CONNECTICUT DEPARTMENT OF ENERGY &
ENVIRONMENTAL PROTECTION

AN ELECTRIC VEHICLE ROADMAP FOR CONNECTICUT
TECHNICAL MEETING

Technical Meeting held at the DEEP Headquarters, Gina McCarthy Auditorium, 79 Elm Street, Hartford, Connecticut, on Friday, February 8, 2019, beginning at 9:03 a.m.

KATHERINE S. DYKES, Commissioner, DEEP
TRACY BABBIDGE, Bureau Chief, Bureau of Air Management, DEEP

Moderators:
PEGGY DIAZ, ESQ.
PAUL FARRELL
KERI ENRIGHT-KATO
LAUREN SAVIDGE, ESQ.

A p p e a r a n c e s:
Panel 1:
KATHY M. KINSEY, NESCAUM (Present by telephone)
NANCY RYAN, Energy and Environmental Economics, Inc.
THOMAS ASHLEY, Greenlots

Panel 2:
BRETT WILLIAMS, Center for Sustainable Energy (Present by telephone)
JULIA REGE, Association of Global Automakers, Inc. (Present by telephone)
JAMES T. FLEMING, CT Automotive Retailers Association
PATRICK BROWN, The Hartford

Panel 3:
DANA LOWELL, M.J. Bradley & Associates LLC
CHARLOTTE ANCEL, Eversource Energy
KEVIN GEORGE MILLER, ChargePoint

Panel 4:
CHRIS NELDER, Rocky Mountain Institute
WATSON COLLINS, Electric Power Research Institute
RICK ROSA, The United Illuminating Company

KERI ENRIGHT-KATO: Good morning. So thank you, everyone, for attending the technical meeting of the EV Roadmap. We have a pretty packed agenda. I'll go over some logistics in a little bit. Commissioner Dykes is here to provide some opening remarks. So I'll just let us get right to that and then get to the agenda.

Just really quickly, if you haven't heard, the restrooms are through the hallway past the elevators, if you do need them.

With that, I'll turn it over to Commissioner Dykes.

COMMISSIONER DYKES: Thank you, Keri, and thank you, everyone, for being here today. I'm just terrifically excited to see a great crowd and a lot of engagement on this important issue. We've made a lot of progress over the past couple of years here in Connecticut in reducing our carbon emissions and other pollutants from the electric generating sector, and I think that I see in these years ahead here at DEEP a real opportunity in working with all of you in this room to help make sure that we can get on track to start achieving similar levels of reductions in the transportation sector.

Having come from the Public Utilities Regulatory Authority and spending a couple of years as a commissioner over there, I know that the work that DEEP is doing on this Electric Vehicle Roadmap is going to be really, really important to intersect with the activities that PURA has underway with respect to grid modernization and thinking about rate design issues and how the utilities could be planning for the integration of electric vehicles.

This EV Roadmap, I just want to really commend our staff, Keri Enright-Kato, who you'll be hearing from in more detail in just a moment, for helping to put this process together. DEEP is taking a multi-pronged approach to reducing transportation energy consumption and harmful emissions, and we have within our air bureau obviously a tremendous history of working to reduce pollutants from the transportation sector. And so this EV Roadmap really brings together the combined mission of our energy and environmental protection agency to lay out exactly what the issues are and what the building blocks of an ambitious policy look like, and importantly, having a process where we can hear from

stakeholders and engage the best ideas and models that you can bring to us, whether it's from your own industry or advocacy or examples from other states, or ideas that we can pioneer for the first time here in the State of Connecticut.

So this is intended to be a very interactive process, a very interactive day, and I know that we're going to have a lot of great panelists joining us, but we really want this roadmap to be one that works for the State of Connecticut and works for our ratepayers, works for customers, fleet owners here in the state.

You know, this vehicle electrification is just one solution in our broader suite of activities that we need to take on in order to meet our ambitious carbon reduction goals, and the EV Roadmap is just one strategy within that solution. Obviously, there are many other elements to reducing carbon emissions and other criteria of pollutants cost effectively and effectively from the transportation sector, and this includes smart growth planning, transit oriented development, and clean and active transportation options and innovative partnerships. These all play a role in advancing

the state's energy and environmental goals.

And I just wanted to also stress as a new aspiring commissioner coming into this department the importance that equity must play in the success of any policies in the transportation sector. And so, you know, we're really focused on ensuring that we find solutions that support equal access and equal participation and benefit from clean transportation for everyone.

So I'm really excited, actually, in addition to the agenda that we have today, to also announce to you what we're releasing today. We've issued a letter to the two distribution utilities, United Illuminating and Eversource, requesting that they will submit to DEEP under Public Act 15-5 pilot proposals to demonstrate different options for integrating electrification of public transit here in the State of Connecticut.

I think folks are aware a couple of months ago that DEEP was able to award some dollars from the VW settlement onto our department of transportation to support the electrification of more than a dozen buses in the State of Connecticut. And we don't want to just stop there. What we're hoping to do with this request

to the utilities is to ensure that in this process where DOT is going to be pursuing the electrification of these public transit vehicles that we can use this as a learning opportunity to assess how the utilities can most integrate these buses onto the distribution grid in the most cost beneficial manner.

So we're going to be asking the utilities to bring to us different options looking at whether it's installing distributed energy resources, onsite generation, paired with the charging infrastructure, and how that might optimize for the impacts of the charging on the grid, thinking about other types of demand response or demand reduction options that could be paired with the charging. We're going to be interested to see different rate design options that the utilities might propose. Again, recognizing that if we're going to make progress in this sector, to make it easy for fleet owners to consider conversion to electric vehicles that we need to understand both how to make this attractive for those fleet owners, those customers to switch to this new type of fuel, as well as minimize the impacts of this electrification on

the costs of operating the distribution grid.

So we're really excited to be sort of getting even more benefit from these VW dollars by not only assisting DOT in the electrification of these buses, but using this as a pilot that we can examine the best options for integration of those buses so that we can learn more and hopefully endorse a model that could be scaled up and made available for all types of fleet owners across the state. So we're thrilled to be requesting this from the utilities.

And I will stress that we hope to make this a very open and participatory process. So stay tuned, as we expect we'll have technical meetings and other things of that sort. We want to hear from third-party providers who may be able to assist with the integration of these vehicles and work with the utilities and with DOT. So just look for that. But I just stress that because, you know, electrification of public transit obviously provides many, many different benefits, not just in terms of reducing carbon emissions, but also in terms of assisting with reducing criteria pollutants in air pollution in very vulnerable communities in our urban areas. And

so, again, from the spirit focused on equity and equitable participation, I'm just personally really excited that this is an early part of our progress on vehicle electrification in the State of Connecticut.

So with that, I'm excited for this agenda, and I don't want to hold it up anymore. I'll turn it over Keri Kato and look forward to hearing the discussions today. Thanks, everyone, for being here.

(Applause.)

KERI ENRIGHT-KATO: Thank you, Commissioner Dykes. So let's go ahead. Here we go. So I'll just quickly walk through the agenda for folks. As a reminder, there are a few hand-outs -- or a hand-out of the agenda that I'll just walk through real quick.

So we'll have four panels today, one break on either side of lunch, and wrap up around 4:10. So hopefully if you're in and out through the day, that's absolutely fine, if you're here throughout the day. We'll break for lunch around 12:30.

So I mentioned restrooms already. I would encourage you to put your cell phones on

silent, if you can. And then at lunch we'll go ahead and break, and there's lunch in the park. I know it's raining out. But there are carts, and there's some locations across the park that you can get lunch.

So for those of you who are new to the EV Roadmap process, here's a quick overview of its purpose. We called for it in our 2018 Comprehensive Energy Strategy, so we're delivering on that recommendation. It's intended to outline a 2030 vision, but focus on near-term objectives to support the deployment of increasing number of light-duty ZEVs in order to ensure meeting our air quality and climate goals.

And it will help inform the parameters for what we may consider when soliciting and developing strategies for the EV infrastructure deployment proposals under the VW NOx Mitigation Grant.

And this slide probably looks familiar if you came to the scoping meeting. But as a reminder, here's our approximate timeline for the EV Roadmap process. We held a scoping meeting in December and took comments. And today is the DEEP technical meeting that we said that we would do.

And I'll just point out that we are taking comments on the technical meeting. They're due February 21st. I've listed the email address you can send them to, or you can go into the energy filings page and post them there as well. These slides will be available on our web site, so don't worry about writing down the email address. We'll get those posted so you know where to send it.

And then we plan to issue a draft EV Roadmap in the late March to April time frame, hold another hearing, public comment period, as well as written comments as well. And then we hope to issue the final in the May to June time frame.

So the next set of slides are simply to provide you with a little bit of context on both the recommendations made in our Comprehensive Energy Strategy and our Greenhouse Gas Reduction Strategies. So as shown in this slide in this pie chart, the largest source of emissions for Connecticut economy wide is the transportation sector making up about 38 percent. Transportation sector emissions are generated primarily from the use of fossil fuels in passenger cars and

light-duty trucks. We've seen a small decline since 2001, but they mostly remain static.

So taking a closer look at the Comprehensive Energy Strategy, I'll highlight strategies number 5 and 6 which are to reduce transportation greenhouse emissions. We should accelerate the adoption of low and zero-carbon vehicles, and strengthen alternative fueling infrastructure across the state. So this led to the specific recommendation to develop an EV Roadmap that includes a review of sustainable incentive funding models and, in collaboration with PURA, examines the appropriate regulatory framework for EV deployment in Connecticut. So this is a guiding principle or purpose of the EV Roadmap.

The other transportation-related recommendation was to increase mobility, connectivity, and accessibility by advancing smart-growth, mixed-use, transit-oriented development, along with the use of innovative transportation partnerships. So as the Commissioner mentioned previously, the EV Roadmap is really looking only at one solution right now while we're doing other things to look at the

other pieces of the puzzle or other slices of the pie that will help us reduce emissions in the transportation sector.

So we believe these two recommendations emphasize a holistic and equitable approach to reducing transportation energy consumption and emissions reductions. So it's critical that our efforts enable clean and affordable transportation options for all.

So looking at our GHG emission reduction targets, so hopefully you're aware that we do have some statutory obligations to reduce emissions. And this slide represents our Global Warming Solutions Act which is at 10 below 1990 levels by 2020, and 80 percent below 2001 levels by 2050. And this past year we passed Public Act 18-82 to set a midterm target of 45 percent below 2001 levels by 2030. So, as you can see, this is a pretty quickly declining pathway to hit that 2050 target so where the reductions need to come from.

So over the last few years the Governor's Council on Climate Change has been doing a pathways analysis to understand where the emissions will come from to hit that 2050 target.

It also guided our recommendation for the midterm target. And clearly we need emissions across all -- emission reductions across all sectors. We know that we need to, one, generate electricity primarily from renewable sources; two, electrify our transportation sector; and three, improve the efficiency of our buildings coupled with the deployment of renewable energy technologies. But today we're talking about transportation, so I'll just focus -- I circled the transportation sector wedges.

And taking a closer look at that, we know that passenger light-duty vehicles or trucks electrification is just one of those wedges. Electrification of clean fuels of heavy-duty and long haul trucks and rail is also necessary, along with reducing vehicle miles traveled.

So this past December after completing the pathways analysis, the GC3 released its report, Building a Low Carbon Future for Connecticut, achieving a 45 percent reduction by 2030. So if you haven't seen the report, it is online. There's an executive summary, so a shorter version of it. And it provides high-level recommendations and a suite of strategies to put

us on a downward trajectory to achieve the midterm target of 45 percent below 2001 levels by 2030. So if you haven't seen it, I encourage you to take a look. For today I'm going to take a closer look and focus on the transportation sector recommendations in that report.

So based on the pathways analysis, we know we need to reduce transportation sector emissions 29 percent from 2014 levels. Thus, high level transportation sector recommendations include maintain increasing fuel economy and low and zero emission standards, so pushing back against the federal rollbacks, maintaining the CAFE standards, and the California standards. Increasing light-duty zero emission vehicle penetration rates at least 20 percent by 2030. Advancing initiatives that eliminate the rate of annual vehicle miles traveled growth by 2030. And developing sustainable funding for transportation electrification and transportation infrastructure.

So while the EV roadmap for Connecticut is primarily focused on the development of ZEVs, this effort represents only one of the strategies to decarbonize the transportation sector. The multi-pronged approach that includes smart-growth

planning, transit-oriented development, and clean and active transportation options and innovative partnerships is absolutely necessary.

I think it's also important to highlight the implementation of these strategies must include approaches that are the equitable, affordable, and enhance access for low to moderate-income families. And while today's panels are focused on vehicle electrification, we specifically ask panelists to speak to how we can ensure equitable solutions.

So with that, I will go ahead and turn the mic over to my colleague, Paul Farrell, who will talk a little bit more about the Connecticut ZEV initiatives to date and setting the stage for our panel discussions.

PAUL FARRELL: Thanks, Keri. Thanks, everyone, for coming out today. My name is Paul Farrell. I'm the assistant director of air planning in the bureau of air management, go figure. And I'm here to provide you with sort of long-term perspective on why we should have EVs in Connecticut in the first place.

So since I'm the air head here, I'm going to talk about air pollution, and the first

thing is NOx. So NOx is a component of urban smog. It's a pretty significant component. And in Connecticut, since we've done such a wonderful job controlling air pollution from our stationary sources, that means the slice of pie attributable to the mobile sources has only gotten bigger, and at this point it's pushing 70 percent, which is not a small number. Compounding the fact we do not currently comply with both National Air Quantity Standards for ozone and for urban smog. So you can see all of Connecticut does currently not meet the standards for both the 2008 and 2015 Ozone National Ambient Air Quality Standards. That's a significant and pressing need and public health concern that we have here.

One of the other cool things I do at my job is that not only do I deal with policy but I also deal with monitoring, so all the equipment out there that tells us all these numbers. And we also do a lot of modeling, too, to get these values that we look at. One of the cool things we found out this summer is that there's actually a satellite that passes over Connecticut every day that looks at NOx emissions. This is from February 4th at 1:30 in the afternoon, and these

are NOx levels. Now, this is not to say these are unhealthy levels of NOx, but this is NOx relative to the air pollutants in the atmosphere. And if you notice, the transportation corridor on 95 to 91 up to Springfield and even further, a little correlation there, wouldn't you think? So from a policy and a technical perspective, electrification of transportation really makes a lot of sense.

So what are the drivers for EVs in Connecticut? First and foremost, if you ask me since this is my program, is the regulatory driver. We've adopted the California tailpipe emission standards in Connecticut. This requires the auto manufacturers to make cleaner cars.

Raise your hand if you think the OEMs are building EVs out of the goodness of their hearts. No hands. Okay.

So under the Clean Air Act, Section 177, Connecticut has adopted California's program. So that means a couple of things: We can only adopt California's program. We can't change it. We can't fuddle with it. We can't require greater numbers than they require in California. On top of that, though, we know that do need more. Keri

made that very abundantly clear, what we are looking at is not going to be sufficient. So we're working in partnership with our regional partners. We've adopted a multi-state ZEV MOU. Eight states back in 2013 took the effort to put 3.3 million EVs on the road by 2025, a big number compared to the regulatory standards that we were looking at at the time, probably even bigger. And Keri also mentioned about the statutory drivers that we have in Connecticut as well. So I'm going to touch on the first two.

So the ZEV program itself is really one part of a bigger program that drives cleaner transportation choices in Connecticut. I'm not going to go into the first two, the LEV GHG thing, if you guys are following the national news, could be a presentation by itself, a lot of drama going on there. The LEV criteria improvements, cars are getting cleaner and a lot cleaner than they have been. We're looking at 73 percent cleaner than 2004 standards which were remarkably cleaner than the 1990 standards by 2025.

So ZEV, how it works really the goal is to push OEMs and push the technology and get it to commercialization quicker. So it's driven by a

certain percentage, not a big deal with some of the things you all hear today, battery electric vehicles, transitional zero emission vehicles, plug-in hybrid vehicles are very popular, fuel cell vehicles are starting to come out as well.

This is just going to be the sort of regulatory driver. These are the numbers that the OEMs care about. These are the numbers that they're going to pegged for for compliance. So the numbers that we're seeing for what we need versus what they're looking at for compliance, there's a big gap there. So you've got to keep that in mind too. So the policies that we put in place at the state level are going to be really important in bridging that gap from a regulatory requirement to what we need for our GHG reductions.

So it's a pretty complicated program. Really why it works great for manufacturers, there's a web-based compliance platform. They get to report credits. It's a credit-based system. That's important to keep in mind. There's trading, there's banking. The credits are generated based on type of technology, how big the cars are, how big the batteries are, how far they

go on a charge. So all that goes to generating additional credit that they can then use for future compliance. It also serves to drive down the numbers that they need to put in service to meet their compliance requirements.

And these are some of the numbers if you want to compare them to the previous ones, what we really need to get our GHG targets. And when these slides are posted, you can toggle back and forth and look at the difference, and they're pretty significant.

So a few words on the ZEV MOUs. This is driving a lot of the work right now. It's really looking at the states getting together and adopting complimentary strategies outside the regulatory drivers to promote ZEVs and EVs in their respective states. We know that we need to work together, but we also recognize that we are actually competing against each other for these vehicles. Because it's such a credit-based system, and there's regional pooling, and we're not counting vehicles as they come into the state, we're actually in the mode where we are competing against our neighboring states to get EVs delivered here. So that's why some of these

policies that we're talking about looking to build on are so important for Connecticut.

Part of that multi-state ZEV MOU is the development of an action plan, and that was refreshed last year. This is available at NESCAUM, the New England States for Coordinated Air Use Management's web site. So I definitely recommend that you take a look through this to inform your comments to Connecticut. These are some of the strategies that we've been looking at and that we think are important to pursue. Among them, consumer education and outreach, looking at EV and hydrogen fueling infrastructure, consumer purchase incentives -- there's going to be a whole panel on that today -- light-duty fleets, and working with dealerships. We recognize that dealerships are incredibly important partners in getting more EVs on the road, especially at levels beyond what we need.

NESCAUM also worked on the EV charging infrastructure strategy for the corridor for the northeast. This is important as well. These are going to touch upon some of the electricity issues that you're going to hear about today too, such as rates, interoperability, signage for charging

infrastructure, the rules and priorities that states are going to have with this, you know, where should we prioritize. Again, for DEEP and for our part under the VW settlement, we've reserved 15 percent of that money for EV infrastructure in Connecticut. A lot of what you tell us is going to inform our thinking along those lines as well.

Consumer education outreach. This is a great program. Drive Change Drive Electric, it's cutting edge. I've never seen anything like it in all my time in government. Public/private partnership with the auto manufacturers and states got together to create a whole consumer education outreach process. Right now it's mostly soft. You're going to see it, internet, Facebook, that sort of thing, Instagram advertising. We're looking through the second phase beginning -- which we're planning this year to really try to push the message even further. So stay tuned for this one. This is going to be developing as time goes on.

But this isn't all Connecticut has done. We've also worked on EV charging station grants. This is a little bit of history. We've

allocated a significant portion of some monies and we developed a bunch of charging stations in Connecticut mostly focused on municipalities. So what we've done then is put out over 300 public charging stations and 782 total plugs broken out between those.

Here's a map of what it looks like in Connecticut now. Again, kind of where we need them, along the coast, along the transportation corridors. You'll notice there are some underserved areas. That's really something we should look at.

CHEAPR. This is the consumer incentive program that we've had in Connecticut since 2015, the first one in the nation to offer point of purchase rebates for electric vehicles. So some of the eligible vehicles -- I'm sorry, the significant limitations on the program is the vehicle has be under $50,000, and it must be highway capable. So speaking to Commissioner Dykes really focus on making sure these programs are equitable and available for everyone, and Brett Williams, who's going to be on the panel later today, is going to speak to this in more detail, we feel that in Connecticut by limiting

that value there to $50,000 is really shifting the whole market, the new car market and where people are buying new cars, a little bit to the left, a little bit, you know, much lower than that luxury market. Actually, we're finding that most of the EVs rebated under CHEAPR are $40,000 or less.

These are some of the vehicles and some of the numbers that we've seen in Connecticut. So as of late, the Tesla Model 3 has been very successful in Connecticut, the Chevy Bolt has been very successful, and the Nissan LEAF. Those are the full battery electrics and the plug-in hybrids.

A little graphic of when we started CHEAPR. Launch CHEAPR in the middle of 2015, and EV sales in Connecticut since then broken out by some of the more popular models that we see. And we really do see spikes when new popular models hit the market. A lot of this information is available on our evconnecticut.com website. In addition to CHEAPR, we also post ride and drive events. We've done half a dozen of these, maybe more, throughout the years to try to get people behind the wheel. People don't know what they don't know. And not having ever driven an EV --

actually a survey: How many people in this room have not ever driven an EV? A couple hands. All right. For this crowd, I would have expected 100 percent.

Outside here it's a lot less, I'll tell you that. And the primary goal, and this again people that have no experience with an EV behind the wheel, get to see actually how fun and snappy they are. It's successful. Tracking, I haven't seen data lately with the new sales that comes from these events. It's pretty good.

It's not all about electricity. I see Joel Reingold out there. We're working on hydrogen too. And I want to make sure Joel is very aware of that. I know he is. So there's two efforts going on here. There's the Toyota Air Liquide effort going on. They're looking at basically a hydrogen corridor through the northeast. Hydrogen vehicles are part of the solution to our climate needs, probably the longer term solution, but they do offer, I would say, an experience more similar to what we are familiar with gasoline engines. You pull up to a station, you plug in, you fuel in five or ten minutes, you're good for 300, 400 miles.

After that there's some details on why hydrogen is good. We're still working on a hydrogen fueling station grant in Connecticut. Stay tuned. We're looking at a -- our area of focus right now is in the I-91, I-95 corridor. There is a hydrogen station being put in Hartford, so we're looking at, at least there that would create a linkage for interstate transportation fuel cell vehicles through Connecticut in the next couple of years.

Now, Volkswagen and Electrify America, there's a lot going on there. There's a lot of I'll call it quasi-private investment if you're talking about Electrify America because they did sort of do some bad stuff that made them have to spend all this money on electric vehicle charging infrastructure. Hey, who am I to judge? The result is going to be good on this. They're looking at $300 million plans.

So cycle 1, the first 30-month plan, they put out -- or they're looking at installing 2,500 chargers at 450 sites in 38 states. That's a lot of work. That's pretty much doing what Tesla did in 25 percent of the time. So incredibly resource intensive efforts. The good

news is we do have two in Connecticut down in Stratford and in Waterford with combined 14 outlets up in -- and these are pretty big, 150 to 350 kW, so those are fast chargers, and they have one coming in Wallingford, Connecticut pretty shortly.

Cycle 2, it just released February 4th. I have to say I haven't read it yet. But their focus is sort of the same, sort of expanding a little bit different. So they're still looking at spending 235 million on ZEV infrastructure, but they're also doing ZEV education, awareness and marketing, so reaching out to folks that don't know what they don't know. And that's what we're finding is an incredibly important part of doing what we're doing here.

Cycle 3, we don't know what their deadline is yet, but that's going to be the next bridge we cross with Electrify America.

VW, and what Connecticut is doing with that. Our allocation is about $56 million. We have a ten-year disbursement schedule. We did our first allocation of about $12 million last fall. Commissioner Dykes mentioned that the Department of Transportation was getting money for a dozen

electric transit buses. That was about $5 million of that 12 million, and that includes infrastructure. We're also doing two fully electric shuttle buses for UCONN.

So that's just a funding allocation of our VW money so you know where it's going.

Eligible equipment, it does include fuel cell equipment as well and energy fueling stations.

Information on our grants. And again, it's about air pollution. So the important thing to realize about the VW diesel mitigation grant is that's a diesel mitigation grant. So we would like to spend more on electrification, but we're limited by the federal consent decree, so a lot of these projects that we've seen and funded, while they're replacements of diesel for diesel, it's much cleaner diesels for all of the diesels that are being taken out of service. And we're also really just responding to projects that are -- but there were some additional ones. There were 17 CNG refuse trucks, so diesel refuse trucks, CNG refuse trucks that would be operated in urban environments, I think, in Hartford and Waterbury.

