great. Thank you. That's a great question. I think 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 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. So, hopefully you know 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 a lot 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. So, I think those are two big challenges still.

Michael Nicholas: I guess I'm next. This is Mike Nicholas. Yeah, I think Rachael brings up some of the same things I would highlight such as infrastructure. I think I'd say that getting infrastructure home is very challenging in whatever we can do to putting that into codes and regulations 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 overtime, 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. So, assisting in any way of getting infrastructure and availability would be a key policy. So, we're having a key area or key barrier.

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. So, if they don't know of any models, they wouldn't consider them when they're buying a car. So, just awareness of the options I think is a big issue and then I would actually 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. So, high electricity prices for electric vehicle is an issue in some utilities and it doesn't need to be. So, I would say consistent utility policy and getting the costs right from the utility side is a big area that could be worked on.

Andrea Denny: Great. Thanks everyone. We're going to follow that up with -- oh sorry. I'm getting ahead of myself. Matt and Garrett, do you want to take a stab. These answers have been so complete, I'm not sure what else you're going to add, but I'm interested to hear it.

Matt Rogotzke: I'll keep it brief. I would just reiterate, 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. So, 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. So, the location of charging and education about charging is key I think what we heard from states.

Andrea Denny: Great. Thank you so much. So, I want to jump back to Rachael. Rachael, we have a number of questions come in from a couple of different people, and I'm going to condense and paraphrase a little bit, but all related to alternative battery technologies, and I wonder if you could talk a little bit about other types of battery technologies DOE might be looking at. Whether there are other technologies that you think are promising, etcetera.

Rachael Nealer: Could you clarify the question a little bit? I'm not sure exactly what you mean by other technologies. Do you mean like the battery chemistries?

Andrea Denny: So, a couple people mentioned aluminum air batteries, galvanic salt batteries, basically non-lithium ion batteries. There are a couple of different technologies mentioned.

Rachael Nealer: Yeah sure. So, 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. So, it's a 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 sort of challenges and opportunities you might be able to increase the specific energy of one of the chemistries to another level, but you run into like lithium plating issues.

So, lithium ion has its challenges as well, but it has been proven out today and so we want to build on that, but we also are especially at the lab level. So, we haven't gotten to it quite scale up, but we are investigating new technologies as is the role of DOE we to be kind of on the cutting edge.

Andrea Denny: Great. Thank you, and one more question for you. You have a slide where you talked about the displacement of gasoline and some of the associated greenhouse gas savings, and there were just some questions about what assumptions you made about PHEVs and about typical gasoline consumption and coming up with those numbers and also whether the greenhouse gas estimates include offsets from increased electricity.

Rachael Nealer: Absolutely. So, I would point folks to the link at the bottom of that slide. So, we did publish that report. It's cumulative impacts up to 2017, it was published in 2018 based off some of our work which is also updated on a monthly basis. So, maybe that's also a plug for folks that are interested in these impacts and the increase in sales that Argonne National Lab does monthly sales reporting. So, 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 like I mentioned in the talk, you know, 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.

So, it does take 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 and all of the nitty gritty assumptions.

Andrea Denny: Thanks, that's really helpful. So, I'm going to move on to questions from Mike and the first question was whether you have any comparative information about the EV uptake in section 177 ZEV states versus non-ZEV states?

Michael Nicholas: I don't think we have a report focused on that. I'm trying to think if we have -- so one place I would look would be our Charging Gap Report where we look at the state by state or metro by metro the uptake in those specific regions and then you 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.

Andrea Denny: Great. Thanks. And then another question for you, can you talk a little bit about how demand for public charging might change as vehicle range increases?

Michael Nicholas: Yeah. As the vehicle range increases, they need to go to the charging station less. Your utilization increases because you don't have to, I mean, I guess it would be convenience increases. Not going as much has a lot of benefits to the charging infrastructure. So, 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. So, I think we'll see, I guess, 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 one low power or no home charging, I think it'll broaden up that market. Yeah and faster charging can be more possible with larger batteries. There's lots of things.

Andrea Denny: Great. Thank you. We're going to move on to a couple of questions for Matt and Garrett. The first question was, who are the states that you did not talk to and if our state, you know, the questioner's state was one of them how can they get connected?

Garrett Eucalito: Great question. I don't know the full list off the top of my head. Like we said, it was 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.

Andrea Denny: Great, and one more question for you all - I mean, NGA. The question or concern about demand charges for fast charging and what could states or utilities do to help lower those costs and make fast charging more accessible?

Michael Nicholas: This is Michael Nicholas. I was just looking into this and then as I alluded to earlier, there's thousands of utilities each with their own policy on high power charging, which can either include demand chargers or not is 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. So, in exchange for a higher cost per kilowatt hour on a low use station, you can get reasonable amounts of, I guess, a reasonable cost, but 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. So, 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: Yeah. This is Matt from NGA. 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. So, 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. So, 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.

Andrea Denny: Great. Thanks so much, and I just wanted to close with one last question for all of the speakers and while you could probably talk extensively on this, I'm going to ask you to give like the one-sentence version of your answer, which is 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: This is Rachael. I'll throw out that I think there's a lot of power in community here. So, 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 I think a great first step. So, 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 my one-sentence answer is 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: Yeah. From NGA side, I think the one thing we would say is an easy thing people can do is within state government and within local government to talk to your colleagues in other agencies, because 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.

Slide 74. Connect with the State and Local Energy and Environment Program

Andrea Denny: Great. Thanks so much everyone. I really appreciate all of the speakers taking the time to be on our call today. You gave us a lot of great information. I'd also like to thank all of the participants. I would encourage you to please click on our webinar feedback form. It's really something we use extensively to help us shape future webinars. Please also sign up for our newsletters if you're interested in hearing about upcoming webinars around electric vehicles and electrification. Visit our website and with that, I'm going to close today's call and turn it back over to the operator.