All our VW information is posted. It's

public. Everything we get we put up there, so have at it. If you're looking for something and you don't see, email us, we'll get it to you.

With that, I don't know that we're going to jump into questions, but that's just my presentation.

(Applause.)

KERI ENRIGHT-KATO: Great. Thanks, Paul.

We'll go ahead and move right into the first panel. So if I could have the panelists for panel one come up, that would be fabulous.

I will just let folks in the audience know we do have a few people participating remotely. So we have them on the phone and participating in our webinar. So I will set up Kathy Kinsey.

PEGGY DIAZ: Good morning, everyone. Thank you for joining us. My name is Peggy Diaz. I'm in the legal office here at DEEP. And I'd like to introduce our panelists. Joining us today, we've got Dr. Nancy Ryan. She's a partner at Energy and Environmental Economics, E3, where she leads the electric transportation practice area. She advises utilities, regulators, OEMs,

fleet owners, and technology companies on economics, strategy and policy around transport electrification. She's an economist with over two decades of experience. Dr. Ryan previously held several high-level appointed positions with the California Public Utilities Commission, including serving as a commissioner from 2010 to 2011. She was a senior economist at the Environmental Defense Fund from 2001 through 2005, and taught applied economics at UC Berkeley's Goldman School of Public Policy from '96 to 2007.

Kathy Kinsey is joining us on the phone. She's a senior policy advisor with the Northeast State of Coordinated Air Use Management, NESCAUM, where her work is focused on electric vehicle initiatives and implementation of the Multi-state Zero Emission Vehicle Action Plan developed by California and eight other states that have adopted the ZEV mandate. Prior to joining NESCAUM, in 2015 she served as the deputy counsel, senior policy advisor, and deputy secretary for the regulatory programs and operations with the Maryland Department of Environment. She worked there for more than two decades on a broad range of environmental, permit

enforcement, regulatory policy, and collaborative multi-state initiatives.

And lastly but not least, joining our group is Tom Ashley. He is the president of policy for Greenlots. He leads the company's policy, regulatory, and government affairs strategy and engagement with a focus on growing the electric vehicle and electric vehicle charging markets. Tom has extensive experience in clean energy and transportation policy and planning. Prior to joining Greenlots, he served as the director of utility and regulatory affairs at Plug Share where he focused on the policy frameworks necessary for vehicle grid integration. He's consulted for Electric Drive Transportation Association and worked for numerous government bodies, including the US Senate Committee on Environment and Public Works, the Office of Energy and Environmental Industries for the US Department of Commerce's International Trade Administration, as well as with the Vermont Department of Public Service Energy Efficiency Division, and the California Public Utilities Commission.

So thank you to our panelists for joining us today. We have a few presentations.

Do we want to start with Kathy or --
KERI ENRIGHT-KATO: Kathy, can you hear us?
KATHY KINSEY: Yes, I can hear you. Can you hear me?
KERI ENRIGHT-KATO: Yes. Can you share your screen now?
KATHY KINSEY: I sure can try. Let's see, can everybody see my screen?
KERI ENRIGHT-KATO: Yes, it's perfect. So go ahead.
KATHY KINSEY: Great. Thanks. Thank you, Peggy, for that introduction, and good morning, everyone.
The multi-state ZEV action plan that Paul mentioned has been a really important part of our work on transportation electrification, but today I really would like to talk about a separate effort that NESCAUM recently facilitated with a broader group of 12 northeast corridor states from Virginia to Maine and the District of Columbia. And the effort was to develop a strategic regional EV charging infrastructure plan for the northeast corridor. Paul mentioned it in his remarks a little earlier. So I'm going to provide a

high-level overview of the strategic plan and talk a little bit about some of the overarching infrastructure issues that the plan identifies and that the northeast corridor states have initially focused their attention on.

So this is a regional approach, which makes a lot of sense, we think, for the northeast corridor. The northeast states are for the most part comparably small. They are located in close proximity to each other. This is a really densely-populated region of the country, as you know, and there's a lot of interstate and regional travel for both work and pleasure throughout the entire northeast corridor. So its EV drivers in the northeast have the benefit of a well-planned regional charging network that offers a convenient and seamless charging experience. It's built consumer confidence in the technology itself which hopefully leads to some accelerated EV adoption.

So given the significant additional infrastructure funding that's coming into the region now, both from the VW settlement, from Electrify America, as well as the states, and the utilities programs that are being proposed and approved throughout the northeast region. The

region really benefits from a coherent investment strategy that promotes the coordinated and complimentary public and private investments.

So this strategy was developed by steering committee representatives in each of the participating jurisdictions. And what it does is it basically provides investment and policy guidance and direction to public and private investors to facilitate regional coordination on infrastructure buildout and policy issues.

So the plan was finalized last May and it does three things: First, it identifies priorities for primary charging use cases: Charging at home, workplace charging, charging around town, on the road, destination locations. Second, it makes recommendations for investments by the key public and private investors, which you see here on your screen. And then finally, it makes recommendations to address 13 overarching infrastructure issues that range from interoperability to broadening access to clean mobility options for disadvantaged and low-income communities.

So three of the key infrastructure investors today are the states, obviously, EVSE

providers, and in particular Electrify America as part of that group, and the utilities. So in terms of investment roles on the part of the steering committee, there was general consensus that EVSE providers, in particular, Electrify America, should be focusing their investments on public DC fast charge deployment along travel corridors and at community sort of strategically located community charging hubs, and some other key public locations, like airports and train stations, transit centers. The strategy recommends the states focus their resources on workplace charging, on Level 2 public charging, and also filling in DC fast charge gaps along travel corridors.

Utilities, the states felt, are particularly well suited to tackle some of the more challenging underserved communities, like multi-unit dwellings, also workplace charging, investment at transit related locations, and utilities also, I think, have a really important role to play in outreach, consumer outreach and education, and of course establish a rate design which we'll hear about later on in the day.

So that's all I'm going to say at this

point about investment recommendations. There's a lot of detail in the report. It's available on NESCAUM's web site for people who are interested in digging a little deeper.

So many of the 13 overarching infrastructure issues that the plan identifies, and some that were actually not explicitly identified in the plan, are issues that have a direct impact on the consumers' public charging experience, and that is what the northeast corridor steering committee has really been focused on in recent months. So the strategic plan makes some high-level recommendations on many of these topics, and the steering committee has been engaging in some pretty informative discussions on these consumer use issues since the fall.

And last fall in September and October NESCAUM partnered with Plug In America on a series of informational webinars for the state, and then we held a two-day workshop with major EVSE providers in November. And I should be clear at this point that none of the recommendations in the plan, including those overarching issues that group talked about, are binding on the state. I

mean, these are simply that. They're recommendations. But that said, the states are trying, to the extent possible, to develop a regional consensus on an approach to these issues as an initial step for state grants and procurement contracts.

So I'm going to touch briefly on some of these key consumer use issues. So interoperability is a very broad term that is often used to refer to a number of different aspects of charging station operation. And one of the reasons why it's so important is because it can affect consumer access to charging stations that are actually outside of the network that consumer might belong to.

We don't want consumer access to charging infrastructure to be conditioned on network membership, but we do want to promote EV convenient billing that doesn't require consumers to carry multiple RFID cards around in their pocket in order to be able to charge at a station that's outside the consumer's network. And we also want charging station owners to be able to change network providers without having to actually change the hardware.

So I will say that there are others in the room, like Tom Ashley, who has a lot more expertise on this subject than I have, and that's all I'm going to say about it except to mention that the strategic plan for its part does recommend two things on interoperability. One, that states require publicly-funded charging stations for public use be open to all drivers regardless of network membership or subscription fee. And two, that the states convene a multi-state workgroup to consider other aspects of interoperability and a range of issues and make some policy recommendations to the state for consideration and potential implementation. So that work with the workgroup is just getting underway now.

So there are a number of different ways that consumers can pay for charging, and I think the important public policy goal here is to promote universal consumer access, again, by ensuring that consumers can pay for charging at stations with one or more, you know, commonly used payment methods. So credit and debit cards are one example, obviously, smart phone apps are another, a credit card 800 number is yet another.

And I think everyone agrees on this concept, but not necessarily on what payment method, if any, should be required by the state. So the question of whether states in the context of their grant and procurement contracts should mandate one or more payment methods for public chargers is one that the steering committee is currently considering.

Physical accessibility as opposed to consumer access, billing access, and payment access was not an issue that was explicitly identified in the strategic plan, but the steering committee is considering this issue as well. The question is, you know, should states require publicly-funded charging stations to meet accessibility standards. So should they be accessible to drivers 24 hours a day, seven days a week in all circumstances? If not, under what circumstance is that appropriate? What about stations that are serving heavily-traveled highways, corridors, should they be treated differently than other public charging? Should Level 2 be considered differently? So there's a number of different questions around this issue.

Maximizing charger uptime is really

important to build consumer confidence. I'm not sure that there's a lot of good data out there, but there's certainly some anecdotal evidence about operational problems at existing charging stations. This is pretty much an acknowledged problem. So the strategic plan recommends states and other investors -- I hope you're not seeing this on my screen -- it's gone -- states and other investors who are installing charging stations establish some very clear maintenance and repair responsibilities and obligations. That includes like posting service contact, you know, consumer service information, considering the installation of multiple stations at each site as a matter of policy so you have redundancy in case you do have operational problems. You will at least minimize the risk of stranding drivers. And also consider requiring the EVSP provider to make some real-time information on the operational status of charging stations available to drivers through smart phone apps.

So one question is whether the state should actually set requirements or goals for publicly funding charging stations and, you know, basically require them to be operational for a

defined percentage of time. And if so, you know, what would a reasonable time requirement be, and would it be different for DC fast chargers versus Level 2 or in different sites or different circumstances?

Pricing transparency. When you put gas in your car, for the most part, you usually know what you're getting, and you know how much it cost, but that's not necessarily the case with EV charging stations. Pricing information is not always clearly disclosed, and units of sale can vary. You could be charged based on the kilowatt hours, you could be charged a particular unit of time like pay by the minute, or there could be a flat fee, or there even could be additional fees associated with the charging station. So for that reason, the strategic plan recommends that pricing information be clearly and conspicuously displayed in advance of any sale of electricity. And this can be done, you know, in a number of different ways. It could be done by through a display screen or stations with a smart phone app, or maybe an 800 number for consumers who don't have smart phone apps.

So I'm going to end there. And I'm

happy to take questions after the other panelists have completed their presentations. And thank you very much.

PEGGY DIAZ: Thank you, Kathy.

All right. We'll move on to Tom.

THOMAS ASHLEY: Good morning. So I just have a couple of slides on interoperability because frankly interoperability can be really challenging to map out and think about and not conflate all of the different parts of the interoperability ecosystem. So I'm going to talk about that a little bit, and then I'm going to sit back down and be available to offer a perspective on a number of additional topics.

So first of all, these are the way that Greenlots speaks about some of these topics. So these are -- this is a little key to these terms. So we've been advocates for open standards or protocols for a long time, including helping found the Open Charge Alliance, which has been the body that has really supported the industry in moving forward on hardware/software interoperability.

So we talked about open access. Kathy talked about it quite a lot. Open access is a pretty big umbrella, and it really just speaks to

the ability of drivers to access charging. So whether it's, you know, they need support for ADA, they need to be able to access it with some sort of payment methodology, they need to be able to literally find it out there. And, you know, also, frankly, I mean, this can be something of an umbrella term also speaking to what I think we would generally understand as range anxiety or frankly lack of charging infrastructure. So if there's a lack of charging infrastructure, you don't have very good access. But one of the big pieces here, and Kevin at ChargePoint is going to speak to this a little bit later, Kathy talked a little bit about networking operability. And I'll talk about that in a moment.

And then just straight interoperability. Greenlots really has focused this terminology on what I'll show you on the next screen as sort of the core of this ecosystem which is, again, how hardware and software can communicate with each other and create an ecosystem where an owner/operator of the charging infrastructure has a lot of flexibility going forward about software systems, networks, so they can switch, and then can also bring in additional

hardware. So there's a lot of flexibility there.

Okay. So this is a relatively simple graphic of the interoperability ecosystem. I don't know if there's -- so this is sort of the center point that Greenlots tends to focus on. So that is the communication between the hardware and software, and that flexibility that I just mentioned that that brings. We really think this is sort of the core of planning charging infrastructure deployment is making sure that there's flexibility going forward for how you communicate with it, how you can add and scale infrastructure deployment programs, et cetera. But there are a lot of other pieces. So a couple I'll touch on.

So I'm going to talk -- well, I'll talk now about sort of driver roaming and network interoperability. So this is a big piece of policy. Kathy talked about it in the context of NESCAUM with the northeast states. And we have seen a number of sort of strong signals from the market over the last year. ChargePoint and Greenlots announced, I think it was December, that we signed an agreement for driver roaming across our networks. We saw earlier announcements

between ChargePoint and EVBox, also ChargePoint and AddEnergie or FLO. And I think we're going to see a number more. We may not blanket the entire industry, but this is a big change. The market was really sort of unwilling to support this, and part of that is because there's really still not a clear business model out there for -- well, for existing in this charging space. And so there's been a real sort of commercial disinterest in potentially giving up some level of data or future commercial opportunity. However, all the signals from the regulators, policymakers, stakeholders have been very clear that this is a topic that must be addressed, and so we in the industry have begun to address it. And I think that this region is really -- we're going to see this be something of the epicenter for the deployment of driver roaming or network interoperability, and we're very excited to see that.

There are a lot of -- there are a number of different methodologies. So I put OCPI here, which is the core communication protocol that is at the heart of the major announcements over this past year, but there are other network or billing interoperability communication

methodologies, and then there's also a clearing house model. Some of you may have heard of Hubject. That is one of three models in Europe. We haven't yet seen adoption here in the US, but we will likely at some point, certainly as more and more sort of smaller networks are coming out.

So I also wanted to talk just quickly about a couple other pieces. So I didn't put it here, but the main communication methodology that's coming up between the vehicle and the rest of the ecosystem is likely going to be based on ISO 15118, which is basically powerline communications between the vehicle and the rest of the system. And this all can get very wonky very quickly, but the short of it is we're kind of calling this plug and charge. So the idea going forward is that when vehicles and hardware/software are supporting ISO 15118, drivers will just have to plug in their car, and that is where the authentication happens of accounts, of payments, et cetera. But there are a number of other pieces here. Some are just the physical ports themselves. We have a number out there. And as heavy-duty vehicles are coming online, we may have a number more.

And let me just finish up over here. So as we're thinking about how to integrate all of this with the grid, I know we're going to hear a little bit more later about smart and managed charging, so ultimately the grid has to be able to communicate with this stuff and vice-versa. And so one of the major methodologies right now is OpenADR, which is a pretty standard demand response and additional communication methodology between utilities or grid operators and devices or systems on the grid. But as we're seeing sort of more things happening, integration of distributed energy resources, DERMS platforms, et cetera, there are a number of additional ways that that integration may occur. But OpenADR is sort of a core open standard.

So I also just wanted to note that there are different business models out there. There are different ways of thinking about all of these things. The market is clearly going towards interoperability pretty much across the board, but, again, that means a lot of different things. And, you know, I will offer it now. Feel free to call or email me if you have questions about these things. It can be complex, but if you're able to

sort of separate those different pieces, so hardware/software, vehicle to system, driver to system, and system to grid, I think it starts getting a little easier.

And one of the nice aspects I would just note again about OCPP is the latest version also supports ISO 15118, so it's a very clean communication of the system, but again, we may see additional methodologies going forward, and indeed we may see different business cases moving forward that drive different aspects or ways of thinking about interoperability.

So I'm sure that is more than anyone wanted to hear today about interoperability, and so I'm going to stop and sit down.

PEGGY DIAZ: Thank you. Nancy.

(Applause.)

NANCY RYAN: Good morning, everybody. And I'm very pleased to have the chance to join you today. I grew up in Connecticut. I went to college in Connecticut. And I live in California today and was a California regulator, part of the efforts to drive the market transformation in EVs, and very much appreciate that Connecticut and California are partners moving forward, and I'm

happy to participate today kind of in that spirit.

So I just want to make a few opening comments that I think will be helpful in framing the discussion in our panel, and then I want to get to the discussion. So reflecting on the presentation that Paul Farrell made earlier, I think it's really important to stress that what Connecticut and the other Section 177 states are looking to accomplish is a grand market transformation of personal mobility but also of public transit, and I think Paul didn't talk that much about it, although it was probably in his very comprehensive slides, also goods movement. So we're really looking at a very large-scale wholesale transformation of transportation with the need to do it in a really short time.

My company has done a lot of pathways analyses for states, and especially extensively for the State of California, and one of the things that's really stood out for me in that work is that the transformation of light-duty vehicles, so cars and light trucks, has to happen at a pace that's actually quite a bit faster than what's envisioned by the Zero Emission Vehicle program. So really the coming decade is a pivotal decade

where we see the market transformation realized by 2030 that EV battery electric vehicle and plug hybrid vehicle really become the dominant technology moving forward.

One thing that's very important to appreciate, and I'm sure if you take a look into the Connecticut pathways analysis, you'll see that this transformation on transportation is going to be occurring simultaneously with the wholesale transformation of electric generation. So at the same time that we have extensive electrification of the transportation system, and also many buildings, we're also seeing this progressive transition into -- and fairly rapid transition to a zero carbon generation system. Here in Connecticut that may include some nuclear power, but on the renewable front it's primarily going to be driven by solar power and offshore wind, and each of those technologies has distinctive patterns of diurnal and seasonal variability which have to be taken into account in the overall integrated resource planning process.

And one of the findings that we systematically see everywhere we go, even though the resource mix is different every state we've

looked at, is that the way to realize this overall transformation, low carbon transformation in the economy, is to ensure that we have deep integration between an increasingly electrified transportation sector and an increasingly low carbon generation sector. So what used to really be separate and distinct sectors, the power sector and transportation, really need to become closely integrated. And the vehicle to accomplish that is smart charging. So whether you do it by rates or by direct load control, like air conditioner cycling, or by demand response programs, some way to harness the latent flexibility in EV charging loads is a critical ingredient and, again, realizing that wholesale transformation in a cost effective way.

And why I bring that up now because I think it's a very important part of the equation that regulators need to solve. So I see that really regulators are in a position as they try to accomplish this wholesale market transformation while they're trying to make that as fast as possible, as equitable as possible, they have to balance that with another important consideration which is how to ensure competition and innovation.

So competition is important to lower prices to customers, and competition is also important to get all the different participants out there competing with each other for who's going to have the best and cheapest model to support customers' mobility needs in the charging network. So I think that's a key topic that we should return to in the course of this panel.

Obviously, regulators have to address other concerns as they try to balance market transformation with competition and innovation, you know, those include consumer protection to the extent that it's within a utility regulator's purview, as well as, of course, safety and reliability of the electric grid, and the reliability piece, again, brings us back to the smart charging piece.

Now, many states have looked at how they can accelerate adoption of electric vehicles, and for utility regulators that tends to center on what's the appropriate role for the utility to play in this transformation. And different states have kind of come down in different ways. Within my own State of California the state has come down all over the place in different parts of the state

dealing with our different utilities on what is the kind of appropriate division of investment, risk management and role in providing that charging ecosystem.

And there are two, I would say, dominant models. One is kind of full-on utility ownership from the point of interconnection right to where the charging cable plugs into the car, so the utility owns and operates the network. So that's been proposed by California utilities and adopted in some instances or adopted selectively. The other model, which will be familiar to some of you all from the state nextdoor, the make-ready model, where the utility is responsible for upgrading the service connection, and then in addition takes some responsibility to upgrade the customers facility to accommodate chargers, and then they also pay a rebate that partially underwrites the cost of the charging infrastructure. And typically a make-ready is associated with some of the obligations that Kathy Kinsey talked about in her presentation on interoperability and so on, and I think that's very sensible.

My observation about these different

models is that what they really come down to is different kind of ways that the regulator is putting structure on a fundamental partnership relationship, and I think it's really important to adopt that framing. So, you know, who are the partners? There's the utility, there's the EVSP, the EVSE, so the company that makes the charging station is in there. There's the host, there's the vehicle owner, and then the other part we haven't really talked about yet, but also the OEM, the automaker.

And what I see is kind of ideal characteristics in a partnership is that everybody has some skin in the game, so everybody is putting some dollars at risk, and that the roles are structured in a way that the different players are really managing risks that they have the best ability to manage. And closely linked to that is that we're not just leveraging their money, we're leveraging their intellectual capital, we're leveraging their data, so the things that they uniquely know, and the expertise that they've accumulated.

So, for example, EVSPs, many of them are building networks all over the country. They

work with hosts that are multi-state operations. They've accumulated understandings about how to work with apartment building owners or Walmart or Safeway or whatever. So I think taking full advantage of those different private knowledge bases is a really important way to ensure lower cost, better operations, and ultimately innovation.

So let me just say a few things about, you know, a few final thoughts about where I think innovation is especially needed. The first thing that I think is important to think about with public charging is that, yes, the charging station is at a physical level delivering electricity to the car, but really fundamentally, if you think about the network of chargers, it's really all about enabling personal mobility and doing that in a way that's convenient to the customer and, you know, perhaps incidentally meets some of the customers other needs that are linked to transportation, and that's a very different business model than what utilities fundamentally do. And as people have noted, there's not a commercially viable business model yet for -- stand-alone business model for the charging

business, which is why we see public subsidies or ratepayer subsidies for it, but we want to push in that direction. And, you know, there's no viable business model for selling gasoline, per say, but there's a business model for selling gasoline along with potato chips and doughnuts and coffee in the form of the convenience store. And so I think we really need to make sure we stimulate the innovation that's going to come up with what's what model that works.

I think a couple of other areas I'll note is, you know, over time we need to drive down the cost of the equipment, drive down the cost of recruiting hosts, drive down the cost of operating systems, and I think that just comes from -- it comes from scale, it comes from experience, it comes from repetition.

And then finally I think the other area where innovation is needed, but also some degree of consolidation Tom already talked about, but various aspects of interoperability. But going back to my initial remarks, you know, getting the interoperability settled, the protocols, the equipment, and then really developing the business models to realize smart charging, that again is

critical to long-term transformation, simultaneous transformation of the power transportation sectors, and we have to get that right. And I'm very excited that all these New England states and New York, some of the mid Atlantic states are now stepping forward because I think you all have different contacts to the western states which tend to be vertically integrated or generally more coordinated states, whereas most of you all have real retail competition. I think that creates a different ethos around the industry and I think makes you a really fertile testbed to solve that problem and to also spawn some of the other important innovation that's needed.

So thank you for listening to me now, and I'm looking forward to talking with Tom and Kathy and Peggy. Thanks.

(Applause.)

PEGGY DIAZ: Thank you. So I'll just start questions to our panelists, and then we'll open it up to the audience.

So beginning with Kathy. Kathy, can you hear me? Are you still with us?

KATHY KINSEY: Yes, I sure am. I'm here.

PEGGY DIAZ: You focused your remarks on issues that directly impact consumer experiences. Are there other issues that the New England states should be looking at?

KATHY KINSEY: Sure, and there are lots of them. A couple of things that the corridor steering committee, Northeast Corridor Steering Committee are looking at, one is the need for DC fast charge permit process streamlining. So one of the things that we've heard from EVSP providers, many of them, that are actually installing DC fast chargers is that the local government permitting process is often very difficult and lengthy. Most jurisdictions haven't actually ever permitted these stations, so there aren't any established permitting processes. They're not really familiar with the technology. In some cases they're trying to treat DC fast chargers like gas stations which is the wrong model. Some jurisdictions are now unnecessarily subjecting permit applications to a zoning process.

So NESCAUM is facilitating a steering committee workgroup to look at all of this, to identify the issues and the problems, develop a

set of best permitting practices and outreach materials as well for states to use as part of an outreach effort to local government permitting officials. And my colleagues at NESCAUM, Jesse Way, is actually leading this effort. And the process will involve talking with local government permitting officials, and hopefully engaging them in this process and educating them. So that's one thing.

The other thing that I would mention that I think is really important are EVSE ready building codes. This is installation of infrastructure. Charging infrastructure in new construction can be as much as a third of the cost of a retrofit. So it makes a lot of sense to get building code standards in place as early as possible. And it is one of the most effective strategies to promote consumer adoption, and it can have a huge impact in the future going forward. So a growing number of states and local government and municipalities and counties are doing just that. California, Hawaii have adopted EV ready building code standards for new construction. Vermont has a code for both residential and commercial development. Cities

like Denver and San Francisco and New York City and Los Angeles have all adopted codes.

A little bit closer to home, Massachusetts is the most recent state, at least in the northeast, to start an EV ready rulemaking process. So they just put out proposed regulations, and they are definitely worth looking at. They would require new single-family homes to be EV ready, and two-family homes would have to have at least one EV ready parking space. And then this is the really challenging factor. Multi-family buildings in Massachusetts regulations require 20 percent of multi-family building parking spaces to be EV ready. And then they have requirements for commercial and industrial buildings. And their requirements also cover various upgrades and expansions to existing buildings.

So it's a pretty comprehensive step in EV ready building code standards. It's probably going to be voted on by the Board of Building Regulations and Standards next month. So I think this is something to track and to look at as a possible model for Connecticut.

And so I think I'll stop there, but

those are two important initiatives.

PEGGY DIAZ: Wonderful. Thank you.

Moving on, maybe first for Nancy and then, Tom, if you want to give the business perspective. But Nancy, in your experience looking at knowing Connecticut wants to embark on its market transformation, what can we learn from California's experience with respect to EVSE ownership models?

NANCY RYAN: Sure. Thanks, Peggy. So as I kind of alluded to in my remarks, California is really kind of a microcosm for the rest of the US in that its regulator, the California Public Utilities Commission, has followed a path so far where it's really let the California utilities' three major investor-owned utilities that it regulates come forward with their own ideas for how they would like to develop charging infrastructure. And so San Diego Gas and Electric, in particular, and also Pacific Gas and Electric in Northern California, have pushed for a utility ownership model where they really wanted to own and operate the full set of charging -- or a large network of chargers.

San Diego got further with the

commission than PG&E did. I'll come back to that. But San Diego is currently doing a pretty large-scale pilot where they do own and operate chargers. And the rationale for doing that was that they are using a -- or they're piloting a pretty interesting smart charging approach that involves a day-ahead rate that has both a locational and a time varying dimension. And the reason for the time varying dimension is that San Diego is really the epicenter of solar development in the US. It has the highest amount of solar on its system of any utility in California, probably any utility in the US, and to the point that they really need to build up daytime load on some occasions in order to avoid curtailing some of the solar that's generated.

The locational dimension is important because they need to avoid bottlenecks of their distribution grid and also because on these days where they have surplus solar, what they really want is for people to charge at work, but on other days where maybe it's closer to a traditional peak day, so a summer day, they may prefer them to charge at home at night. So I think that's a really neat system. They were able to persuade

the California commission, which has generally not been friendly to utility ownership, to allow it there in order to enable that program.

In general, the California commission has leaned more towards the make-ready model and the first utility to really put that forward, and actively promote it in California was Southern California Edison who proposed an initial pilot for what they call the Charge Ready Program which involved make readies to support Level 2 charging primarily at workplaces, multi-family housing, and public places.

They have a report that's available. So they completed the program. It was subscribed and indeed oversubscribed within a couple of months of being approved by the commission. They've largely completed the program. These are reports that kind of is a retrospective on the pilot that they have submitted to the California commission. It's posted on the commission's web site, probably on Edison's as well. And the main thing that they learned from that was that this model was very attractive to a variety of hosts and EVSPs, and that it especially worked well for workplaces and public settings, but did not work

well in multi-family housing.

And consequently Edison came forward and proposed to the commission that they would do some DC fast charging plazas, like what Electrify America is building, and do them in areas where there's a high concentration of multi-family housing because maybe that's ultimately a cheaper and easier way to make it possible for people who live in apartment buildings or condos to meet their charging needs rather than to go through and deal with all these individual hosts and the fight between the residents of the condo about who gets what parking place close to the elevator and so on and so forth. So that's what they are piloting.

And the last thing I'll say on this is that one of the latest things the commission approved is actually make-ready models for Pacific Gas and Electric that supports deployment of DC fast chargers. And there the one thing that was interesting because PG&E did come in initially and ask for full utility ownership of that network, and what the commission said is that, you know, we'd rather see the utility ownership in the disadvantaged communities where it may a be more difficult investment proposition for EVSPs but

elsewhere we think that a make-ready model is sufficient to underwrite the EVSP's investment and more conducive to getting the kind of competition innovation that we would like. So nice spectrum to choose from and, you know, growing body of experience that I think you can learn from.

PEGGY DIAZ: Do you have any other --

THOMAS ASHLEY: Sure. And I guess let me apologize. So I realize that all of you may not be so familiar with Greenlots or our business. And so let me just mention that Greenlots is a technology company. So our core business and indeed sole product is a software platform for managing electric vehicle charging. However, we also provide services such as the deployment of charging infrastructure. And so I think that the reason why I wanted to highlight that right here is because there are a lot of different business models out there. There are a lot of different players interacting with this transportation electrification market in different ways and in similar ways.

As Nancy mentioned, so the not so well kept secret but still fairly logical misperception of many decision-makers is that there -- well, let

me step back. So the logical misperception that is fairly common out there is that there must be a private market business model for owning, operating and managing charging infrastructure. As we heard from Nancy, there isn't right now. I think we all hope and expect that there will be, but as acknowledged, this may end up turning out to be very similar to the gas station model, which really is predicated on driving consumers to buy additional products and services. That said, I think some of the values around managed smart charging grid services, et cetera, may close that gap and indeed provide sort of additional revenue streams or cost savings that can be part of a successful business model going forward.

But as it regards to the utilities and these different utility ownership models, we've seen commissions -- it's a very active regulatory environment out there. We've seen commissions act in a lot of different ways. And indeed, as Nancy said, we've definitely seen competition as a key component of commission decision-making.

So I would note, you know, one of the strongest statements we've been seeing out there, first by Washington state, more recently in

Minnesota, and in different forms in other states, but basically there's a recognition that we have to engage utilities to be able to accelerate and expand this market, and that does look like a lot of different things. So some utilities don't want to own charging infrastructure; some do. Some want to provide rebates. Some frankly don't care very much right now about managing charging because the scale of EV adoption is relatively low. But going forward, we are going to be seeing a lot of different business models explored. We will see some that hopefully will be successful.

But what I wanted to share is, so for Greenlots the type of utility facilitated program that is most attractive is one where the utility is managing the charging because we make a product that is designed for that use. Whereas, you know, other players out there, they may be more on the hardware side or provide software networking, but the product is more focused on the workplace, the retail environment, and it's very site host driven rather than utility driven.

And so I think there's been, again, sort of this logical assumption or misunderstanding that it's like utility versus the

competitive market or the private market, and that is not the case at all, as Nancy really spoke to. This is about kind of putting all the pieces together and finding ways in which all of the stakeholders can work together and most effectively. And we are seeing a lot of different opportunities to engage with different programs, whether it's Electrify America, whether it's utility programs, some of the mitigation trust programs that are upcoming. But I would just sort of highlight that the real competition we're seeing out there right now is when there are motivated purchasers of EV charging equipment and services. And those are not the drivers. The drivers need those services, but they're not purchasing the charging infrastructure, they're not purchasing the software. Those are the owners/operators of charging infrastructure, and utilities have an enormous role to play as motivated buyers. And any type of utility engagement creates a more advantageous market environment for all of us to engage with.

PEGGY DIAZ: Thank you. Tom, also, as the EV market matures and more drivers are enticed to go electric, how do we ensure price

transparency and a seamless charging experience?

THOMAS ASHLEY: So the seamless charging experience is coming. We're really doing a good job of making progress on driver roaming and network interoperability. We're not there yet. Some of it is aspirational. Some of the pieces are now in place, but now they have to actually be deployed, and in some cases that may not be possible depending on the existing equipment or networks out there. But pricing is a little more challenging.

So you mentioned I used to work for Plug Share, which many of you know is one of the best resources for finding information about charging infrastructure. But as we're talking about managed charging or dynamic rate structures, it's not so simple as you pull up and you know that you're going to be charged $5 for that session. Sometimes we're communicating in kilowatt hours, so it's 20 cents a kilowatt hour. Drivers aren't used to that. And so there are a lot of mechanisms for showing pricing, but the bottom line is that we need pricing to be dynamic to properly integrate charging with the grid and send the right price signals to drivers.

And so this is a challenging area, and we're going to continue to see apps, screens, et cetera, showing various information. And we are maybe going to see a little bit more standardization of that, but fundamentally I think we're going to be continuing to see a lot of different pricing rate fee structures and sort of business models based on different ways of paying or engaging drivers for services.

PEGGY DIAZ: Terrific. We're going to move on now to some audience participation. So if you have any questions for our panelists, please take the mic.

BENJAMIN MANDEL: Good morning. How is everyone doing? I'm Ben Mandel from CALSTART. Thank you all for your remarks this morning. I wanted to pick up on the make-ready point that a few of you touched on. I know, Nancy, you obviously have California experience. You spoke of the southern California Edison program. New York is in the process similarly of articulating a make-ready program for public access DC fast charging.

I wanted to get your perspectives on bringing in the other side of this, which is

medium and heavy-duty fleet electrification. That's been an element that California has more recently layered in and that I think northeast states would do well to emulate but perhaps can anticipate a little more in advance than California has done alongside the light-duty piece. So I'd just like to get your impressions and maybe see some recommendations for Connecticut.

NANCY RYAN: Let me kind of take a step back -- that's a great question -- and kind of make one broader recommendation which is that I think a mistake, well, maybe it's not a mistake that California did, but what California did is kind of say just bring us your ideas. And they got a lot of one-offs, they got a lot of, you know, it was not a sort of consistent systematic approach that any of the utilities brought forward. And the California commission actually recently put out or opened new rulemaking to say, okay, well, what have we learned from all of this, can we take a more systematic approach going forward.

And I think you are in a position in Connecticut where you could say maybe before you

get a lot more, you know, applications from or requests from your utilities in rate cases, you know, ask for strategic plans, as the State of Hawaii did, and say tell us, you know, across the board, across these different aspects of goods and people movement, what's your longer term plan, how are you going to stage it, what do you think is necessary to enable electrification for medium and heavy-duty fleets and over what timeline. So that's something that I would urge you to consider doing.

I think that what's pending -- actually, I can't remember. There are so many things going on in California, I can't remember. You probably know better than me whether there's been a decision. But I think that PG&E and the commission did tell the utilities after they approved the first round of light-duty charging programs, pilots, the commission told them don't bring us anymore of those, you know, bring us something for, you know, medium and heavy duty. And so I believe what both Edison and PG&E -- so that's most of California -- I believe what they put forward was like a make-ready model for medium duty and heavy duty with a view, again, that we

want to underwrite business models for third parties who can help bring those solutions to fleet operators, but we don't want to just install the utility as the incumbent there. So I think that's the spirit of it. I don't know that those are really very far off the ground, so we don't know yet if that's sufficient to accomplish that. But trucks themselves are a hugely variable component. I mean, trucks have so many different vocations and fleets are various, you know, degrees of how much of a business they account for. So it's super diverse.

And CALSTART, I should say, I'll give you guys a free advertisement, but CALSTART has been around for something like 30 years, originally in California, but you guys are all over the place now, and they're a real fountain of information for how to work with the whole spectrum of the charging network and transportation. We used you all as subcontractors when the project required deeper knowledge of some of these technologies than we could ever have.

THOMAS ASHLEY: So a few things. So one I just want to acknowledge. So you'll hear from Kevin at ChargePoint later. Some of you may

know Greenlots and ChargePoint are pretty sharp competitors in the market space and have some different perspectives on how to grow and scale the market. A couple of things we really agree on: One is when we're talking about transportation electrification, we're not just talking about passenger vehicles. It is transportation electrification. And I would say it's historically been more on road than not on road, but we're also talking about aircraft and boats, off-road airport equipment, you name it. So we are talking transportation electrification that is not discriminating in any sort of weight class or use case.

And I think that we both very strongly agree that sort of this make-ready model, which is the utility provides service to support charging, this is a foundation, like this is not something we need to disagree upon around the industry. Indeed, I would go so far as to say that this is simply a baseline that we're going to see regulators all over the country embrace over time. I would really liken this, frankly, to line extension policies. So you build a house and you need new service. It's going to be very similar,

I think, in treatment across the country. You're building an EV charging station, you need new service, that's provided by the utility. Maybe there's a customer payment of some sort or a load or managed charging component of that, but it's just part of traditional utility service.

So that said, I guess I would just acknowledge that, you know, if that's the foundation, then what's next. And that's where we're seeing some of these different business models, whether the utility is owning more stuff or setting up some additional structure to be able to manage charging, et cetera. But I don't know if you were here earlier, Ben. So Connecticut has decided to explore and move forward transit electrification and utility support for such. And I think we're going to be seeing a lot more of that here and elsewhere across the region because certainly the transit space there's a clear business model for going electric. There's a clear environmental imperative for going electric. But the business case around going electric in the goods and logistics industries is a little more challenging right now, and a lot of that is because the type of use cases that exist out there

either require depots and depot charging with -- I mean, we're going to be seeing 50 megawatt needs for a large, you know, truck, bus depot, but also the infrastructure out there on the roads, on the highways it doesn't exist. And someone has to pay for that, and no one really wants to, frankly. But we are definitely going to be seeing heavy duty moving forward, but it is certainly incumbent upon all of us to always be thinking across weight classes when we're talking about transportation electrification.

BENJAMIN MANDEL: Thank you.

KATHY KINSEY: Peggy, can I jump in on this one?

PEGGY DIAZ: Sure.

KATHY KINSEY: Thanks. So I would just add to what Tom was saying. I think that there's a real opportunity here. We have a federal infrastructure bill, a bipartisan infrastructure bill that's being put together in Washington. There's a lot of support for including electric vehicle components, infrastructure components, in that bill. And I think there's a real opportunity both for light-duty vehicles but also for medium and heavy-duty funding through that federal effort

to jump start some of the infrastructure projects that are needed to get medium and heavy-duty applications off the ground.

PEGGY DIAZ: Thank you.

MARK SCRIBNER: Hi. I'm Mark Scribner, program manager of electric vehicles with Energy New England, and we support many of the municipal utilities in New England like Wallingford electric department.

And I was wondering if maybe you could expand a little bit. You were talking about what the business model is for charging, but I think specifically our utilities see the business model right now for encouraging off-peak charging and, you know, Level 2 charging, but they're not always seeing the business model for the ownership, and I think it's probably enhanced or expanded for public utilities. And I wonder if you could elaborate on that a little bit.

THOMAS ASHLEY: Maybe I can start and you can add. So it is very important for us to all recognize that there are different types of utilities out there, and I think it's very easy for us to talk, certainly in Connecticut, about Eversource and United Illuminating. So the model

there, assuming regulatory approval, is that they can be rate based, right, so there's a rate-of-return included in those investments, whether they be the make-ready or the chargers themselves. Public power doesn't have that opportunity. Right? It's more about, as you said, off-peak charging, load growth, integrating renewables, et cetera, et cetera.

MARK SCRIBNER: Keeping the rates low.

THOMAS ASHLEY: So Greenlots works with some of the largest municipal utilities in the country LADWP, SMUD, Seattle City Light, et cetera, and frankly what has been driving activity by those utilities it's really been environmental commitments. And so they have frankly been reticent to spend money on charging infrastructure, but they are extremely supportive of others who want to spend money on charging infrastructure. And I think we're going to kind of see that, we see a lot of co-ops starting to engage now, and it's really about -- what we're seeing the common theme really is as facilitators, so it's not necessarily as infrastructure managers. We are seeing some of that, but it's resources so that customers in the service

territory know how to get involved in transportation electrification. They know what rates or programs might be available. They're being driven to act in a way that is in the best interest of the public utility. But the dollars are a real challenge. And so whether it's mitigation trust monies, whether it's something else, there is a real need to drive dollars to public utilities, municipal co-ops, et cetera, to be able to leverage the role that they can play as facilitators to move the market forward.

NANCY RYAN: Just one quick observation. Whether you're a POU or an IOU, one thing that really matters is to use those extra kWh of sales to lower your average cost of service which is beneficial to all ratepayers. And one way to do that or, in particular, the way to accomplish that is by smart charging. And as Mark said, today that's mostly, you know, providing incentives to get the charging into off-peak hours. In the future if you have a lot of solar on your system.

Who's heard of the duck curve? So you're facing the famous duck curve, which is basically solar over generation during the day.

You may want some workplace charging to soak that up, but I think that's a unified theme. We've generally seen everywhere we've done studies on costs and benefits of electrification that there are or can be, you know, net ratepayer benefits to all ratepayers from electrification and that those are always higher if you accomplish some kind of smart charging.

THOMAS ASHLEY: Sorry. I just want to add there. So one of the greatest challenges I think we all have as stakeholders in this and certainly decision-makers have is appropriately thinking about scale. So we're talking about a roadmap process looking at 2030. I don't mind telling you that Greenlots believes that 100 percent of vehicle sales in 2030 will be electric if we put together the right policies, deploy the right amount of infrastructure, et cetera.

When we're thinking about public power or investor-owned utilities, when we're doing the ratepayer cost benefit analysis, often we're looking at these pilot programs, you know, the scale is very small, it's a very low percentage of the necessary infrastructure to drive large-scale adoption, and so the ratepayer cost benefit

analysis doesn't work, right, you have to scale to get to those benefits. And that's where all utilities and all ratepayers are really going to benefit is with significant scale. And so the challenge is deciding to spend the dollars now and going forward to help drive large-scale adoption which in the end is going to be positive basically for all of us.

PEGGY DIAZ: I think we have time for one last question.

JOSHUA BERMAN: Josh Berman with the Sierra Club. In the opening remarks there was some discussion about equity considerations, and I know that I guess in my mind one of the both opportunities and rationales for engaging utilities in the EVSE space is to increase the equitable deployment of access to electrified transportation. I think this has obviously been a challenge. Tom I know is involved in the Maryland decision where, I thought, interesting innovation fund idea was denied by the commission.

I was curious if you guys have any comment on where the utilities have been most successful and commissions have been the most receptive to innovative ideas about how to ensure

that utility engagement is going to really increase equitable access to electrified transportation.

NANCY RYAN: I mean, I don't know how well it's worked yet, but, you know, the Massachusetts commission, the California commission, I think, and other commissions around the country have pretty consistently directed utilities to spend a portion of the dollars they've allocated for make readies or utility ownership in lower-income or disadvantaged communities, but I don't think there's a great track record yet. So I think that the jury is kind of out on that.

The other thing that I'll say is I think is it important for commissions to appreciate that the EVSPs whose businesses are being fundamentally underwritten with public and ratepayer dollars, those are network companies. And while they may get funding -- Tom is probably going to kick me under the table -- while they get funding, I think, sort of on a station-by-station basis, they're really building out a network. So it's worth thinking about, if we're going to finance the development of these companies'

network, should we put some sort of obligation on those companies that the network that they build out isn't just like the most profitable or potentially profitable areas but requires the opportunity to build a network on the public nickel requires some obligation to serve those other areas.

PEGGY DIAZ: So maybe looking at the example that we've had with cable and broadband deployment?

NANCY RYAN: Right. So do you want to kick me on top of the table?

THOMAS ASHLEY: No, no, public violence is not --

NANCY RYAN: You don't do violence against women.

THOMAS ASHLEY: -- not a good one, no.

So Josh, you know, as you know, equity has been a big priority for Greenlots, ChargePoint, others around the industry, and indeed commissions have been fairly supportive, maybe a little less so in some places, of equity. But I think we're really sort of at a nascent stage of understanding what is really necessary to leverage the opportunity that we have with

transportation electrification to improve the lives of a lot of people out there. And so I think that in California some of the programs initially it's literally just geographic allocation of charging infrastructure based on a scoring mechanism that California has to identify disadvantaged communities.

Well, if, you know, the residents of those communities don't have electric vehicles, that's not very helpful. Right? It might improve ambient air quality in the area and lower pollution, but it's not driving opportunities for local residents. And so we are starting to see some more innovation out there by utilities as they're thinking about program designs, and certainly utilities are getting more engaged with stakeholders to leverage sort of shared ideology and ideation.

But I will say this: Until we out there, and regulators, start sort of really innovating and thinking about utilities not just as power providers or infrastructure providers but potentially as, you know, ride share providers or used car salesmen -- and I realize that may seem a little outside the pale, but that's what we need

out there. We need to leverage and make assessable used vehicles. We need to better support car and ride sharing programs. Uber and Lift are really moving towards electrification, but those services are not accessible to a lot of people out there. And so utilities and sort of the stakeholder process around utility program development we really see as the core opportunity going forward to solve and adequately support EV activity, but it does really require an expansion of our thinking about, you know, the art of the necessary and possible.

PEGGY DIAZ: Thank you.

NANCY RYAN: Two sentences: Actually, it occurs to me that the California -- or try to get it into two sentences with a lot of commas -- but it occurs to me that at least some of the California utilities have reported some on their pilots and I think generally actually hit or exceeded their targets, and I think that's actually not that hard because generally most freeways are surrounded by disadvantaged communities because you don't want to live near the freeway if you can afford to live far away from the freeway. So I think, at least the way

the scoring works in California, it has, in fact, not been that hard for them to satisfy the requirement. Whether that's actually meeting the needs of those communities is another story. And I completely agree with Tom that if you don't have the complimentary policies to get the people into the cars, it kind of doesn't really accomplish a lot to bring the chargers to them.

PEGGY DIAZ: Wonderful. Well, thank you to our panelists. I think it's been an interesting discussion. Thank you for kicking off the rest of the day today. And I think both of these two members will be hanging around for a little bit, so if people didn't get an opportunity to ask their questions, I'm sure you can approach them later in the day. Thank you.

NANCY RYAN: I'll be here all day.

(Applause.)

KERI ENRIGHT-KATO: So we'll take a five to ten-minute break.

(Whereupon, a recess was taken from 10:56 a.m. until 11:11 a.m.)

KERI ENRIGHT-KATO: Okay. We're going to go ahead and get started on the next panel if folks could take their seats.

PAUL FARRELL: Brett is out in California. So we are actively reducing our carbon footprint just so you know.

Thanks, everyone. And I'm happy to moderate the second panel this morning on accelerating EV adoption. I think I touched upon in my opening remarks how important that is for the State of Connecticut and how important it is for advancing our greenhouse gas and air quality goals.

So before I turn it over to Brett, I'm just going to run through the bios for the panel, two of which are here virtually, and two of which are here in flesh and blood. So I'll start that.

Dr. Brett Williams, who is online right now, is the Center for Sustainable Energy's principal advisor for clean transportation. He's the CSE point person for electric vehicle market analysis, stakeholder engagement, policy analysis and business development. His activities are carried out in support of EV rebate programs in five states, including California's $500 million Clean Vehicle Rebate Project for which he directs transparency and evaluation methods. Brett has an undergraduate degree in physics, public policy

analysis from Pomona College, Claremont, California, and a master's in environmental development from Cambridge University in the UK, and a PhD in transportation technology and policy from UC Davis. Previous to CSE he was a researcher for Amory Lovins at RMI, and a postdoc scholar at UC Berkeley, and an assistant adjunct professor of public policy at UCLA. So Brett is uniquely qualified to speak to the issues facing Connecticut as it looks at its rebate program and its dwindling resources, shall we say.

Next up will be Julia Rege. She's also online. I think she's patching in from the DC area. She's a senior director for environment and energy at the Association of Global Automakers focusing on fuel efficiency, electrification and other automotive environmental policies. Prior to joining Global in 2011, Julia served as a senior regulatory engineer at Hyundai America Technology Center focusing on energy and environmental regulatory issues. She also worked at the US EPA's Office of Transportation and Air Quality as an environmental engineer. Julia has a master's in environmental engineering from the University of Michigan, and a BA in environmental science

from Northwestern.

Jim Fleming, to my left over here, is the president of the Connecticut Automotive Retailers Association, CARA. He serves as the secretary and treasurer of the Automobile Dealers Association's charitable foundation in addition to his membership in the National Automobile Dealers Association, NADA. In his spare time Jim is also a director of the Simsbury Bank and Trust Company and serves as a commissioner of the Simsbury Police Commission. Jim holds a B.A. from The Eisenhower College of Rochester Institute of Technology, and a master's in public policy from Trinity College.

And to Jim's right is Patrick Brown, the chief technology architect at The Hartford. He's been a member of The Hartford's Environmental Committee since its inception in 2007. He's been an advocate for many sustainability activities at The Hartford over the past 14 years. Patrick frequently represents The Hartford on the Governor's Committee on Climate Change. Prior to joining the Hartford, Patrick was a staff scientist performing research in climate change in Cambridge, Massachusetts.

So thank you to all the panelists today. And with that, Brett, I think I'll turn it over to you.

BRETT WILLIAMS: Thank you very much. Can everybody hear me okay?

PAUL FARRELL: Yes.

BRETT WILLIAMS: So thanks for the opportunity to inform the state's EV roadmap process. And right off the bat thanks to Nick, Nick, Amy, and others at the Center for Sustainable Energy who are the workhorses producing the analysis that I get to play with and show you today.

For those of you who don't know, CSE is a nonprofit program administrator, technical advisor and provider of outreach services. My role as principal advisor really is, as Paul mentioned, is to wrangle and make meaning from data produced by four statewide electric vehicle rebate programs in California, Massachusetts, Connecticut and New York, which we administer on behalf of state agencies like DEEP.

So this just gives you a flavor of the different blends of policy designs that exist because each state does have its own policy

priorities, constraints, and market contexts. We know there is no one solution that fits all. And hopefully my breadth of experience gives me a little something to say firstly about the EV market overall; secondly about CHEAPR specifically, the electric vehicle rebate program; and then get into different considerations for policy design.

So let's dive into some discussion of the market as a whole. So the market as a whole has added, on average, roughly about five electric vehicles per year. And although not all of those models have come in full force to Connecticut yet, the expiration of the travel provision in ZEV regulations does present an opportunity for more supply in the state, but as Paul mentioned earlier, it also presents a challenge for the state to make sure it has the policy frameworks that motivate the demand that creates the market that is attractive.

So of those roughly 40 choices that are on the market at any given time, I would say these two dozen are the more mainstream products, at least in 2018. Already a dozen of these vehicles are larger sedans, SUVs or cross-over vehicles,

and already a dozen of these vehicles are less than $30,000 after state and federal incentives. And this is important because people don't often realize the average purchase price of a vehicle is 32,000 or $35,000. So there is more choice, and there are more affordable options. That has resulted in the kind of shape of things in Connecticut over time, as seen by one of the dashboards we actually do for the Automotive Alliance.

You can see all told there were over 9,000 electric vehicles in Connecticut by September of last year. That number is probably well over 10,000 now. And about 60 percent of those were plug-in hybrid electric vehicles, and that was enough to make Connecticut actually number nine on the electric vehicle market share when you look at the entire period I like to call the post-modern electric vehicle era. And I'll note that that is one place higher than the neighbor to the north. However, recently in the most recent data Massachusetts has kind of jumped up that list a little bit, so let's remedy that through the electric vehicle roadmap process, shall we?

And if we don't remedy that from sort of a sense of competitive rivalry, let's sort of think about remedying that from a sense of sober reality. So here's one of the stakeholder goals. Some more aggressive goals were presented earlier this morning. The blue are those 9,000 vehicles I talked about earlier. So the blue is where we are. The green is a simplistic vision of whither we are tending so that we know what to do and how to do it.

Another sort of sobering calculation, which is a simplistic view, again, but precise enough to sort of make the point is consider the fact that CHEAPR has rebated roughly 54 percent of the state's electric vehicles. And it currently has funding at -- will probably get us past Memorial Day but may not get us to Labor Day. And that will get us at an average rebate price of about $1,300, which I think is reflective of the current program, another 1,300 vehicles in the state, which will be associated with a total of about 2,500 extra vehicles.

So if we are to continue to build a supportive ramp toward these goals, and if we were to need to fund that entire ramp all the way to a

level of 140,000 vehicles more, the sort of -- the calculation for that is $90 million. So that's at an order of magnitude more investment. But that's not surprising because we're talking about an order of magnitude more vehicles.

Now, there's a saying that all mathematical models are wrong, but some are useful. I do hope that number is wrong, but I think it's enough to sort of just frame the conversation in terms of the desirability of significant durable funding and what that might mean for program effectiveness. So we do administer another program in another state that has gone on wait lists five times out seven years, and unfortunately that's not the way to sort of build consumer confidence and dealer effectiveness in terms of using the incentives to sell electric vehicles. So again, this is just kind of the framing context with motivating slides. Let's talk about what has been accomplished so far.

So the easy part is figuring out what vehicles have been -- and in a very transparent way there's dashboards online. And you can go to that point at the bottom of the slide right now you'll see the shape of the rebates over time,

even by model, which I'm not showing here, about 64 percent of past rebates are plug-in hybrid electric vehicles, which the research literature, by the way, does indicate are very impactful environmentally and otherwise. However, it is interesting to note that the funding is predominantly a little over 50 percent going to battery electric vehicles, so that kind of tension between vehicle count and funding amounts.

Now let's peer back behind the curtain to an analysis that was produced just for today's meeting. And it's real interesting to see that most of the program funding today has gone to moderately priced vehicles.

Now I'm going to switch this perspective from program funding to program vehicle count. So it's a very similar picture, but the next slide is a little bit different. And the reason I wanted to do that is because I actually have the same slide for Massachusetts, and I wanted to make it more directly comparable. Now in Massachusetts their high-price vehicles don't receive large rebates, but it does show a different picture between this and this. So now this speaks to policies. And again, there's no

right answer here. Three other states we administer have chosen not to exclude high-priced vehicles from eligibility for the program because of the value they bring to adding vehicles to the road, increasing the prestige and desirability of a product that has some old baggage of being perceived not as effective as all those cars are that we know. Nevertheless, CHEAPR made a difficult decision early in their program design which was to have a hard MSRP cap. Having made that decision actually was a decision addressed at one of the questions, esteemed questions of the day, which is how do we design programs to assure equitable access to a wide (inaudible) consumers. So CHEAPR has already made some of those difficult decisions, and it turns out the data are showing that some of those decisions have paid off. And part of the reason I want to show that is not just in terms of what vehicles are being supported, but the implication for what consumers have been rebated. So the consumer income distribution in green is more to the left, or lower in refunds, than the consumer income distribution in blue, which I would say is more to the middle, but then also have kind of a long tail to the right, like

that last one.

And again, there's not a right or a wrong approach here, but it does show that CHEAPR's tough decisions early in program design have paid off. Even though MSRP is not income, it has an effect on the income distribution of the rebate recipients. And for somebody that administered the California program, it's really interesting to see this slide because, in essence, the blue income distribution looks a lot like California's income distribution before its income cap. And the green income distribution looks like California's income distribution after its income cap. So here you've gone at this issue differently, but it's achieved illustratively similar results. And the reason I point this out is because it's of course theoretically very desirable to say, well, yes, we have an MSRP cap, but shouldn't we also have an income cap. Well, there is a sort of implementation underbelly that we've learned from our experience in California where that theory was tested, and it was desirable, and it produced some unintended consequences.

So the contrast to MSRP are price-based

criteria where you simply select which products or which luxury products do not necessarily qualify as the primary targets for public subsidy, with income criteria it creates a lot of outreach and viewer complexity. So consumers don't quite know what they qualify for, and dealers, for fear of liability and getting it wrong, don't use that cash on the hood at a time when we want to build their familiarity and motivate them. And by the way, it's not going to be cash on the hood anymore, and I'll talk about that in a second.

Unfortunately, the application process, the efforts to participate in the program, also increases, and not just for the wealthy but also for the very folks for whom you are trying to reserve funds. Fraud, of course, always, but loopholes that are legal loopholes that are hard to sort of completely close when you're balancing implementation costs and complexity and ease of participation. And it does take about twice as long to process an application that has income verification than it does without, for example. So again, you're creating at a time when the market is starting to pick up with the Model 3 and other long-range benefits helping that, and you're

creating a program that's a little bit more expensive and harder to implement.

And last but not least I think the biggest unintended consequence in California was the idea that it precludes the possibility of a point of sale, which as we heard this morning, was one of the hallmarks of Connecticut's program and in which New York went on to adopt as well. The point of sale is an equity feature in and of itself, and by having income verification you can't have that feature. So, you know, this is an example where the implementation perspective is not necessarily the most important perspective, but it is often the least well understood perspective. And so I wanted to kind of present that as an example where in theory an income-based criteria might -- or an income cap specifically might be a good idea, but in theory, theory and practice are the same, but in practice they're different. So there is an alternative, which Oregon is doing, which we can talk about a little bit later, which is not an income cap but an income kicker, which California also had, and we can talk about that.

So again, we're coming at equity from a

different approach in Connecticut, but the data are showing that some of those decisions, those tough decisions, not easy decisions, have paid off.

Now let's talk about income just generally a little bit more. This is actually a more recent version of the income distribution. There still exists the desire to, you know, carve out the wealthy from the program, especially because there's a lot of myths about EVs and rebates are just for the wealthy. Well, I want to challenge that a little bit. I'm actually peer reviewing research right now that used extensive data. It says income distribution is very different than this. But keep in mind this is not a -- this is not an appropriate basis of comparison. This is a new car buying incentive. So we have to have real expectations about what we can achieve on the equity front in the context of new car markets versus what we can achieve in terms of other mobility-based projects. Right?

So the income distribution of new car buyers is very different than incentive data, very different than the population as a whole, but it's expensive and it's hard to access. The

researchers in the media sort of propagate this myth that these rebates are just for the wealthy. This shows they're not. But even if you were to put up new car buyer data, the data is a little different, a little bit skewed higher, but it's very similar to new car buyer data as a whole. And the reason is, for example, in California UC Davis data indicates that 50 percent of households don't buy new cars at all. Of the folks who do buy new cars, 16 percent of households buy over half of the new cars. That's your appropriate basis of comparison, but it's difficult to access that data. So we're not talking about incentive data or population as a whole.

So I'm happy to talk about income a lot more, but I wanted to sort of tease up this idea that we are now starting to assemble indicators of rebates in four states. And actually all four of our agencies allowed us to sort of assemble those into a single presentation this past summer, which was a lot of fun and very interesting. And we're putting together 45,000 survey responses that are statistically weighted to represent 200,000 EV consumers. Now, primarily California, which is the largest and oldest program, but also in each

of the other states. And some of the things we're learning about income, let me just tease a couple of the other indicators of impact here.

First, you know, there's this idea that electric vehicles are toys that don't get used and don't do any good. And the data showed that actually electric vehicles are replacing older, more polluting vehicles at a high rate, 80 percent, and most of the vehicles being replaced are older and are gasoline vehicles.

Now, there is a little bit of clean vehicles replacing clean vehicles starting to emerge, as you might expect, but keep in mind that 15 percent of households are buying 50 percent new cars. That is actually how used EV get created. Right? So it's an important aspect of the used EV market, which is a separate consideration than sort of replacement rate. It turned out plug-in hybrids replaced vehicles at a slightly higher rate, probably due to confidence and, you know, the longer range battery electric vehicles are starting to show pretty high replacement rates, but all the vehicles have pretty high replacement rates.

The last thing I'll kind of leave you

with is a couple of concepts, and that's this idea that I think there's a question about how do we think proactively about phasing out policy support over time. And this is something we think about in solar, and so it's kind of the default paradigm we have in the back of our head that at the beginning of the market when market volumes are low in black, the need for policy intervention high in blue. That's how we support the growth of the market. But as the incremental cost of a product comes down and then the market grows, the need for policy intervention can be phased down and out. Well, unfortunately, the data don't show that we are there yet in terms of the electric vehicle market. That paradigm doesn't apply. And the reason is because we're not just adding more and more of the same consumer buying a commodity that has increased in price. We're actually moving from enthusiastic EV adopters to more skeptical, more mainstream, more low-income consumers, and they actually need the policy support more, not less, than the consumers who came before them. So unfortunately the theory says we need bigger rebates and we need them for longer. We don't need smaller rebates decreasing

over time.

Now, layer on top of that budgetary constraints and all the real tradeoffs that agencies are faced with. But the data are showing no, no, the importance of policy support, whether that's incentives or whether that's education and outreach or whether that's other mechanisms to help folks get over those barriers, are actually increasing, and that's good because we're actually making inroads into the true mainstream market.

So we have some other indicators impact, you know, rebates are proven to be very important, and even in a counter-factual basis this is for the econometricians and free ridership is low and more counter-factual measure of would you have bought your EV without the rebate, rebate eventuality is high, and we can talk about those indicators impact as well, but I think the trend is more important that I just discussed.

So with that, I'll kind of wrap up. We can talk about why volume is a good concept, not just in theory but also in reality for not just economies of scale, but supply chain creation, which is how innovation actually happens behind the scenes for building dealer confidence in

selling these products for creating workplaces full of cars that validate that idea and makes people aware and ultimately for those very challenging environmental impacts that the agencies like DEEP are charged with addressing which seems to be more and more pressing over time.

We do have a report about the Connecticut dealer incentive, which is unique to Connecticut. We can talk about that as well. But I think I'll just leave it there by saying hopefully -- it's been a lot of fun, great data to bear to inform the conversation, and let us know how we can help or ask Paul and the commissioner what questions you have, and we will try to feed them the right type of data that will inform those decisions.

So thanks very much for your time and attention.

PAUL FARRELL: Thank you, Brett.

Julia, are you there?

JULIA REGE: I'm here. Can you hear me all right?

PAUL FARRELL: Yes, we can. Great.

Brett, can you exit out of your screen?

(Pause.)

PAUL FARRELL: Julia, take it away.

JULIA REGE: Okay. Thanks so much for having me today, and apologies for just being a talking voice over the phone. I'd much rather be there in person, but it just wasn't going to work out today.

So just real quickly let me share with you a little bit about what Association of Global Automakers is for those who aren't familiar. Global Automakers is an association that represents the US operations of international automobile manufacturers, suppliers, technology companies, and other automotive related trade associations. Our members include Honda, Hyundai, Kia, Nissan Subaru, Toyota, along with many others, many suppliers and technology companies. We work with industry leaders and other stakeholders in the US to develop public policies on motor vehicle safety, encourage technological innovations and protect our planet. And our goal is to foster an open and competitive automotive marketplace that encourages investment, job growth, and the development of vehicles that can enhance American quality of life.

So just thinking generally about the concept of accelerating EV adoption, I think it's important to say that Global Automakers and our members are committed to long-term goals of transportation related carbon reduction. And our members have been making significant investments in producing cleaner and greener cars. This includes efforts to improve fuel efficiency as well as electrification of the fleet.

I think this was noted earlier but just to reiterate today, there's over 40 models of electric vehicles, both plug-in and fuel cell electric vehicles. And of our member companies, they currently offer three fuel cells in the market, so they're only really available in California due to infrastructure concerns.

And we are providing our customers with electrified options in nearly every segment today across multiple product lines, at various price points in a variety of ranges and range capabilities, and really there is something out there to meet everyone's needs today. Automakers have also announced plans to offer more electrified vehicles in the coming years. And if you scroll through all the press releases for the

past year, my count has vetted at least 80, if not more, models that would be expected in the next five years. And this is really awesome progress. We think we've come a really long way since 2011, and we're at a really critical point today on looking at how we continue to increase electric vehicles in the market.

But we would also say the reality is that the electric vehicle market is still really young, and so sales of electric vehicles remain at below 2 percent across the nation in 2018. And what we've seen is that Connecticut sales are tracking along. The national average as well is also just below 2 percent for 2018. This just means there's a lot more work to be doing to make sure that states are creating the right conditions to support electric vehicles and also the market to grow.

Global Automakers has worked with Connecticut, NESCAUM, and other agencies, utilities, and stakeholders on the fundamental question of how we promote electrification. We believe automakers are doing their part when it comes to the technology, offering more vehicles and choices, advancing the technology, advancing

range, and increasing promotion opportunities, whether it be ride and drive events, auto shows, advertising and marketing, working with and training dealers, and many more. This does not mean that we don't have more work to do, but it is a continual path and each year more investment and more efforts are going into expanding electric vehicles by the automakers. But fundamentally these efforts are going to fall short if we don't have substantial consumer interest in buying a new or even a used electric vehicle, and so the question remains how do we get more customers to go electric.

Well, first, increase and expand consumer incentives. Second, fund electric charging and hydrogen refueling infrastructure. And third, initiate both proven and innovative efforts that either support customer decision-making or generate more consumer awareness. All of these efforts are critical to accelerating the market.

So I know the last panel focused on infrastructure. I'm not going to delve into that. But I do want to say that Global Automakers believe that all electric vehicle options are

needed, and therefore we strongly support the need for both electric charging and hydrogen refueling infrastructure. And to date Connecticut has really demonstrated great leadership in the northeast when it comes to hydrogen, so we really encourage them to make plans to develop a roadmap and tailor it specifically to Connecticut's needs and customers.

For incentives, incentives have been proven to increase consumer interest in electric vehicles and ultimately help to get customers to buy or lease an electric car. This is really great news, and it supports the need for ongoing incentives as we work together to accelerate the markets. However, the future of federal tax incentives is uncertain, and because of this, it's all the more important that states need to double down on their incentives to make sure that we have adequate and sustained funding and that rebates are being maximized to encourage every consumer to buy electric. There's challenge, of course, but the goal should be to increase the number of new electric vehicles and thereby also increase the amount of used cars available. To have a truly successful electric car market we need to be

turning over the entire fleet and making sure there are affordable and preferred electric options that meet every customer's needs.

And we know there's challenges in finding funding, but in context California has year over year found millions of dollars of supported incentive programs, and this has led to a market share of nearly 8 percent in the past year in California. I mean, this is really, really incredible progress that we're seeing in California. And so we believe that each state that wants to meet California's level of success should also be committing proportionate funds to their incentive program. And to the extent funding is not readily available, there are a number of policy options that can be pursued, everything from RGGI funds, like many of the northeast states have leveraged, to the implementation of programs like the low-carbon fuel standards where a portion of the electricity based revenues can be used to leverage consumer rewards, as is being done in California right now.

And just one final point on incentives. When funding runs out or a program is removed, there is a noticeable and real impact on the EV

sales, and that can be really problematic for trying to build out an electric vehicle market. I think probably the most spoken about example is that in Georgia where they repealed their $5,000 rebate for EVs in 2015, and they had a market that was exceeding -- nearly exceeding 3 percent and exceeding California's market at the time. When that rebate went away, sales dropped to near zero levels. And Georgia sales have continued to increase since then, but the reality is they're only at 1 percent of the market right now, far behind all the other states when they really were leading when their rebate was in place.

One other example is the State of Washington where their EV tax exemption ended, and we saw sales of full-line automobile manufacturer of EVs have fallen under that exemption. So really incentives can take a big toll on the market. And again, as I said earlier, with the future of the federal tax credit, which offers up to $7,500 uncertain, this really is putting more urgency on the states to make sure incentive programs are funded, sustainable and available to all consumers that want to buy an electric car.

And then finally I'll just real quickly

I do want to comment on consumer awareness. I know Paul in some of his opening remarks today talked about the development of the Drive Change Drive Electric campaign. And I just want to say that this is a really important program because it brings together automakers and states to really get at the fundamental issue of how we increase awareness of electric vehicles and demonstrates that driving electric fits easily into any lifestyle. The reality is if we want consumers to buy electric, we need to be making more customers excited about these vehicles, have the knowledge they need to make the choice to buy an electric vehicle, and see that there really is a vehicle out there that meets their needs. This campaign is going into its second year, and we're really excited about that, and we look forward to promoting it more in the coming months.

So just in summary, electric cars are here to stay, but accelerating the market is challenging and relies on a number of factors. We believe consumer incentive, infrastructure development, and other efforts that increase consumer awareness are critical to increasing EVs in the market. And therefore states like

Connecticut have a critical role to play in supporting and building the EV market, and in doing so need to find ways to find consistent and ongoing funding for its incentives and infrastructure development, and therefore development of the roadmap can be really important to ensuring that the state commits the right level of funding and effort to increase EVs. Thank you. I look forward to engaging with the discussion following the other panelists.

PAUL FARRELL: Great. Thank you, Julia. Next I'm going to throw it to Jim Fleming of CARA.

JAMES FLEMING: Thank you very much. Again, I'm Jim Fleming. I represent 270 auto dealers in Connecticut that last year sold about 10 and a half billion dollars worth of cars, and that's roughly 17 percent of all the retail sales in the state.

Paul told you a little bit about my background. But prior to working for the auto dealers -- I think this is important to both my commitment and the association's to getting EVs on the road -- I served for many years on the legislature's environment committee, pissed off a

few republicans by voting to have Connecticut join CARB as opposed to using the federal standards, and also served for a while as the commissioner of consumer protection. And having listened to the comments of the first panel, I have some thoughts about probably the best way to ensure that we can reduce range anxiety.

My intention today was to cover really four things: One, how are we doing in Connecticut? The Center for Sustainable Energy did a good job in pointing out how we're doing. What I think is important to say is that DEEP was way ahead of the curve. Years ago when we sat down with them, when dealers sat down with them because we were invited by the commissioner to give our input on how can we get electric vehicles on the road in Connecticut, and what the commissioner at the time did is he asked us, and we said the way to get them on the road is to do the same thing manufacturers do to get vehicles and what dealers do to get vehicles on the road, you give an incentive, but you put the incentive on the hood of the vehicle at the time of sale and not six or seven months down the road, and that's what will move any car, electric or internal

combustion engine, out of the showroom and get it onto our streets. And we've done very well in Connecticut in doing that.

The other topic I wanted to cover is what are we doing to get vehicles on the road. The first thing is, is I don't use slides, and I know, Paul, you hate these. When you sit through so many of these hearings and panel discussions, sometimes these things start to put you to sleep. But, you know, it isn't brain science. I had to get these vehicles out on the road. You must have incentives, and I'm going to talk about the issue of incentives. And a comment was just made about what happened in Georgia.

In Georgia, this is what the Georgia sales looked like when they made a really dumb decision to pull the incentive. You don't need to look at that up close. You can see what happened. Georgia made another mistake. They not only took an incentive away, they put a disincentive in place down in Georgia. There's a lot of discussion out there today about since cars are paying a gasoline tax and electric vehicles are not paying to maintain our roads, that perhaps we should start putting some kind of a tax or fee for

electric vehicles. That would be the worst possible thing the state could do. Because it's very difficult right now, and even about 2 percent, of getting these vehicles out. So you want to have good incentives, and you don't want to do stupid things like put disincentives in place.

We need more models. When we started out with CHEAPR a few years ago there weren't a lot. Oh, one other I want to show you. This is -- well, we definitely need to have more models on the road. So years ago there were very few. We're now up to about 44 different vehicles on the road, electric vehicles on the road. Now people buy cars based on what their needs are. And so if you -- I know Ann Goldman used to say something about a clown car. Now, a clown car is a very, very small electric vehicle that you might see in a circus driving around, and that was not a very attractive option for most people if they had a couple of kids and the kids played hockey, you'd have to throw equipment in. So what the manufacturers have done is they've not only made electric vehicles, but they made electric vehicles that meet all the different needs for consumers

just as they have done with an internal combustion engine vehicle, whether it's an SUV or a four-door vehicle or a two-door vehicle. That's why people buy cars. So what manufacturers have done is they've produced more and more electric vehicles. It's made it easier for dealers to address the needs of the consumer when they come in. By 2025 it's estimated -- like right now we're at about 44 electric vehicles. We should be well over 85. So that's another thing that we're doing right. We're not only getting more models, we're getting more variety.

The other thing that has to happen, and it is happening, is you need longer range. And as the vehicles are on the road longer and longer and more and more manufacturers have become involved, some of which have, like Volvo has said, they're going to be all electric within the next ten years, battery range is becoming less and less of an issue. But the concern about battery range goes to, I think, what this panel is supposed to talk about, and that is this issue of range anxiety. Connecticut has about 2,100 gas stations in it, and at those gas stations they may have two, they may have four, they may have six, they

may have eight pumps. We have 313 EV charging stations in the state. People get terribly nervous when they come into a dealership and they're talking to the dealership about, well, am I going to be able to charge, and where am I going to be able to charge. So we not only need to incentivize consumers to purchase vehicles with some kind of a rebate, but we have to seriously look at range anxiety because that is a real impediment to trying to get people into electric vehicles, and we need to consider incentives to make sure that we have a really good charging network.

I call it access for all. Volkswagen now is talking about developing their own charging network in the United States. Tesla has a very good one in place throughout the United States. Other manufacturers are talking about doing that. The private sector is perhaps going to enter into it and try to build charging facilities. Utilities may end up doing it. But the key to this is, is that every one of those charging stations has to be accessible and can charge any vehicle that comes in there. We cannot afford to have nonstandardization. And while we're at the

beginning stages of this, we need to look very carefully at it.

And I told you I used to be the commissioner of consumer protection in Connecticut, and we regulated gas stations. If you build a gas station in Connecticut, there's a regulation that says you have -- and you have air for people's tires, it has to be free. So the Department of Consumer Protection right now has the ability to order a gas station to make sure that there's free air. If you want to have a license, you have to provide free air. The state, and maybe the federal government, should look at that issue, and that is, is if you want to have a charging station, it must be accessible to all. It doesn't have to be free, but it has to be accessible to all. If we did that throughout the United States, we would more and more and more lower range anxiety.

So one of the things I think DEEP has to look at, perhaps the Department of Consumer Protection has to look at, and certainly the Public Utility Control Commission has to look at, is to ensure that that happens. And you can either order that, make it a requirement or a

mandate, or you can give an incentive. If you still want to have a private charging network, well, perhaps the electricity that you're buying then to pass onto the public might cost you more. The DPUC could look at providing less expensive electricity to any charging station that again is accessible to all. That will probably do more to get electric vehicles on the road than anyone else, especially in cold climates like we have here in Connecticut. People worry about it. They worry about getting stuck in a snowstorm and where am I going to charge.

Another issue I thought was very important to address is the issue of fleets. Only 2 percent of the nation's -- out of all of the fleets in the United States, I think the best one out there is -- California is at 4 and a half percent; New York, surprisingly, is a little better, it's about 4.8 percent; Connecticut is doing actually pretty well, we're at 1.2 percent. The legislature needs to look at this in terms of purchasing electric vehicles for fleets.

The issue of range anxiety is going to be far less for state fleets, whether it's fuel cells, because we do have fuel cell charging

ability in Connecticut. But my point is, is that's another area where the state must provide perhaps an incentive to state agencies to do this, and that will get more electric vehicles on the road.

Finally, the issue of -- and I think that the Center for Sustainable Energy did a good job of describing it -- would you want to put in place some kind of a means test or an income means test for eligibility to have a rebate. One of the things Connecticut did right -- and it sounds good, but one of the things I think Connecticut did right when they put their rebate program in place, CHEAPR, is they kept it simple. If you're going to ask those who are retailing these vehicles to make decisions, to check income levels, I think it's going to have a negative impact on whether or not these vehicles can be sold. So I think what Connecticut has done, which New York copied, was the right way to do it. Look at the price of the vehicle, decide what the rebate ought to be based on the battery capacity, and keep it simple when you're trying to sell, simple not only for the consumer, but also for the retailer.

So I'd love to take some questions later, but with that, Paul, I'll turn the mic back over to you.

PAUL FARRELL: Great. Thanks, Jim. I appreciate that, and appreciate the presentation.

Next up, Patrick Brown from The Hartford.

PATRICK BROWN: Patrick Brown. I'm sorry, Jim, my poster board holding needs some work.

JIM FLEMING: If you want to borrow my Lauren Bacall voice, you're welcome to it.

PATRICK BROWN: So I first want to thank former Commissioner Klee for his years of service and hard work to DEEP and to the residents of Connecticut, and also to congratulate Commissioner Dykes and thank her for inviting The Hartford to participate in the panel to share our experiences.

The Hartford is an insurer based in Hartford. We're proud to call Connecticut home for 209 years. I suspect that my children are under the impression that I was here for the formation of the firm, but as proud as we are of our history, we really are looking forward. And

we developed a sustainability strategy. I want to kind of take a macro view first on that and talk then about how EV adoption and our promotion of EV adoption fits into that.

So our sustainability strategy really consists of four pillars. You have ethics -- thank you. I'm Gerald Ford. I can't do two things at once. I'm sorry.

So ethics and governance, diversity and inclusion, community and giving, and then environmental stewardship. We really formalized our environmental stewardship efforts around 2007. We had developed an Environment Committee, of which I'm a part, as chaired by our general counsel, and our board of directors. We also issued our first statement on climate change, updated in 2014, available on our web site. And we also established 2007 as the base year for our first greenhouse gas reduction goal.

So since 2007, we've reduced our greenhouse gas emissions by 66 percent, understanding that The Hartford, in particular, in the insurance vertical, we don't really produce a lot of greenhouse gas emissions, but nonetheless climate change for us is an important part and a

risk to us in our industry, so we take it very seriously. And we do think that we should do our part to contribute to greenhouse gas emissions and make sure we set a standard, an example for our peers, for our children, and make sure that we can contribute to society at large in terms of the greenhouse gas emissions and environmental responsibility.

So there are really kind of three things I'd like to focus on today with respect to EVs and The Hartford. One is really what we're doing, as I indicated, for greenhouse gas emission reductions, in particular, what we're doing as a company on our fleet vehicles and other vehicles that we use as a matter of business. The second thing also is how we promote EV adoption for our insureds. And the third thing I want to take a little bit more time on is what we're doing to foster EV adoption among our employees as well.

So first, as I said, we've reduced our emissions by 66 percent since 2007. We've established new goals for us as a company, an interim goal of 25.7 percent reduction based on the 2015 year by 2027, and a 46.2 percent reduction by 2037, which closely aligns to the

legislation that was passed and is now law and establishing the goal for the State of Connecticut as well.

So as it relates to EV adoption and hybrid vehicles, part of that strategy is in doubling the percentage of hybrid vehicles we have in our fleet. Today we have 10 percent of our corporate fleet that are EVs or hybrids. We're going to double that in the next three years to 20 percent. And then also in the next three years to establish the goal to make 100 of our campus security vehicles and our shuttles electric vehicles.

So in terms of our insurance and the products that we offer, we have a number of products that promote environmental good behavior. Certainly in our commercial side, not that I want to dwell upon that too much, but we do offer some unique products in that space, underwriting things such as solar and wind farms and the like on the generation side of things. But on our personal lines side, particularly as it relates to EVs, we do offer discounts for EVs for those that choose to ensure with The Hartford. And that's not unique in the industry, but what is a little bit

more unique is that any EV charging stations that are in the house are considered part of our standard homeowners policy. That's a little unusual for the industry because that's often considered part of the vehicle infrastructure, but we offer that as just part of our standard policy, a homeowners policy.

Also in terms of employees, so we're really, really proud about a number of efforts that have gone on at The Hartford in the past ten years or so. We have what's called a Hartford Environmental Action Team that was formed. It's employee led. It's employee driven. It's all volunteer. We have more than 800 employees that are part of HEAT, and they throughout the year sponsor a variety of initiatives to really promote, educate and advocate for environmental responsibility among our employees and our stakeholders.

And one of the things that they've done in the past three years or so, they've hosted two ride-and-drive events in partnership with Plug In America to really bring EVs closer to our employees and allow them to drive them and to talk to dealers and others who are there at The

Hartford in our facilities. So it really gets sort of the groundswell of support, and we found really it came to a surprise to us as well.

In 2016 for a poll of our employees, 51 percent at the time were not likely to purchase an EV as their subsequent vehicle. This past year at our latest ride-and-drive event we're now at 93 percent of our employees have indicated they'll purchase, expect to purchase, or will consider purchasing an EV for their next car. So that's quite a turnaround. And I think a lot of that maybe certainly could have been triggered by the industry and what's happening in the industry, but also I think it's really an important lesson for us in terms of how really having an education campaign and one that's really led by the employees for the employees has helped to expand really the enthusiasm and the commitment on the part of our employees around the EVs.

Also in the first ride-and-drive event really 82 percent of our employees who participated in the poll have never driven an EV. This past year it's now only 8 percent have really never been exposed to an EV. So we've really turned that around through the advocacy of our

HEAT team.

Also, last year we had partnered with Nissan Motors and Connecticut Green Bank -- many thanks to Bryan Garcia and his team for their help in this -- to offer our employees an incentive to buy 2017 Nissan LEAFs, and of course we've also advocated for the latest incentives that are offered, the 2018 and 2019 LEAFs. And what we've found, we know at least ten LEAFs that were purchased by employees through those two promotional campaigns.

We also every year have a survey of our employees on commuter behaviors, which includes questions around ownership and usage of EVs. That contributes to our calculation of our Scope 3 emissions.

So what we're doing also in our infrastructure to support the use of EVs and option of EVs by employees is really around charging stations. There have been some discussions around those. So to date we have 30 ports for charging for our employees between our Hartford and Windsor offices. And I can tell you as an owner of two EVs, they are used extensively. So we started in 2011 with our first two charging

stations and now, as you can see through the chart on the lower left, we're really thrilled to have the problem of really having a capacity issue relative to demand. So we really see a hockey stick in terms of the usage of our stations. And as a consequence, we've added more stations this past year, and we're looking to expand further as the years progress.

Since we started tracking, which was in 2017, which aligns really to sort of the challenge we had with capacity of how many EV drivers were trying to register to use our charging stations, we've seen an eight fold increase in the number of drivers. So we presently have 89 drivers that are registered with the company. That's frankly, I think, a little bit of an understatement in terms of EVs because those are unique drivers, not necessarily unique to EVs. So folks such as myself, we're really seeing the excess of vehicles that visit our campus with some regularity and use our charging stations.

So for us it's been a real great problem to have in terms of adoption of EVs by our employees. And we're also honored and thrilled to have been identified by ChargePoint, who we've

already talked about in terms of one of the larger networks of charging stations in the US, that we are the number one provider of ports for employees and private employers in Connecticut, and we're number five in New England. We'd be happy, if there are others who are challenging us today, if we could get a groundswell of support. We certainly love the competition.

So with that, I'll pause and go to panel discussion. Thank you.

PAUL FARRELL: Great. Thanks, Patrick.

(Applause.)

PAUL FARRELL: And thank you to Julia, Brett and Jim as well. I, of course, have this long list of questions as a moderator, but I think I'm going to take my prerogative also as a moderator and instead of that I think I want to open it up to questions immediately because I think last time in the last panel there were some unanswered questions out in the audience, and I'd like to do my best to avoid that in this case. So you guys come on up if you want to ask questions.

In the meantime, I guess my first one for Patrick, just to get it going while folks gather their thoughts, is could you speak to a

little bit more about this sort of on the ground experience you had at The Hartford rolling it out to your employees? I'm getting the sense it's not just a if you build it they will come sort of effort, and there seems a lot of work and forethought behind that.

PATRICK BROWN: I think when we first rolled out the first few charging stations, it was in our visitor lot in front of the building. We were hard pressed, frankly, to find a lot of employees that had owned EVs. It was 2011. It was still early in the industry. It was a bit of still a nascent technology, but nonetheless we could envision that EV usage was going to grow. And I think we're a couple of lessons learned for that as well, not only in the context of really the importance of communication, education, advocacy and having that really be owned by our employees, really great numbers, that over 800 of 16,000 employees belonged to the HEAT team and are active, but also just in kind of thinking forward, so a couple of lessons learned on that.

One, when we installed the initial charging infrastructure, it didn't anticipate the size and capacity of batteries and how they would

grow. So I think our infrastructure as the number of models and the range of those models and the kilowatt hour capacity grew, we realized that we needed to perhaps scale our infrastructure. So our newer charging stations are -- when we had the old ones they kind of did some power sharing. So Level 2s got a little bit dubious when you talk about having to split power between a couple of cars. But all of our newer charging stations now have greater throughput. And we anticipate that given what's happening with range that we're trying to put infrastructure in there to scale when the technology scales. So I think that's a key part.

And also putting, I think, a real, again, a good problem to have for us was that demand outstripped supply. And while for the first few years that wasn't a problem, we realized that our charging stations are in kind of a premiere spot for folks, and so when you come in in the morning and plug your car in, you're less inclined in the middle of the day to go out and then try to find a new parking spot. And so we had to a couple years ago put a policy in place that -- it was formative. It kind of went along

on some please, please, please, you know, move your car when you're done. It wasn't terribly effective. So we've now put in a new policy that has been much more effective. And it's not just -- it's not punitive, necessarily, we're trying not to be punitive, but I think just underscores that, listen, we're offering this as an amenity to our employees, we're all trying to do the right thing here by not only The Hartford but our community, and so please be cognizant of other people who also wish and need to charge their cars so they can make their commute a little bit easier and avoid any sort of range anxiety. And that's been very, very effective. So now at this point we're able to turn over two to three cars per day per charging station. So that's really been a great lessen for us to learn.

PAUL FARRELL: Great. Thank you.

Are there any questions in the audience, or should I keep going?

ANA LISA PAQUE: Hi. My name is Ana Lisa Paque, and I'm an EV enthusiast and owner, and I represent the EV Club of Connecticut. Atlis Bollinger, Rivian. These are three American EV pickup makers that are currently accepting

deposits and reservations online for their fully electric EVs made in America with impressive battery range that are expected to be delivered in 2020. So my son wants one.

He said, "Mom, is it legal for me to buy one in Connecticut?" And I said, "You know, I don't know. I'll ask. I'm going to the EV Roadmap meeting."

So I would like to know, is it legal to buy that EV pickup for him online and have it delivered to our home in Connecticut? If not, how is this helpful in rapidly deploying EVs and ensuring that all options that meet every customer's needs are available? There are currently no EV pickups on the market. Ford keeps saying they're going to introduce one, and they're not taking reservations. Thank you.

JAMES FLEMING: I think that's probably for me. As probably most of you well know, there's been a real pissing match between dealers and Tesla, and not necessarily Tesla, but the way that vehicles will be sold in Connecticut and the other 50 states. I don't want to take up a lot of time here because the legislature is going to be debating this again. The concept that those

vehicles cannot be sold in Connecticut is not true. Anybody who gets a license from the State of Connecticut as a manufacturer and follows those rules, can sell their vehicles in Connecticut. And for close to 100 years manufacturers have gotten a license, and they have used what's called a franchise system to sell vehicles in Connecticut. So the issue is not whether or not it's legal for them to sell here. If they get a license and they franchise, they absolutely can. There's a much bigger issue with direct sale versus franchise, which I don't think is the subject of today's meeting, but they can sell here, yes.

ANA LISA PAQUE: So what you're saying is it's only legal for them to sell in the State of Connecticut if they choose to abide by the dealership model instead of the revolutionary new direct to consumer model which is in line with the revolution in EV?

JAMES FLEMING: If they follow the law, they can sell here just like everyone else, yes.

ANA LISA PAQUE: Okay. Thank you.

PAUL FARRELL: Thank you for the question.

Lee.

LEE GRANNIS: Lee Grannis, Greater New Haven Clean Cities Coalition.

I'm a little mystified here, Jim and Julia, about marketing of EVs. I back in the nineties when we first got into this alternative fuel issue -- well, not issue -- they were brought to market, there was initial marketing, and it got out there and then it went silent. Again, we're really pushing EVs, and it's being done at the grassroots levels, but if you watch TV, you don't see much marketing of EVs. You see some hybrid marketing. Is this going to change? Because the only way you can get to some of these people is through the boob tube. So I'd be interested to know what's going on.

PAUL FARRELL: Julia, do you want to take the first crack at that one?

JULIA REGE: Sure. Well, I mean, I think there's a couple of things here. And the first is we have more models coming online now, which automatically adds to more interest and rollouts for the vehicles as well. And there have been manufacturers in the past couple of years who have increased advertising, particularly at the

national level, to promote their vehicles, but there's also a number of other ways.

There's a fundamental difference between advertising and marketing, and so the commercials you're asking about, we consider that advertising. Marketing is so much more than just advertising. It's making sure that the dealer networks are set up, the repair networks are set up, that the information about the vehicles is readily available, even to a certain extent working on the consumer awareness campaign in the northeast. That's an aspect of marketing the vehicles as well. And then you have things like ride-and-drives as well.

Another really great place where you'll see a lot of marketing efforts underway with electric vehicles are at auto shows. And auto shows have traditionally been the way that automakers interact with consumers without having that pressure that you're going into a dealership and not ready to buy, you can go and see the cars. And in the past, I would say, five years we've gone from seeing two, maybe three electric vehicle offerings on the floor to multiple offerings by multiple companies across the floor. And this is

a great way to engage consumers and get them really interested in the cars as well.

Advertising is an individual manufacturer decision. I can't actually speak to what my manufacturers are planning to do or what they want to do with advertising, but I can tell you my experience is every day there is just more touch points for consumers of electric vehicles out there, whether it's things, again, like ride-and-drive, campaign efforts, information on the internet, and then traditional advertising as well.

PAUL FARRELL: Thanks, Julia.

Jim, do you want to add?

JAMES FLEMING: Yes, I'll just add a little bit more to that. Auto shows are a great way to do it. I know the last four or five auto shows that CARA has sponsored, the Connecticut International Auto Show, we've highlighted EVs.

DEEP is doing something which I think is really great. At the auto show each year an award is presented to the dealership that is selling the most vehicles under CHEAPR. We publicize it. It's a big deal for our dealerships. They get plaques. I will tell you

that auto retailers account for about 30 percent of all of the revenue to TV, newspapers, radio, so a lot of money gets spent on advertising. So I think you're absolutely correct that if that kind of money can be more directed to the electric vehicle market, it will help -- certainly it's going to help sell vehicles. So when you have a company like Volvo coming out and saying that they're going to be all electric, that means a tremendous amount of money as they move in that direction is going to be spent on selling electric vehicles because they're going to be selling only those electric vehicles. So yes, you're correct.

LEE GRANNIS: I misspoke. I should have used the word advertising instead of marketing because we're all doing that, and I've personally been doing it for the last few years with federal money. The only thing is a lot of people are visual, all the way up to the commander in chief, and that's the only way you're going to get some of these people into the dealerships to at least look at them.

JAMES FLEMING: We do ride-and-drives just for that reason. Some people have the perception that an electric vehicle is a golf

cart. Boy, the torque on electric vehicles is absolutely amazing. The features that are in electric vehicles now are absolutely amazing. And it's a whole different experience to sit in a car and actually drive it versus looking at it online, although dealers use both online and electric ride-and-drives. It's a good idea.

You had also raised one other issue with me earlier on that I forgot to address it, and that is with respect to access to charging stations. One thing that has to be looked at, perhaps it's an issue for the Department of Public Safety and for the homeland security office in Connecticut, is that in the two recent hurricanes or big storms, one down in South Carolina, the other one down in Houston, it was a major issue for people to get their vehicles charged. And you don't get a lot of hurricanes up here, but I can tell you that it does affect consumer behavior when they worry if something were to happen or a major snowstorm were to hit and the power went down will I be able to charge my vehicle. So not only do we need access for all to whatever stations are out there, certainly in an emergency situation I think that that's something that has

to be put on the table as part of public policy because it's another reason -- it's another disincentive, if you will, to people purchasing electric vehicles. And we need to dispel that and let them know if something does happen they're going to be okay.

LEE GRANNIS: Off the grid.

JAMES FLEMING: Yes.

PAUL FARRELL: Thank you, Lee.

Another question from the audience? Please step up. Guys, it's probably easier if you form a line because then we are more efficient in moving from question to question. Thank you.

ROBERT DICKINSON: Robert Dickinson, member of the South Windsor Energy Committee.

In regard to electric vehicles getting a free ride on the roads because they're not paying gas tax, I think it should be brought out it's been estimated that $100 million a year is the cost, healthcare cost of burning fossil fuels. Probably a third of that is transportation. So each and every electric vehicle that's put on the road is going to save a certain amount of healthcare costs. And I guess you could probably compute that by knowing cars and so forth and so

on. And I think that needs to be brought out when people start talking about special taxes on electric vehicles. I mean, we should have a special tax on every gallon of gasoline to compensate for the health costs.

PAUL FARRELL: Thank you.

ALEC SLATKY: Hey, how are you doing? My name is Alec Slatky. I'm director of public and government affairs with AAA Northeast.

And the question I have for you is about the used car market for electric vehicles because the CHEAPR rebate is for new vehicles. And I'm not exactly sure how other rebates work around the country. But as those fleets are aging, those are going to be transitioning into vehicles for sale on the used car market, and I don't know if anything has been done -- I mean, kind of, Brett, you know, national best practices, are there any sort of incentives for purchasing used cars, or is the idea that, you know, they're out there and people will probably --

PAUL FARRELL: Hey, Brett, do you want to take a first stab at that one, please?

BRETT WILLIAMS: Sure. Can you hear me?

PAUL FARRELL: Yes.

BRETT WILLIAMS: So this definitely is out of my core expertise in the new car incentives a little bit, but there's a couple issues that I am aware of. First, there are a couple of small piloting projects in California that offers a used car incentive, and actually the Oregon program, the Oregon rebate program, which will be administered moving forward, involves a used car incentive as well. So we'll know a lot more about that.

There is -- it's not about controversy, right, another one of these ideas that sounds great, and then it gets a little more complicated. One of the good things that's kind of happening right now is that used car -- used EVs are maintaining the discount that they received when they were new cars, in other words, the state incentive is helping to make used EVs more affordable as well. So that's a little bit of a problem in terms of residual value for the first car buyer, but it's actually giving access to electric vehicles to the second car buyer at a lower price. And so there's this sort of policy theoretical conversation about, well, if that's

the case, then do you sort of double down on that, and you can still make the case for it in terms of helping make those already quote/unquote affordable used EVs even more affordable. But what's happening at the same time is most of the new EV incentive programs are facing funding challenges, so you get into a little bit of a zero sum conversation. And you know, the new car market dynamics that I mentioned aren't necessarily the affected thing, but the best way sometimes to produce a lot of used EVs is to get a lot of EVs on the road.

And so that's some of the complexities or the dynamics that I'm aware of. I don't think there's a really good answer, but I know we're starting to enter into the world of incentivizing EVs, and the research is starting to study used EV markets more, so we'll know more moving forward.

PAUL FARRELL: Thanks, Brett. So what you're saying then is that the impact of the federal tax incentive, the impact of any additional state incentive then serves to reduce the sort of secondary value of the vehicle, it's depreciating faster, or is that also a function of the technology being older and people looking at

cars like buying a used cell phone?

BRETT WILLIAMS: I think it does take into account the general depreciation, that current new car incentives are helping to keep used car incentives lower than they otherwise would be. Now, granted, that's a temporary thing, right? It won't be the case forever.

The other thing that's happening is right now in the early used EV market, the used EVs are not necessarily going to the sort of priority populations that you would hope they would ultimately reach. Right? So used EVs are staying within the same types of demographics as the new EVs, not entirely, but not the automatic win that we would hope on EPRI's perspective. So what that means is, again, just a moment in time, and that the market needs to be followed a little bit more in terms of those used EVs really getting to a broad base of consumers. So that's why, again, it's a little bit complex about where you put the money when you have all these complicated trade-offs.

JIM FLEMING: Paul, one way to -- dealers have looked at that. Most electric vehicles are leased, so in three years they're

coming off lease it's at that point that, whether it's dealers, banks or a public policy decision gets made about the interest rate. Interest rates are used cars are going to be higher. If there's a way to ratchet those interest rates down with some kind of either a government program or an OEM on a vehicle that's still under warranty, that's another way to ensure that we can get those vehicles back out on the road. And we have looked at that. We're trying to figure it out. But the interest rate could be key to getting them on the road.

ALEC SLATKY: Thanks.

PAUL FARRELL: I think the person behind you may be actually well qualified to answer that question on interest rates.

MATT MACUNAS: Hey, Matt Macunas.

JULIA REGE: This is Julia. If I may, I was just going to add on, particularly in the State of California where there are so many incentives on the overall new EV market, you can find used EVs that are coming off of lease for after three years with extremely low mileage, like 16,000 miles, which is for some traditional cars what a person will put on in one year rather than

three, and those cars will sell from 8,000 to $11,000. And so that's part of the impact that you're seeing with the incentives that are put on them for the new vehicles. And that's really a good thing, because it does help us get more of the vehicles into the secondary market because people are seeing the price as advantageous for them, and the low mileage, too, is also a really good thing that attracts people's attention.

The other thing that you do see in California, and I think Brett just sort of referred to this, is there are specific programs in California aimed at scrappage, so taking the oldest cars off the road, which oftentimes are associated with people in the lower-income communities, and providing them with additional incentives for getting, first of all, getting rid of their old car, and second of all, for purchasing an electric vehicle, so they get additional rebates on top of that providing they use electric vehicle in addition to getting rid of their really old car. And that can make the vehicles close to zero dollars at purchase price. So there are ways to do it, but again, you get back to the fundamental issue of where is that

funding coming from and how do we make it available to everyone.

MR. FARRELL: Good points. Thank you, Julia.

Matt.

MATT MACUNAS: Matt from Connecticut Green Bank. Actually, I didn't come up here to talk about that, but yeah, I'd love to weigh in on it. I mean, great points by everybody. Working with CARA a few years ago we had some conversations, identified a potential market gap with UTVs coming off lease. We wanted to get our feet wet with the lending market ourselves, like see how that works, offered an interest rate buydown through three participating credit unions that now offer statewide coverage, and it was informed upon the results. One really positive outcome of that was that one of those credit unions, even after our interest rate buydown was out, they decided to jump in and continue to have a lower interest rate for EVs versus regular vehicles. So we hope to continue kind of spurring that market transformation right there.

Two quick statements to Lee's point about mass market advertising. If anyone was

watching the Super Bowl, they might have seen an Audi E-Tron commercial advertised at Super Bowl advertising rates. So, I mean, that's pretty telling right there. That's a good sign.

I want to thank Patrick. Obviously, working with you and the HEAT team in 2017, that was a great experience. We're still in touch on sort of the follow-ons with that.

PATRICK BROWN: It's good to put a face with a disembodied voice on the phone, Matt.

MATT MACUNAS: Thank you. And then I wanted to -- actually, I was curious about this colloquy here between Jim and the EV club, and put a finer point on the question. Those are interesting new pickup models coming out. If they were to, let's say, a rigging were to get a franchise license in Connecticut, does that mean they have to establish physical plant here, or can they ricochet off of an existing dealership as an intermediary? I just kind of wanted to get a finer sense of that.

JAMES FLEMING: Sure. Again, you would have to get a franchise. What Connecticut law says is that any manufacturer that wishes to sell vehicles in Connecticut has to do it through a

franchise dealership. There are, as I said, 270 franchise dealerships out there. Many of them are dual where they have multiple brands, some even under the same roof. So there are many options to do it legally and get them sold. The one thing that the Connecticut statute provides for, which is important to consumers, is first it's regulated locally. So if you have an issue, Lemon Law, whatever it is, it's going to be regulated here in Connecticut. And if the dealer doesn't follow those rules, the dealer could have his license pulled. And I think that's a very, very important thing to the franchise system.

The other thing is, is that dealerships are required not only to sell but to service onsite so that you don't have to drive halfway across the state because whatever company decided to come in here and sell vehicles without a license couldn't actually service them here. You must be able to service the vehicles, and you must have the parts available so that when there is a problem or a recall, it gets done efficiently, quickly, and right away. But yes, there are dealers that would take that franchise today.

MATT MACUNAS: Fair enough. I'm not

trying to weigh in on authority but --

JAMES FLEMING: I know. It's complicated. These guys know it's complicated too.

MATT MACUNAS: Fair enough. Thanks for the time, Paul.

PAUL FARRELL: Thanks, Matt.

PETER O'CONNOR: Hi. I'm Peter O'Connor with Plug In America. Good to hear that our ride-and-drives are appreciated and our consumer protection work.

On the used EV market we think that's very important for expanding EVs into the low and moderate income segment is the used EV market. And a couple of issues besides simply the purchase price are the assurance that the battery is functional. So we've looking at some changes in California to ensure that battery display is accurate and hasn't been reset or tampered with. Just as you can't with an odometer for a used vehicle, we're looking at that for the battery capacity display because that can be accidentally reset. And also in California where they provide battery assurance if you buy a used EV that if it has to be replaced the state will cover that. So

there are options besides simply rebates or interest rate that you also have to look at which is to say the viability of that used vehicle and they are working on that.

PAUL FARRELL: Great. Thank you for the comment.

Are there any other questions? Because I realized we are standing between you and lunch on a Friday afternoon on a clearing day, not an enviable position. So with that then, I thank you for your time and attention.

(Applause.)

KERI ENRIGHT-KATO: So we'll go ahead and break for lunch, and we'll start promptly at 1:30. Thank you.

(Whereupon, a recess for lunch was taken at 12:30 p.m.)

AFTERNOON SESSION

1:35 P.M.

KERI ENRIGHT-KATO: Okay. We're going to go ahead and get started. If I could ask folks to take their seats. Okay. Great. I hope everyone had a lovely lunch. It looks like the sun is out, so that's a good end to a Friday.

So we're going to move on to the third

and fourth panels of the day. So the third panel is the role of time-of-use rates to encourage EV adoption and to mitigate adverse grid impacts. So I'm going to do a quick introduction of our panelists, and then we'll move right into their comments, and then the other panels will ask a few questions, and then we'll go to the audience for questions.

So we're lucky to have three distinguished panelists for this panel who will be speaking to rate design, metering and submetering, managed charging, associated grid impacts, among other things. So we're very much looking forward to their expertise on these important topics. So thank you to all the panelists for joining us today.

So first up will be Dana Lowell. He's technical director of MJB&A's transportation group, providing clients with strategic analysis, project management and technical support for vehicle electrification and emissions reductions programs. Recent project work has focused on the the effects of vehicle electrification on the electric grid, as well as electric vehicle costs and benefits. Before joining the company in 2004,

Dana spent seven years as the assistant chief maintenance officer for R&D at MTA New York City Transit's Department of Buses where he was responsible for implementation of clean fuel technology programs.

We also have Charlotte Ancel. Charlotte is the director of strategic development at Eversource Energy, a publicly-traded Fortune 500 company, serving 4 million electric, gas and water customers in Connecticut, Massachusetts and New Hampshire. Charlotte leads Eversource's electric vehicle storage and other clean energy development and policy initiatives. She was previously vice president of power supply and general counsel at Green Mountain Power where she led the power supply, regulatory and legal and project development teams.

And our last panelist, Kevin Miller, is director of public policy for ChargePoint, the world's leading network of electric vehicle charging stations. Kevin works with legislators and regulatory agencies throughout the northeast and midwest to overcome barriers to transportation electrification. Before coming to ChargePoint, he served as the chief financial officer for the

Executive Office of Energy and Environmental Affairs in Massachusetts where he led fiscal policy and strategy for six state agencies. Kevin was appointed to the New Hampshire EV Charging Infrastructure Commission, and is the infrastructure cochair of Drive Electric Pennsylvania.

So again, welcome to our panelists.

So I'll go ahead and turn the mike over to Dana.

DANA LOWELL: So good afternoon. I thought I would maybe set the stage for this panel by sharing some results of some modeling that we did a few years ago specifically with the State of Connecticut which answers the question what effect could high levels of EV penetration have on the grid here in Connecticut in terms of how much energy we use and how much load will that impose.

So we looked at two different scenarios, and in no way are these scenarios intended to be my prognostication of what will happen. They're more sort of aspirational and intended to portray what needs to happen if the state is going to meet its goals. So Connecticut is part of the 8-state ZEV MOU, which says we want

to get 3 million EVs on the road by 2025, and the state also has formal goals to reduce GHG emissions by 80 percent by 2050.

So what we looked at is, if the state met their goals under the ZEV MOU and then penetration continued kind of at a similar rate, what would that look like, and that would be our sort of mid-range scenario. And then we said, well, how many EVs would need to be on the road for the state to actually meet their goals by 2050, and what would that look like in terms of EVs?

And so what you see here is that if the state meets its ZEV MOU goals and then the penetration kind of continues at a steady rate, there could be almost 600,000 electric vehicles on the roads of Connecticut by 2050. On the other hand, if they really are serious about meeting the goals to reduce greenhouse gas emissions by 80 percent, there probably needs to be almost 3 million electric vehicles on the roads of Connecticut by 2050.

And so my next question is, well, how much power will all of those EVs use? So this is our analysis of what that looks like. You'll see

that electricity use is actually projected to grow relatively slowly here in Connecticut over the next 20, 30 years. And under our midrange ZEV MOU scenario, 600,000 EVs would add about 5 percent of throughput to the grid by 2050. However, on the other hand, the scenario 80 by 50 with almost 3 million EVs, that would add about 23 percent of throughput to baseline projected energy use statewide.

So the next question obviously is, well, that's throughput, and that is one thing, but what about load? As you all know, I think that a lot of the costs of providing electricity are driven by peak load. So we also looked at what those EVs would do in terms of load on the grid, and we looked at two different scenarios. One we call the baseline, which is everyone owns an EV, they get home from work, and they immediately plug in their EV and start to charge it. And the second scenario is what we call an off-peak charging scenario where a very significant portion of people would delay the start of their charging until after the afternoon, late evening peak load period.

And I think what you see by these

charts, this happens to show 2040 under the 80 by 50 very high-level scenario. I think you'll see that under baseline charge there's really no control, people don't give thought to when they charge. You could have a very significant effect on afternoon and late evening or early peak load. And in fact, the 80 by 50 scenario, the 2.7 million EVs, could add 25 percent to the current afternoon peak load. On the other hand, if people delayed the start of their charging into the late evening, early morning hours, you will be able to utilize times when the grid is not as well utilized, and you can dramatically reduce the peak load impact.

And in fact, our modeling shows that if you do that, if you move load into the times when the grid is essentially underutilized right now, the cost of serving that EV load will be significantly less. And our estimate was that under this scenario in 2040 it would be $50 million less in the state. So that's a significant amount of money.

So the point is that there is economic, significant economic reasons for trying to control when people charge and specifically for moving

home-based charging into the nonpeak load periods. So the question becomes -- and that sort of sets us up for this panel which is, okay, how do we address that issue? What are the approaches that could be used to do that?

Sort of the classic traditional way that people think about this is time-of-use rates where you charge less electricity in off-peak periods than you do in on-peak periods. And that's kind of the way that most commercial customers are charged today, but residential customers are not. But you'll see on this chart that virtually all utilities, maybe not all, but many, many utilities do offer customers, residential customers, voluntary time-of-use rates now. Typically they apply to the entire house, and they typically do not get a lot of uptake from customers. Some utilities are experimenting with EV only time-of-use rates, so it would apply only to your EV charging. And the biggest problem with that is it requires, generally requires a second meter. And that can become very expensive.

What I wanted to just in the next couple of minutes here, throughout there is the idea that there are other ways to approach this

problem than just time-of-use rates, and I just want to give a couple of examples of some innovative things that the utilities around the country, including two in this region, are doing to sort of address this issue of getting people to charge when the utility wants them to charge in order to reduce the utility's costs. And so just to sort of open up the data and thought about that.

So the first one I'm going to highlight is Green Mountain Power. And Charlotte can speak to this much better than I can, but I'll just sort of briefly say what's going on. If anyone has any questions about this, you should direct them to Charlotte, not me. But effectively Green Mountain Power is providing free charging equipment to residential customers, and they're also offering, if you use one of the chargers provided by Green Mountain, they're offering a flat rate charging fee. Like you as a customer can charge your EV all you want pretty much any time for a flat fee of $30 a month. The only catch is that Green Mountain says if I have a problem with load, if I have an event where load is really high and I want to reduce load, then I'm going to tell you 24

hours in advance, and I don't want you to charge during that time. You can charge during that time, but if you do, I'm going to charge you 60 cents a kilowatt hour for doing that. So it is, again, it's a rate base or incentive, providing an incentive for the customer to do things when the utility wants them to do, but it's not technically a time-of-use rate in the way that people traditionally think about it.

Selco Shrewsbury Electric Co-op in Western Massachusetts has a similar program. And again, this one is focused on giving people charging equipment for free, but in return the utility gets to kind of choose and control how people charge. And one of the I think the unique things about this is they give them a Level 2 charger, but that charger is locked so that during peak periods, 5 p.m. to 9 p.m., it can only charge at Level 1, and then other times it opens up and you can charge at Level 2. And then also the utility reserves the right, again, to call an emergency type event where they will actually go and control the charger. If you're plugged into the charger during the event, the utility will actually control your charge rate in order to be

able to control load. So the customer is getting something. They're getting free charge equipment, but the utility is actually getting better control over how people are charging and therefore control the load.

The last one I wanted to highlight here is Con Edison in New York where they're providing an incentive to people to charge off peak, but it is not a rate. They're thinking of it as an off-bill incentive or off-bill payment. So they basically charge you. Whatever you charge, they charge you the normal rates, but then based on your charging behavior, they will send you a check or give you a credit in some way every month which is kind of an off-bill credit. And this is a very, very generous program that Con Ed has. Like, if you sign up for the program, they'll give you $150. As long as you keep the device to be plugged in, and as long as you are charging at some point in time in the month in their service territory, they'll give you another $20 a month. And oh, by the way, for every kilowatt hour that you put in your E vehicle during nonpeak periods, they'll give you 10 cents a kilowatt hour even if they didn't sell you power. It is a really,

really generous program, actually, that ConEd has going, but it is, again, the basic concept is it's a way to incentivize people to charge in a way that the utility wants them to, but it's not strictly a time-of-use rate.

So I just wanted to throw that out there in terms of just getting the discussion going or getting the thought process going that there are definitely benefits to getting people to charge in the way that is beneficial to the grid and to the utility, but there is more than one way to think about trying to incentivize that behavior.

KERI ENRIGHT-KATO: Great. Thank you, Dana.

Okay. Charlotte, you're up next.

CHARLOTTE ANCEL: Charlotte from Eversource. I really enjoy and appreciate and we're in sync with the way that M.J. Bradley has been modeling and thinking and talking about electrification of mobility in the region, and we appreciate the work that you guys are doing here and in other states. I would say strategically we're completely aligned. And now the question is just how do we best design the specific tactic to

get there.

So a couple of interesting things: One, we know that -- I'll just talk about how Eversource views electric vehicles and mobility issues at a high level. So we know, right, this week we learned that -- we had a further confirmation that the last four years were the highest -- were among the top five hottest years in the whole recorded history of climatology. So in our view at this point greenhouse gas emissions, it's not a question anymore. We think that the answer is electrification of everything and further efficiency of everything.

You will no longer see Eversource in any forums advocating for incremental gas pipeline infrastructure, full stop. We think the full answer is in clean energy. And the two industries near term that we're the most -- the two sectors near term that we're the most focused on are transportation and heating, so to talk today about transportation.

The issue that Dana just presented on in terms of electric sales and the decline of electric sales, so our electric sales in Connecticut are flat or forecasted to modestly

decline, and I think we should all view that as a success, the success of our efficiency programs in this state, and also success of efficiency at a federal level in terms of increased R&D and improved appliance and building code standards. And I know there's some work that the Connecticut EV Coalition and others are doing in the legislature currently about improving building standards even more to include electric vehicle charging, and we're supportive of that as well.

We think that electrification of transportation, in addition to being necessary to advancing our region's GHG goals, will also be very helpful to our long-term goals of keeping rates for Connecticut customers stable and low. Because electric -- our math is that every dollar of electric vehicle make-ready infrastructure that we do, so every dollar of customer money that we invest in the infrastructure to support electric vehicle chargers, so that's not the chargers themselves, but it's the service drop, our experience and observation in Massachusetts is that can yield more than $1.20 in rate reduction benefits because of the increased electric sales that flow to all of our customers. It's a

beautiful impact of a decoupled world where the utilities' earnings are fully decoupled and no longer connected to how much electricity we sell. So we see one value stream for all.

And we think of electric vehicles as kind of the new efficiency from a regulatory model. Right? You make efficiency investments where you give one customer an upfront rebate because you can show that over that efficiency measure's life it will leverage decreased baseload sales and decreased peak -- in some cases peak energy costs in a way that will benefit all customers. So that's how we justify it. And it's not a subsidy. We say the same thing as being true with respect to electric vehicles, and that's that every dollar of infrastructure investment leverages $1.20.

We also look at the potential. Our view is that electric vehicles are not going to shut down our grid in terms of need for significant new infrastructure. The fact that all things being equal all utilities basically almost throughout the country would see declining sales will actually help us in terms of grid impacts. And that while there will be isolated or discrete

impacts in certain areas, that that is best managed through a peak management approach which is designed to use and manage all of that charging in a way that takes down our two largest peak-related costs which are our ISO New England capacity costs, which are set based on our share during New England's peak every summer, so that's one yearly peak, and then also our 12 monthly peaks in Connecticut that set our transmission expense, you know, under the regional network service provision of our open access transmission tariff. So we view those as two additional value streams.

Our long-term vision, and it's our hope that we'll be proposing this at some point in a pilot version to test this in 2019 in Connecticut, is more of the approach of what we were doing in Vermont and what ConEd is doing where we provide upfront rebates or incentives for customers in exchange for providing a buy-down of a Level 2 residential charger, and that we are able through our control room to aggregate and control the chargers and use them to manage our yearly and monthly peaks. So that would be part of the value stream that produces ISO New England capacity and

RNS costs that we would be sharing with customers as the participating customers as a way to provide an incentive. We would also retain some of those, a portion of those savings to go to the benefit of our nonparticipating customers to show there's no subsidy. So the same way we do demand response, the same philosophy around demand response tariff design. We also think that there could be some opportunity for value sharing and incentives as a result of the increased electrification benefits that I just described, that dollar versus $1.20, that there's a little bit of -- there could be some value there. So that's our long-term vision.

Just to build on Dana's presentation and just to make sure everybody knows, we actually do at Eversource have time differentiated rates, time-of-use rates for all of our customer classes. We have one including for our residential customer classes. The experience of us here in Connecticut is the same experience I had in Vermont. There are very few customers that are -- and we had smart meter driven time-of-use rates in Vermont that we spent a lot of time advertising. And over two years we got about 12 customers to sign up for them voluntarily, and actually five of us worked

at Green Mountain Power, and we're involved in the tariff design.

So we think that they're not as reflective of human behavior, and we prefer more a model where I as customer come home or go to work, I plug my vehicle into a Level 2 charger, and I know that when I -- after a certain period, like in the morning or at the end of the workday, that I can trust that my vehicle will have a 75 percent charge. That's our vision.

We'd also add that another challenge with an additional new -- we've thought very seriously, and we continue to think seriously about it, and we appreciate stakeholder feedback, that if we were to create another time-of-use rate, like an off-peak rate, that the metering costs alone, like I think 500 to $1,000 would more than absorb any incremental savings or benefit for our customers. And we think that over time, and time will tell if we're right about this, that classic time-of-use pricing will become an anachronism, and that the world will move to a more controlled set-it-and-forget-it automated model. So that's our view.

KERI ENRIGHT-KATO: Great. Thank you,

Charlotte.

Okay. Kevin, you're up next.

KEVIN MILLER: Thank you all very much for making it back from lunch. I know that sometimes it's hard to do so and not take a nap. But I'm hoping to keep things thrilling with another perspective on time-of-use rates and some of the technological issues that we have to take into consideration.

I'm Kevin Miller. I'm the director of public policy for ChargePoint. And if you're not aware of us, ChargePoint is the nation's largest network of EV charging stations. We were founded in 2007. We're a Silicon Valley Company, but all of our stations in Connecticut are Connecticut owned and operated. We've got over 60,000 charging spots in our network, about 400 of which are in Connecticut. We design and manufacture and sell Level 2 and DC fast charging stations to independent site hosts who primarily own and operate those. And then we also provide an array of services to make those stations work and connect to the grid and be part of the ecosystem that Dana and Charlotte just referenced for managing that charging.

So one of the key things I want to point out, I'll point out three or four, all about the technology and the different model for refueling, and how some of those considerations have to be put at the forefront in thinking about how to manage this load, where to manage this load, and in which use cases you would.

So, as many of you are aware, I think there are only two people here who don't own EVs or who haven't driven them. EV charging happens where life happens. It's a paradigm shift in refueling where you're refueling when you arrive at your destination rather than on your way to it. So with 90 percent of charging taking place at home, at work, and 10 percent of charging taking place elsewhere. You can plug in at almost any place, but that's an important piece to think through when thinking about which types of use cases should we be targeting and which types of stakeholders will we have to interact with in order to facilitate a smart load management system that also ensures that at the end of the day these batteries, these resources with wheels, can still use those wheels. So all these different stakeholders that you want to take into account

from the drivers themselves to fleet operators, ride hailing, ride sharing, heavier duly vehicle fleets will have unique needs. So all these pieces really need to come into consideration. And they all have different equipment and network needs. No one is the same. So to Dr. Ryan's point before, making sure that each of them has a choice of a competitive batch of services and equipment is really valuable because there is no one-size-fits-all approach.

Here to illustrate that the use case for charging really drives the value to the grid from new EV load is three model load profiles. The first in orange is workplace. As you see over a 24-hour period that you've got in front of you, as you get closer to 9 a.m. magically when the workers are arriving, you see a first peak. And then when they get that nudge from their employer at The Hartford, they'll move, but you'll get the new batch of drivers coming in in the early to mid afternoon. So that gives you a lot of interesting opportunities for workplace charging from being a natural duck curve helper to being able to do load management by not just doing that virtual nudge that we heard from earlier, but that you're able

to also decrease the load and decrease how much power is being delivered at a given time. So that can be done both at the utility level as well as for a site host who may have tens, hundreds, if not thousands of charging stations deployed.

Fleet vehicles also have a really predictable load, and so that presents some really interesting opportunities for collaboration and creating grid value. And then residential charging in green where you see -- this is a case. This is actually pulled from California where San Diego Gas and Electric has a TOU rate in place, and at about 11 p.m. you see a huge spike, and folks have delayed their charging to take place until that time. So these are three use cases. Things where you're talking about purely public charging on the Level 2, or especially the DC fast charging front, those are less opportune cases to have active load management without any opportunity for interaction between the driver and that load management demand response event, whatever it may be. So key things to take into consideration that there is no one-size-fits-all approach to applying these types of solutions.

This, I won't get too far into the

weeds on this slide. I think you've seen some of this before in what Dana was showing. But looking at this slide, I want to point out a few things. So the top chart shows what the average weekday load for home charging or the average weekday usage, 11.4 kilowatt hours. The picture below illustrates, again, a TOU rate. The orange line here shows residential charging behavior when there is no incentive to delay charging versus the red load where there is. Sorry, it's the inverse, the orange versus red.

So it's really key to be able to manage that load, and thinking about how you do it is important, as we've just heard. The requirement to have a secondary meter can be a barrier to enroll. Even more stark than what Charlotte described is LADWP, the Los Angeles Municipal Utility, tried to offer a TOU rate which would have required the installation of a second meter, and they had zero folks who enrolled in it. On the other hand, we've seen real success with TOU rates as one option, in addition to some of the others that you've heard. Baltimore Gas and Electric did an EV only TOU rate pilot which provided that secondary meter. So there is still

that cost, but there was enrollment and there was success. So no one-size-fits-all approach, but there are ways to avoid that additional cost.

Right now Xcel Minnesota has a pilot where they deployed 100 smart connected charging stations. And they are part of an on-bill EV only subtractive billing time-of-use rates. So the customer gets a bill at the end of the month and subtracted from the total house load is the load attributable to an EV. And they're getting that data, which is verifiable, accurate and reliable from the smart charging station.

So plenty of options, but it's important to make sure that we're balancing what our intended outcomes are with the regulatory frameworks that are in place. In most situations you're not able to use a smart charging station or other options from vehicle based diagnostics, whatever it may be, to get that data. So what are the requirements that we have in place? Do we need to revisit those? And I'd say that they're not only applicable to time-of-use rates, but you also see real value for those types of technology for implementing a low carbon fuel standard program, like we've seen in many states. Right

now Massachusetts is looking at a clean peak standard, and they're evaluating how are they going to verify that data. Voluntary credit markets are things that are also of interest in which having that regulatory clarity can be really valuable.

And I'll try and wrap it up real quick. I'm not going to read every bullet here. But what I just want to try to point to is that it's important not only to think about the use case, but all the entities that interact in the charging ecosystem to make sure that our load management program works for everybody. At the end of the day you need to make sure you're taking care of drivers who can get to where they need to go so that they know that when they wake up they can go to work, or that when mom or dad have to pick up the kids from baseball that if they pull in to get a fast charge on the way there that they won't be prevented from doing so.

Site hosts are also important to take into consideration. Who's deploying the station? Are you artificially putting a barrier up from The Hartford to deploy some of their stations or for any of our site hosts or those of our competitors?

How do we make sure that we're taking their considerations into account?

How does the utility and ratepayers make sure that they're getting the grid needs and add value into that $1.20 of the total value from the make-ready investment dollar?

And then also on statewide regulators and policymakers make sure that their range of interests are being met.

One last piece. I'm not going to read all this out, but I would point you to the study. It's really interesting to think about the impact that price has on a charging behavior. Often folks think I need charging to be free in order to incentivize its use. In many cases, though, that is the worst price that you can set for charging in that it leads to the least efficient use of the station. Folks have an incentive to leave.

In Vancouver the city had been offering free charging for years, and they had lines around the block for their charging stations. So they had to start implementing prices. And at the end of the day the study found that to the extent that you have dynamic flexible pricing, either a combination of time-based or kilowatt hour

pricing, as well as some kind of session fee or incentive to turn over that charging session, you make sure that the charging infrastructure is available to more people, but also for the purposes of load management that you can have predictable utilization which helps for planning purposes.

And then last but not least, I'm going to put on my Connecticut EV coalition hat really briefly. I'm a member of that group. And to Charlotte's point, we just want to call out that Senator Winfield just had a bill assigned to a hearing for setting an EV rate building code requirement of 20 percent of parking spots in new commercial construction. There's a hearing on the 14th. So if you like today's material, you'll love that hearing next Thursday. And we are also looking forward to the transportation committee hopefully sponsoring legislation to focus on fleet electrification commitments and incentives. So thank you.

KERI ENRIGHT-KATO: Great. Thank you, Kevin.

(Applause.)

KERI ENRIGHT-KATO: Okay. So we're

going to go ahead and move into some questions, and then I'll open it up to the audience.

So I'll start with the grid balancing, EVs as a grid balancing resource. I guess all of you, can you comment on that and your thoughts around that, and the time frame in which we should really be looking to depend upon that or not.

We'll start first, Dana, do you have thoughts?

DANA LOWELL: No. I was hoping Charlotte would go first.

KERI ENRIGHT-KATO: You can let her go first. That's fine.

DANA LOWELL: I think EVs are, as Charlotte said, and I agree that EVs are a great opportunity, are going to be a great opportunity for utilities to make money and to actually support lower rates for all customers. You know, it is a very significant load that is available that's going to increase throughput through the system and increase utilization of existing assets, and that there is a great benefit. Now exactly when that's going to happen or how and what the time frame is, I mean, I think we've been doing a little bit of research looking at sort of

just the commitments of auto manufacturers and all the new announcements and things, and it does -- you know, progress could stall. And I don't want to be too rosy, because I don't want to give the impression that there isn't public support that's still required, but it does appear like we are kind of maybe on the cusp of EVs starting to make a turn and become significant.

Unfortunately, without continuing sort of policy level support at all levels of government, I think that can easily stall. So it is important for these types of hearings and for people to continue to think about how we can support EVs, but we are starting to see in the marketplace, we are actually starting to see auto manufacturers make, I think, significant commitments to the technology moving forward, and we're also even starting to see people like Shell making investments in EV charging. So I think that's important and an interesting thing that's happening and an important sort of signal.

CHARLOTTE ANCEL: Agreed. We're going through a clean energy transformation where we have this 100 year old grid that was designed to be centralized, so there were a couple large

nuclear and oil and gas-fired plants and maybe like a sprinkling of hydros in certain strategic places that pushed power throughout the whole grid. And now we are -- I think we are on an inexorable march, so you're not going to put the genie back in the bottle to have a totally decentralized grid that will have more and more smaller distributed resources, and electric vehicles are going to be included in those distributed resources.

Right now I would say they do have grid balancing value. We're not yet, in my view, at a place where the technology, vehicle to grid technology, has advanced enough such that you can reliably, beyond a couple pilots in Europe and a couple here, be able to reliably draw on an electric vehicle battery to actually dispatch and shave your peaks. But we are able to have -- one thing that we're learning, and I saw this in Vermont where we had a substantial amount of solar, small-scale solar on, is that one thing with distributed generation is you end up having spots where you have way too much generation and not enough people or load to use it. And that can be really corrosive in terms of -- that would be

an example of an unintended consequence where you may actually be increasing costs to customers instead of decreasing them. And electric vehicle charging could be one of those flexible loads where if we have places -- there's a whole part of the northeast kingdom in Vermont where we built these grid projects and solar projects, and it abuts the Quebec border, and there's too much generation and not enough load, and so I know one of the things that like folks at Vermont Energy Investment Corporation and others have been looking at is can we site some electric vehicle charging up there to provide some energy use to balance that. So that would be the first example. We're looking for pilots and opportunities to do that here in this state, and then we think going on longer, the dispatch, the two-way dispatch of vehicles would be a grid resource.

I'd also note that for all of this stuff we have to be patient with each other and leave space because we don't get it perfectly. One of the things that I worked on earlier in my career, which was a super -- a bunch of us worked on, was this idea that the utility is going to be able to provide every customer a residential scale

behind-the-meter battery that might be like part of your meter so you get it as part of electric service, and we would use it to dispatch onto the grid when we need it, and customers could get like a Tesla Powerwall for $15 a month. We did a lot of work on it. There's a bunch of folks doing it now.

And then I had this guy at Navigant point out to me that electric vehicles, which are going to be parked in all of our driveways, are actually a much more massive scale battery that could provide all of those same benefits and require no incremental investment by the utility or the customer because I'm already buying my car. So I might have the ability to have a much more extended backup. That wasn't something that I actually ever really thought of before. So I would say with electric vehicles as a grid balancing resource, there's going to be a lot of examples like use of we'll use them in ways that we might have not initially thought.

KEVIN MILLER: I agree with all those points. Generally, I'd say that now is really the right time to be at the very least planning and preparing to incorporate the new load that's going

to come onto the grid attributable to new EVs. Our charging infrastructure is already bidirectional, right, so allowing for vehicle to grid capabilities, but a lot more has to be done on not just the equipment or OEM side but on the liability side, and then planning with our utility partners, and the opportunity on those three use cases I targeted before, in addition to the workplace duck curve help, you know, you have the opportunity for demand response, frequency regulation, a lot of different ways to help support grid operations.

And one of the things that makes this more pressing is ChargePoint has been recently starting to deploy our new DC fast charging infrastructure which is scalable, right, it starts at 62 and a half kilowatts and goes to 400 to 500 kilowatts. That's going to be great and support longer term travel or longer distance travel as well as heavier duty vehicle electrification. But what we don't want is a situation where we're replacing the fueling paradigm with that. Right? So to be able to make sure that we're looking at the load balancing needs now so that we can set up rate structures and set up load management systems

in place so that even though that option is there, that's not the only place that folks go because that would not be ultimately to the benefit of the grid and ratepayers.

DANA LOWELL: I agree. That's a very, very, very good point. I think that if EVs are going to work and they're going to be affordable, we have to have a different fueling paradigm. We can't be driving towards an EV just like a gasoline vehicle, because no one would be able to afford that. We need to take advantage of the fact that EVs are sitting in the driveway for 12 hours a day every day and use that time to charge and figure out how we can make sure that 80 percent of charging happens at home and only 10 or 20 percent happens in public, because that is what is actually going to work for the owner of the vehicle and also for the grid.

KERI ENRIGHT-KATO: That was insightful. And another question about EV clustering. So do we need to be concerned about EV clustering or local circuits and what are possible solutions, if so? So I think you kind of briefly touched on it earlier, Charlotte, if you want to go ahead.

CHARLOTTE ANCEL: We think that like everything any good thing can become bad for you if you do it in way excess, and that would be true, obviously, could we say that there is no scenarios where having a bunch of electric vehicle charging in certain areas could shut our grid down? Absolutely, it could. We think, though, the data, if you look at -- and Kevin Vaughn who leads all things electric vehicles for Eversource will give you a lot more -- the data on, for example, California's experience has shown that that hasn't been the case. We do think, though, that utilities -- we are going to have to earn our way in to providing new value to our customers if we're going to continue to exist at all. And we think that one of the key values of that is being the grid operator and balancer, and so that we will have -- we need to evolve that role through what we describe as choreographed load aggregation of vehicles to avoid that. That will be on us.

KEVIN MILLER: And I would agree with that, that need to have that action and that role taking place is critical. In order to get there, one of the things that -- I don't mean to speak for the utility -- but I think that would help

would be to have visualization into that charging behavior right at the level necessary to be able to make those decisions. So you can say circuit by circuit, neighborhood by neighborhood, block by block you can have visualization.

So the point that I made earlier about making sure that we're allowing the right kind of technology to be used as an end use meter, not a utility scale meter, but for the purpose of measuring and providing visualization into charging behavior, that's really critical, and to make that information openly accessible and freely accessible through application program interfaces, APIs, or through, as Tom earlier mentioned, OpenADR for the actual and execution of load management, but it starts with knowing what's happening and where it's happening.

DANA LOWELL: I also agree. And I think it's one of the reasons why some of the examples I showed what the utilities are looking towards beyond time-of-use rates, I think a lot of utilities are really thinking about the fact that letting the utility have a certain level of control over your charging behavior can provide significant benefits, not just in terms of total

load reduction, but also this issue of pocket load reduction as well. There's like multiple benefits associated with that.

KERI ENRIGHT-KATO: And I'll move to the audience, but there was a follow-up kind of on this data collection. So thinking about the ConEd program and the other ones you mentioned, is that data available? At what level is it available to the public so that everyone can use it for planning, or should not be, you know, what -- it kind of sounds like you want access to that -- but what are the different components?

KEVIN MILLER: I mean, so ultimately we don't own the data, right, so our customers do. I think in many cases when there are utility programs, participation is conditioned on making a certain level of data available, either in aggregate or at the end of the program so that insights can be gleaned, and that is critical. At the end of the day it's essential that personally identifiable information not be communicated or conveyed.

So what is the information that needs to be made accessible and how do we do so in a way that achieves what we're getting to and also

provides the right degree of consumer protection and consumer confidence. So the difference between one type of meter and the other, one can have arguments, but at the end of the day if we're having divisions of metrology and seal deli counter scales so that they're accurate so people know that they're getting what they paid for, how do we make sure that we're doing that equally across the board. And so in the California one, the metrology division is taking the lead in certifying a certain tentative code for smart EV charging stations just so we make sure that we have that consumer protection piece in place. So I think it's a balance of how do we protect the right information, and how do we make sure the consumer gets what they paid for.

KERI ENRIGHT-KATO: Okay. Others have any thoughts there?

(No response.)

KERI ENRIGHT-KATO: Okay. I'll go ahead and open it to the audience. I see Claire queued up. Others, if you're interested, feel free to step up to the mic.

CLAIRE COLEMAN: Hi. I'm Claire Coleman, an attorney with Connecticut Fund for the

Environment. Thanks for the great panel discussion. Thanks also for providing the EV coalition building codes effort and Senator Winfield's bill next Thursday. We hope everyone here will come out and testify in support of it.

And Charlotte, I'm thrilled to hear that Eversource is going all-in on electrification. That's wonderful news.

In terms of the discussion before us, my question was somewhat answered by some of Dana's comments earlier while I was sitting here, but I was hoping you could flush out the set-it-and-forget-it concept a little more. Currently right now so I'm a UI customer and have time-of-use rates, come home at 6, drive in my driveway, set the two-hour delay timer on my charger so my charging starts at 8. And in my mind that's sort of a set-it-and-forget-it framework. It sounds like what you're suggesting is to allow a little more utility control when that electricity flows through, but if you could just -- and thinking about deploying and getting consumers to engage more in EVs, how is that accomplished?

CHARLOTTE ANCEL: Sure. Great

question. So I think at like a first principle level, time-of-use rates are designed like a classic utility principle of, you know, one thing that's interesting is all the classic utility principles, when you drill through the jargon of them, they're all actually very rational because they're all designed to protect customers.

So the point of time-of-use rates is we have this principle of cost causers pay that dictates how we charge for everything. So we mean that you as a customer should be paying what your fair share of the marginal cost, meaning anything that we have that's beyond what we would have just to run our regular business to serve your specific needs.

So time-of-use pricing and people that have more -- please, I hope other people will jump in if you would describe it differently -- but time-of-use pricing at a high level is supposed to be -- give a customer an incentive, like a more closely real-time incentive so that you change your behavior in a way so that you know that like you can act better because prices are lower. So you know all of that so well. I just always have to start from that point because I get all tangled

up. And the CEO I used to work for at Green Mountain Power -- so a lot of people don't like time-of-use rates now, and so I think sometimes it's good to start with what is the point of time-of-use rates and we all agree on it.

The set-it-and-forget-it is getting at the same thing. It's finding ways to change customer loads, to take down our peak costs, but it does it in an automated way through some type of either preprogrammed control, or I think now more in the 21st Century like a utility or grid platform operator control where you're sending direct signals to that specific charger based on -- through your control room based on when actual either distribution circuit level peaks are, statewide level peaks are for transmission, or yearly level peaks are at capacity, but just it doesn't rely on you as the customer to have to take any affirmative action. You just in concept -- and we have to be careful about all these beautiful elegant concepts that are really hard to actually deliver on the customers -- but in concept you just plug in your charger, and when you come out in the morning you have a certain threshold level of charging.

I probably didn't add anything to everything you already knew or describe there, but that would be our view. I'll let others respond further.

DANA LOWELL: I think that the ultimate goal would be some level of utility control charging, and then if you get at high enough levels of EV penetration, it may almost be necessary to have that level of control to maximize benefits, but there's an awful lot that can happen in the short term without that level of control.

And, you know, I'm just going to throw something out there. I think the auto manufacturers could help out a lot here if, you know, as soon as you turn off the car a screen comes up that says this car will be ready at 7 in the morning, is that okay, and you have to opt out. And if you want it at 5, you have to actually press a button to make it happen. And then the car has enough smarts and the charger on the wall has enough smarts to control it so that it doesn't start until it needs to. A lot can be done automatically just by the technology on the charger, and a lot of it can be done just

requiring the EV owner to opt out, right, to program what's good for the grid as a default, and if you want something different you have to opt out instead of opting in.

CHARLOTTE ANCEL: But you still need -- the only thing with that, Dana, though, is you still need the grid platform operator to say when there's value and when there isn't. I agree on all of it, but I think that whether it's the -- we'd love to see -- we don't want to own the chargers. We don't want to own the vehicles. We just want to help provide -- be a platform to unlock value.

DANA LOWELL: No, no, I agree. To absolutely maximize value, I do believe there's some level of grid operator utility controls required.

CHARLOTTE ANCEL: Or at least sending a signal to --

DANA LOWELL: In the long term. In the long term.

KEVIN MILLER: I agree with you both vehemently. I think that both are really important angles, and I think sending the signal is critical and making sure that there is that

sort of a consumer protection. Are you just sending that notification to a driver once when they get home, or are you making sure that if they're charging somewhere else and an event is called that they're getting notified, right, through a smart phone app, whatever it is, just so that no one gets caught unawares because at the end of the day these are still cars, and if they can't be used like cars, you'll have challenges when it comes to adoption.

In terms of the question of offering things as a service, I think the service-based model is really interesting for providing fuel itself, right, when you have a package deal for utility if it's providing the infrastructure, ChargePoint offers a service-based subscription model to charging stations. But making sure that at the end of the day that we're balancing a consumer protection need, right, is there an opt-in, opt-out versus how do we take advantage of the ability of the charging ecosystem to amplify and accurately deliver pricing, right, because all the different stakeholders from the driver to the site host, to the utility, to the regulator have interest in accurate sending of signals that also

meets the drivers' needs. So it's making sure that we're balancing that and taking all those into consideration while still making sure the grid operator knows how to look into and ensure that adverse affects aren't happening as a result of this what is otherwise going to be a beneficial technological development.

CHARLOTTE ANCEL: And we're open to hearing. If there are customers -- you know, we're the utility. We're always trying to think -- and we're trying to think more and more about what do our customers want. So as customers, though, if there's a benefit in terms of classic time-of-use rate and design that what I just described doesn't provide, we're really open to -- we're curious, and we'd love to hear about that.

KERI ENRIGHT-KATO: Sorry. You can go next, Mark. But would there be a disadvantage or a reason not to provide multiple ways, so time-of-use rates and incentives?

CHARLOTTE ANCEL: That's a great idea. Maybe collect some data on both and see how they go.

DANA LOWELL: The biggest disadvantage

with time-of-use rates is that for good reason public utility commissions require utility grade meters to be very accurate and to have that actually checked on a periodic basis and for good reason, and that is very expensive. So if you're going to -- you know, I agree that meters or the chargers today have enough smarts to measure.

KEVIN MILLER: And they have the same accuracy and metering capabilities.

DANA LOWELL: But it's an issue of regulation.

KEVIN MILLER: Sure.

DANA LOWELL: The regulators have to be convinced and there have to be continuous convincing that that's going to be continuously true.

KEVIN MILLER: Yeah. And that's why you make sure that you can verify that data is critically important at the end of the day. How do we make sure that what we measure is what actually took place, and that's a process that doesn't happen overnight. That's why in Minnesota the public utility commission is going through a pilot process of just 100 stations. So how do we make sure that what we're doing is feasible,

because they identified a barrier to TOU rate subscription as the cost of the additional meter. And so in evaluating the different options if we're making sure that charging will take place in the future when it could potentially have adverse impacts, and making sure that that takes place in a manner that benefits the grid, they wanted to figure out what are the ways to overcome that barrier, and this is just one option. In addition, there are many others.

We are also participating in the ConEd program. I really appreciate the great proposal that we're starting to see shape up by Eversource in Connecticut. But how do we make sure that we're looking through and making sure that the regulators, not just from the PUC perspective, but also from the consumer protection angle, weights are measures, are making sure that folks get what they pay for, and that it isn't costing more.

DANA LOWELL: The ConEd example is a good example. ConEd is using a device that plugs into the OBD port in the car, like every EV to tell you how much energy it uses, charges data available there. They're using that to provide incentive payments to people. And they can get

away with that because it's not a bill. Right?

KEVIN MILLER: Sure.

DANA LOWELL: So there's a level of required accuracy or assumed accuracy associated with that, and they can do that. But when you get into the ratemaking process and the whole process, there's a whole other level of requirements. So it's not that the PUCs are wrong or anything. It's just the technology is changing. We all have to sort of work out --

KEVIN MILLER: Sure.

DANA LOWELL: -- what data is available and how accurate it is and all understanding, be able to all agree on its accuracy so that it can be used.

KEVIN MILLER: Just two final points on that. So I agree about ConEd. I think they've taken the technology neutral approach moving forward where they're allowing multiple forms of technology to implement their smart charge program. So that technology agnostic approach is really helpful.

And the other point that I'd say is I think it's broader than just the TOU rate issue when we think about the need to accurately measure

that type of electricity and that type of service that's being delivered at the charging station from, again, the voluntary credit market opportunity, if there is going to be exploration of a clean peak program, as is being explored in Massachusetts. How do we make sure that this potential new load can participate in all different kinds of mechanisms, especially as the transportation initiative discussions continue, that there's more value beyond just is this a TOU rate issue in terms of visualization and verification.

KERI ENRIGHT-KATO: Great. Mark, thank you for your patience.

MARK SCULLY: Hi. Mark Scully from Peoples Action for Clean Energy. This is an extremely exciting discussion, I think. I think the use of electric vehicle batteries as a distributed storage I think will transform this industry as it becomes a revenue source for people buying a car, it changes the economics of buying an electric vehicle. A lot of work has been done by Professor Willett Kempton of the University of Delaware and this Vehicle to Grid concept. And one of the interesting things is we think about

shifting load and taking kilowatt hours to and from the battery, but one of the more actually lucrative and valuable goals you can play is if your battery is plugged in and the grid needs these ancillary services of voltage and frequency regulation, we can do it instantaneously with a battery. It doesn't need to fire up a peaker plant. So the economics, I think, are going to be so powerful that we'll have to make this happen.

There are a lot of obstacles, and we talked about this at the recent meeting. One of them is the manufacturers don't want you tapping the battery going back and forth. It might void the warranty. So one suggestion I would make is to move this whole concept along we might consider in Connecticut a pilot project, a vehicle to grid pilot with fleet vehicles where they are fully integrated with the grid, and they're not just sitting in the driveway 12 hours, they're sitting at work for another ten hours or eight hours. We drive our cars 5 percent of the time. So the rest of the time that can be a resource to the utility. It's going to be transformative. So if we could do a pilot in the state of some fleet vehicles at the airport or in the city, that might be a great

way to sort of demonstrate the technology and sort of just move it forward.

So not really a question, just a suggestion and an observation, but tremendous discussion, really exciting.

KERI ENRIGHT-KATO: And I'll let the panelists, if they have any following thoughts on that. And just, you know, he mentioned the airport. Is there a pilot that you all know of, of airports and long-term parking with electric vehicles as a grid resource?

KEVIN MILLER: So first I'd say we shouldn't stop at one pilot. We should always have more and explore. I think there's lots of opportunities at airports, right, from long-term charging to the equipment itself. When you look at the opportunity for non-road equipment electrification on the heavier duty side, that's where you see a lot of exciting opportunities, especially for the environmental benefits that come with it. We are working in the airport space and are supporting a lot of regional airports in the northeast, but in terms of the long-term parking piece, it's not one that we've specifically worked on yet.

KERI ENRIGHT-KATO: I actually drove to the airport on Sunday and did not take my electric car because I was like why would I let it sit there all day, I'll let my husband drive it. But had I maybe got some value out of it, that would have been a different decision.

KEVIN MILLER: Sure. Parking lots, right, a lot of opportunities where you can see value to be created.

KERI ENRIGHT-KATO: Do you have other thoughts on --

CHARLOTTE ANCEL: We're going to add it to our list. And we actually are looking, and if there's an opportunity in the second phase of PURA's grid mod docket, which by the way PURA provides great value, and when you push us on stuff. I've just learned, I know you weren't saying otherwise, Dana, but usually the PUC is always right about this stuff in terms of the concerns. So we respect that.

DANA LOWELL: I wasn't saying they're wrong, just technology is changing.

CHARLOTTE ANCEL: Totally. We're hoping that we're going to be able to propose something that has a big scope in that phase 2,

and maybe there will be an opportunity to work something in there.

DANA LOWELL: Not to throw cold water, I'm a little bit of a V2G skeptic, so I just wanted to make one point, which is that for V2G to work I think you have to be able to take advantage of the randomness of people's travel behavior. And so it requires a certain level of penetration which I don't think we're anywhere close to right now. Fleet vehicles tend to have more predictable travel behavior than sort of just a similar group of residential, you know, personal vehicles. And so implementing V2G on fleet vehicles I think could be difficult depending on the duty cycle of the vehicle. Certain duty cycles may be very amenable to that, others not.

Off the top of my head, the single type of fleet vehicle which is probably most amenable to it is school buses because they are not used in the summertime when we have a big peaking problem and they're generally just sitting around. So, you know, that's, I think, a specific example of how there might be a really, really good correlation between the duty cycle or usage pattern of the vehicle and the needs of the grid.

KEVIN MILLER: I want to agree with that right there. The fleetification of transportation is really critical and presents opportunities but not in the same way, right, across the board. So ChargePoint is participating in Con Edison's school bus V2G pilot where you have that duty cycle which rapidly changes when it gets really hot out and people are turning on ACs, so there's real value there.

And I would also agree that V2G is not the answer. It is a real opportunity for which we need to prepare, but we shouldn't do so at the expense of the 1G, just managing the load as it takes place. So be that through the utility, or if you have a deployment of tens, hundreds, thousands of charging spots in large appointment centers, that you're able to have those site hosts manage how much charging is taking place, and are you creating incentives for them to decrease that charging during peak periods. We can do so in real time on our network, and our customers do take advantage of that. They'll dial down 50 percent of how much charging goes out in a particular environment. So making sure that we're not forgetting about the opportunities that are

before us but also preparing for the ones that are --

KERI ENRIGHT-KATO: Rick, why don't you come up, and we'll let this gentleman go first.

PETER O'CONNOR: I'm from Plug In America. I've been following V2G for a long time, but I think --

THE COURT REPORTER: Would you state your name, please?

PETER O'CONNOR: Pete O'Connor from Plug In America. Just another comment on V2G is that Dr. Kempton didn't recognize how easy wind and solar became the grid, so the prices of those services are not very high, and they are saturated by stationary storage, which is getting spillover benefits from EV technology improvement, and importantly (inaudible) which your vehicle sitting idle in the driveway 20 hours a day, that might not be the future. We have shared transportation in a larger fraction. We have different solutions for charging, charging depots for Uber, Lyft. Things could change a lot. So V2G was a great idea in '97, but a lot has changed since then, so I'm skeptical as well for a few different reasons. But we could still manage charging for load

shifting.

NANCY RYAN: Hi, Nancy Ryan from E3 again. I'll just add a little bit more to this discussion. In my opening remarks this morning I talked about the need for deep integration between the decarbonized electrical system and heavily electrified transportation system. And when we look at grid balancing services in that context and think specifically about services that vehicles can provide, what we see is, A, consistently what Pete just said that frequency regulation is a pretty small portion of the value that can be reaped, but that load shifting, whether it's in the daytime hours on solar dominant systems, or in the nighttime hours in wind dominant systems, like that's really where the value lies. And much of that can definitely be reached with just conventional V1G. I think V2G can be useful in cases where -- anyway, when you have like the sun going down and everybody coming home, and situations like that, then like V2G could be really valuable there where you've got the opportunity for discharge. Well, as you think these things through, it's important to get that empirical grounding.

KERI ENRIGHT-KATO: Okay. Did you have a question?

RICHARD HANLEY: I'm Richard Hanley. I'm with the Connecticut Department of Transportation. So this is going to be sort of a Jekyll and Hyde question because I'm on my state mandated coffee break right now, if I could ask a personal question.

So to Charlotte, on the time-of-use rates I was old enough, or I am old enough to actually have been there when they put those in. And when they started, you got the equivalent amount of discount for the -- on the downside or the savings that you got for the surplus or the surcharge. Over time that's shifted now so that the surcharge is approximately three times the amount that the discount is. So when you're sending a signal, as Kevin mentioned, I would agree it's important to send a signal, but you've got to send enough of a signal, and that's not enough of a signal to convince people, I think, to move to where you'd like them to be.

The other thing is, too, is that I don't know, but I think you need to use the Rate 1 in Connecticut if you have solar on your house. I

don't believe you can use Rate 7. So those were two things that I was going to mention.

Now on to DOT business. So I'm going to be working with DEEP and all the nice folks up here on deploying 12 electric buses, and we'd like to charge deep in the middle of the night, and we'd really like some good incentives to move that charging to the middle of the night. Listen, I'm not going to talk about the metrics. I promise I won't talk about that. But I did want to just sort of put that forward and say that I think that there's a lot of possibilities, especially in the electrification of the fleet, that we're really going to be taking a hard look at this.

And a lot of people were taking about transportation electrification. It would be nice if -- I just wanted to let you know that DOT is the largest user of electricity in the State of Connecticut, and that we have already done a big piece of electrification. If you look at Metro North, that entire system is all electric; it's not diesel. So I want to get a little credit back for the agency.

(Applause.)

RICHARD HANLEY: So anyway, but those

were just my comments, and it's been a really good conversation.

KERI ENRIGHT-KATO: Thanks, Rick.

KEVIN MILLER: Can I quickly say a couple points?

THE COURT REPORTER: Can you speak into the mic for me?

KERI ENRIGHT-KATO: You kind of have to eat the microphone.

KEVIN MILLER: I really appreciate the focus on fleet electrification. It's one of the things that ChargePoint supports and that the EV coalition is really looking forward to seeing more of. I think you bring up a key issue, how do we make sure that the right incentives are in place. And some of that can be done at the grid scale, but also how do we make sure that as it's being designed it's minimizing the potential cost of creation. So ChargePoint works with fleets, you know, around the country. We partnered with a large municipal transit fleet and helped them get from what they thought would be a 5 megawatt deployment of charging stations down to 3 and still get the job done. So how do we make sure that across the board that's happening in a way

that creates value and minimizes cost is really important, so I just wanted to --

RICHARD HANLEY: And that's something we're working on internally and we've been also working with bus suppliers is we'd really like to see some real high tech and very versatile charging profile equipment. A lot of it's sort of on the horizon. But for fast charging I was looking at rates of up to 120, 150 kilowatts per charger, and it would be nice to be able to have those types of systems that could, you know, program 30, 40, 60, 100 chargers for overnight charging.

KEVIN MILLER: I'll catch you --

RICHARD HANLEY: Okay. Very good.

DANA LOWELL: And actually you make a very good point. You know, I'm a transit guy, and I've been doing a lot of work for transit agencies looking at bus electrification and doing modeling around depot-based charging, which is primarily night. And in places like California where they have a pretty robust commercial rate which includes higher demand charges during the day than it does at night, you can see that depot charging is way cheaper in California.

But I've also been doing work for Vancouver where BC Hydro's rate it's a flat rate, demand charge is the same throughout the day. And in that situation charging the buses at night at the depot will actually be more expensive than charging during the day. So depending on the rate structure, you can definitely send incorrect signals.

KEVIN MILLER: That's a great point. And one last personal note since we're on my coffee break right now. I just want to say that I'm also really committed to this personally because while I've driven in an EV, I don't own an EV, but that's because I don't own a car. So I think in order to make sure that everyone can drive and ride electric, we have to make sure that we're creating those options for everybody, and we have to make it work for our fleets.

KERI ENRIGHT-KATO: Great. So I have one more question. We have time for one more question. Is there anyone in the audience? I will give up my question if you have any.

(No response.)

KERI ENRIGHT-KATO: Okay. Great. I will use this space then. So we talked a little

bit about distributed energy resources. So in your mind what does the integration of EVs and DERs look like to help with the costs of the potential of an increasing demand making electric rates go up? So what are some solutions for maintaining electric rates so that we're not seeing increasing rates across all customers and what the role of DERs might be?

CHARLOTTE ANCEL: You go first.

KEVIN MILLER: I'll be brief. So I think Dr. Ryan pointed out two really important issues, which in San Diego Gas and Electric's experience in Southern California one of the benefits of having a really shapeable load from increased EV adoption is the ability to integrate, right, with distributed generation, and just deferring to earlier comments and earlier discussions, that making sure that the utility is able to have visualization into and the ability to influence and send accurate signals for utilization will maximize the value of EVs on the grid which is a really beneficial shapeable load that is responsive to signals, be they price signals or programmatic in nature.

KERI ENRIGHT-KATO: Okay.

CHARLOTTE ANCEL: I described our view of our vision of being a grid platform. And, you know, we believe in regulation, and it's always a balance of making sure that you are pushing on the utility to provide and articulate new value for customers. But then we also have the example like wireline telephone providers. I grew up in northwest Connecticut. My parents still live in the same town. They still have wireline service because there is not cell service where they are. And their wireline service is awful. Like I've had times where I call and I can't get through for like a day, and it's because the wireline business is still that incumbent business, but it's been stripped down, stripped down, and it's dying.

So we think that we want to be a grid platform that continues to be well regulated by PURA and advised on by DEEP and all of our stakeholders, but also making sure that we get opportunities to thrive and invest in those new ways in our business. Because the grid infrastructure is going to be around for the next 50 years, and we don't want to go the way of the wirelines for customers.

DANA LOWELL: I'm not sure I have

anything intelligent to add to that.

KERI ENRIGHT-KATO: Okay. Great. Well, I'll go ahead and close up the panel and just thank you all. I thought it was a very lively and good discussion. So thank you for your time. And with that, we'll head into a break.

(Applause.)

(Whereupon, a recess was taken from 2:47 p.m. until 3 p.m.)

KERI ENRIGHT-KATO: We'll go ahead and get started with the last panel.

MS. SAVIDGE: Good afternoon, everyone. Thank you for being here, and welcome to our fourth and final panel of the day, navigating demand charges. My name is Lauren Savidge. I'm the director of the office of Energy Supply here at DEEP. And thank you to our panelists for being here.

First we have Rick Rosa. He's a principal business development professional in the programs and products unit at the United Illuminating Company. Rick has been with UI for the past 20 years and began working on electric transportation in 2007.

We also have Chris Nelder. He is a

manager in the mobility practice group at Rocky Mountain Institute in Boulder, Colorado, where he heads the EV grid integration team. Chris has written about energy and investing for more than a decade.

Our last panelist today is Watson Collins. He is the technical executive on the EPRI energy utilization team. Watson is a licensed professional engineer who joined EPRI in 2017 after more than 34 years of experience leading strategic projects for Eversource Energy.

And with that, I'll pass it off to Rick.

RICK ROSA: Good afternoon, everyone. This is the last presentation on a Friday afternoon on the exciting topic off demand charges. So I want to thank you all for sticking around till the very last end, which means you'll all very interested in what we have to say here today.

So when we talk about demand charges, it's important that we talk about time-of-use rates because time-of-use rates provides the opportunity to navigate demand charges in probably one of the easiest ways there is to navigate

demand charges, which is do not charge on peak. And when we talk about navigating demand charges and we talk about navigating peak demand, it's important that we not overlook to charging off peak or focus solely on demand charges, because if we do that, then we're going to miss a huge opportunity for a very flexible load in electric vehicles that could be used to help make the electric system more efficient.

When you think about it, our entire electric distribution system, actually generation and transmission distribution system, is designed around just to supply enough electricity for a very short period of time during a few hours of every day. That's not just in our service territory or Connecticut, it's throughout the entire country. And so that's a very inefficient way to design a system, but that's the way it has to happen because you have to make sure you have enough electricity and capacity to provide everyone that needs it. So it's important that we encourage the use of off-peak charging to the fullest extent possible.

Now, obviously there's going to be charging on peak, and there's going to be charging

on peak that is coincident to the system peak that we have here in Connecticut and within UI's service territory. So we want to try to understand today how we might be able to mitigate some of those issues that are potential barriers to the deployment of DC fast charging equipment.

So what are demand charges? Some of you here may be very familiar with demand charges; some of you may not. For those who are very familiar with demand charges, my apologies. For those of you who are not, I'm going to give you a little primer. So, essentially demand charges are the way utilities charge for bandwidth, right. You have internet at home, and if you want high-speed internet, that actually requires more bandwidth from your internet service provider. So you pay more for that. It's also very analogous to your wireless data plan. If you want more data in your data plan, you're going to pay more because it's going to require your wireless carrier to provide a bigger pipe, a bigger bandwidth capacity for you to have that data to stream video, and that's the way electricity works as well.

So when we talk about demand and how

that impacts people on the electricity side, people consume electricity, you have very different types of consumers, particularly when it comes to commercial/industrial customers. Right? And so if we use this example that's on the table, you can see that Business A has five motors that they use in the operation of their business. Each one of those motors has a requirement of 5,000 watts, or 5 kW, and they use that 5 kW for 10 hours a day. Their total kilowatt hour consumption is 50 kilowatt hours. Business B, on the other hand, has one electric motor, and that electric motor has a total power demand of 50,000 watts or 50 kW, and they use that for only one hour a day. So if you do the math, their kilowatt hours are exactly the same as Business A, but they use twice as much bandwidth or power required for the same kilowatt hours.

So you could look at those two columns to the right, total kilowatt hours and total demand, as your speedometer in your car and your odometer in your car. The total kilowatt hours is your odometer. It's how many miles you've traveled. Your total demand is your speedometer, it's how fast you went. So Business A and

Business B traveled the same amount of miles, but Business A drove half as fast as Business B. So put another way, kilowatt hours and the amount of electricity over a period of time and kW or demand is the maximum amount of electricity used at a single point in time.

So why do we have demand charges? Well, let's go back to Business A and Business B. Business A, as we said before, has 5 kW motors that they use for 10 hours a day, and they consume 50 kilowatt hours of electricity. Business B has one 50 kW motor that they use for only one hour during the day. Therefore, as we showed in the chart before, Business A's demand is 25 kW; Business B's demand is 50 kW.

Now that electricity, that power supply, that demand, that energy, needs to come from somewhere. And it comes from generators, it comes from nuclear power plants, it comes from gas power plants, it comes from solar, and it comes from wind. Since we're talking about electric vehicles, we're going to say that Business A and Business B get their power from solar. So Business A has to have solar power that will provide enough capacity, enough electricity,

enough power, to meet his entire demand for the full 10 hours of the day. So that amount of solar will meet Business A's demand, but that same amount of power will not be meet Business B's demand. It will get him as far during the day for half of the demand, but to get his full demand for the whole day he'll have to have twice as much energy delivered.

Because of that, the utility has to build and maintain a distribution system that's capable of meeting Business B's load for 24 hours a day even though it's only used for one hour a day. This is very similar to a sewer system or even a highway system. Sewer systems are designed for maximum flow from a large amount of rainwater. Highways are designed for their peak capacity. They're not designed for a small amount of traffic, and obviously in a lot of cases they're not designed for a lot of traffic either, so if you've ever been sitting in rush hour at 5 p.m. But both of these systems break down when they're overtaxed when too much is asked of them, and it's the same with the electricity system. If too much demand is placed on the distribution system, it can break, it can fail, just like any one of these

other systems.

Lastly, demand charges impact commercial/industrial customers in UI's service territory that exceed 1,560 kilowatt hours per month for a single monthly billing. So from that explanation of demand, we can directly translate that and correlate that to how that impacts an electric vehicle charging station or stations.

This chart is taken from a report that I encourage you to take a look at, it's very interesting, done by the Electric Vehicle Transportation Center. It's a cost analysis of workplace charging for electric vehicles. And I could have chosen a lot of charts that are out there that illustrate the same point, and many of you may have seen similar charts before, but the orange solid line is a DC fast charger, and that's the load curve of that DC fast charger. The orange dotted line is the state of battery charge for that DC fast charger. The blue represents a Level 2 charger, and the green represents a Level 1 charger. This illustrates, I think, very clearly the differences between the types of equipment and the demand that each one of these types of equipment require.

By the way, each one of these graphs is represented by a 2013 Nissan LEAF charging, the same vehicle charging on each type of charging equipment. And also I would also point out that the stated charge on the battery for the DC fast charger is 100 percent and about in this case less than just about 45 minutes. For the Level 2 charger it takes about almost a little over three hours to get to 100 percent state of charging. The Level 1 charger never quite gets -- only gets to 30 percent over the whole four and a half period of this temporal scale on this chart.

So demand charges help to balance the grid in the sense that when you look at how much electric vehicles may be registered in the State of Connecticut over time and how they might be charged and how much load that represents to the electric system, I was actually kind of pleased by the last presentation because some of the numbers presented were very close to some of the numbers that I put together for this chart. But this is a very, I think, conservative approach to projecting how much coincident peak load we could experience in UI's service territory if the state were to reach its ZEV goals by 2025.

And I'm not going to go over all the assumptions that were made, but at the end of the day we see that we can expect by 2028 over 43,000 PEVs registered in UI's service area alone by 2028. That's BEVs and PHEs, which, depending on charging habits but based on the assumptions here, it could add an incremental 60.5 megawatts of additional coincident peak load. And when I say "coincident peak load," I mean coincident to the system peak that UI is experiencing at any given point, and in 2018, for example, that occurred on August 29th at 5 p.m.

If we add that amount of coincident on peak, I agree with Charlotte, it's not going to necessarily shut down the distribution system, but it is a significant amount of load, and I think it's not to be overlooked. The reason we have demand charges is that the utility needs to be able to supply -- make sure that they have the distribution system in place, all of the equipment, all of the lines, transformers, everything that we need to build out the system to be able to accommodate that. Depending on where all that demand occurs, it's very hard to now locationally say, okay, I can maybe forecast what

my peak load might look like coincident to my system peak out ten years, I can run several models. But when we start to talk about where that load might be pocketed, it becomes even more difficult. And so while that 60.5 megawatts may not be a deal breaker for our electric system, there could be specific pockets of areas where substations may be already strained, that we have high incidences of demand for electric vehicle charging that will cause potential issues.

Shifting from demand causation, what demand is, and demand causation, let's look at, this is that same study done by the Electric Vehicle Transportation Center. Demand charges are a temporary barrier to DC fast charging in the sense that when they are utilized at their minimum capacity, the cost per charge is going to be much higher than if they are being fully utilized. And this table has been adapted from that study that I told you about. And all I did was simply plug in UI's current tariffs to give you an example of what it looks like when you have underutilization of in this case workplace charging, but we can apply this to any form of charging, like we can apply this to a singular DC fast charger, you

know, pick one.

So the top three you could maybe say are references because Rate R, our residential rate, is really primarily the base case. There's no demand charge. And with GST nondemand, which is that less than 1,560 kW customer, there's no demand charge. Even Level 1 with demand is still relatively comparable with the other two. But when we start to get into Level 2 charging, and certainly DC Level 3 charging, you can see that the power requirements are much greater, so therefore the energy costs are about the same, but the demand component becomes much, much more significant. Right? And this is the problem for developers of DC fast chargers. Right? When we start to talk about how we can make a business case for increased DC fast charging, that's the barrier right now.

However, if you take that same scenario, that same set of scenarios, the same equipment, same charging equipment, and you maximize the opportunity for charging sessions on that equipment, you maximize the utilization of those chargers, you see that the cost comes down significantly. So Level 2 now is very comparable

to Level 1 charging, and DC Level 3 fast charging is not significantly higher except on an LPT.

Another thing I'd like to point out is these assumptions make the assumption that each one of these chargers is individually metered. That's important because if each one of these chargers were not individually metered, if they were part of this workplace's -- behind that workplace's meter, okay, then these charges could be even less. Because depending on what the demand, the demand of what that workplace provider is already existing, then Level 2 could potentially be just very much be noise for that particular workplace charging.

And I think it's unlikely that workplace providers would provide DC fast charging, I might be wrong on that, but if they were, they might have enough capacity to provide that and manage that load, whether it be Level 2 or Level 3, manage that load so that it's noncoincident with their peak load. Right? So as long as they're not charging -- allowing their employees to charge during their coincident peak load, which may occur at the 2 o'clock in the afternoon, which can easily be done through load

management, they can avoid increasing their demand charges, and so then we bring these costs down even further. And I've not done that math, so there's no next slide, but you'll have to just take my word for it.

So what can we do to help make a business case for DC fast charging? Well, in New York just recently two affiliates of the United Illuminating Company, NYSEG and RG&E, along with the other joint utilities of New York, filed a consensus proposal to encourage statewide deployment of DC facilities for electric vehicles. That consensus proposal was a collaboration between state entities and the joint utilities to come up with a mechanism to help overcome the initial or temporary barrier that demand charges present to developers for DC fast charging.

I think it's important to note that the consensus of the collaborative team established some shared principles on how this effort should move forward. The first principle was that DC fast charging stations should be on the appropriate cost-based electric rate, including demand charges, so that operators are encouraged to manage their demand levels, to manage bills, as

well as electric system impacts when the incentives for these DC fast chargers sunset.

They also agree that there is no cost basis for technology-specific tariffs such as specific EV rates. When I say "no cost basis," you can think of things like what we discussed earlier on this panel, the additional cost to implement an EV tariff only. You can also think in terms of time-of-use rates which we spoke of today. Essentially, it just didn't make sense to have a technology-specific rate for electric vehicles.

And they also agree that the proposal's goal was to provide limited-term cost relief to DC fast charging station operators to address the short-term economic challenges associated with those low utilization levels that we just talked about earlier.

So what came out of that was a program that provides an annual declining per-plug incentive payable to qualified public DC fast charge operators. There's not a lot of qualifications other than that they be publicly accessible.

The incentives are based on bills for

modeled DC fast charging in each utility's service area, and requires the utility to take service under a demand-based tariff.

So essentially the incentive pays the incentive on a per-plug basis. So if you have one charger and the charger has two plugs, you get the incentive, and those chargers can charge equally simultaneously the same amount of power, they would get that incentive per plug.

And the incentive is higher for DC chargers that are greater than 75 kW, because the program looks to encourage developers to implement DC fast charging that is next evolution or next step.

It's only available to DC fast charging stations that were placed in service after the program begins. And as I said, they need to be publicly accessible.

The chart below shows each utility in New York and how many plugs. There's a cap, and there's how many plugs that each utility would incentivize over the next seven years. And it works out to about, you know, about 1,000 plugs per year, which is a very significant number.

As an example of the incentive and how

it works, this is a chart that shows both NYSEG and RG&E's annual per-plug incentive. You can see it's a declining incentive. It starts off essentially replicating RG&E's and NYSEG's nondemand rates, and then it declines over time over the seven years. The difference between the two companies is really the difference in their demand charges. And so they decline over time until the incentives expire at the end of the seven years. So this is one way of potentially allowing the developers of DC fast chargers to hopefully help make the business case for DC fast charging until we can reach critical mass, until we can get to that point where utilization rates make the cost per charge much more cost effective.

I think we probably had some other discussion about utilization rates, but when we talk about fast charging, depending on utilization, there also becomes a point where demand charges and volumetric charges, or kW charges, basically become -- so there would be no charge -- no difference between how much your charge per kilowatt hour or your charge per kW would be.

The other thing that we wanted to talk

about on this panel, I think, is the incorporation of DERs and electric vehicle charging. And RG&E, again, an affiliate in New York, just recently completed at the end of 2018 a battery storage project that incorporates Level 3 DC fast charging. The goals of this program are pretty numerous. Those are all the metrics and all the measures of success. I'm not going to go through each one of them.

But suffice it to say that interestingly the demand curve, the load profile of the service center where this project is located is almost identical to the load profile of the circuit that it's located on. So because of that, one of the main goals of this program is to flatten the demand, the peak demand, that load curve, see if we can lower that curve to clip that peak demand. By doing that, the second goal is to see if we can do that while at the same time charging our fleet of increasingly electric vehicle -- electrified vehicles. We currently are on a program to replace all of our fleet vehicles with -- all of our light-duty fleet vehicles with electric vehicles, and we want to charge all of those fleets from that.

Lastly, my last slide here is I wanted to talk about electric vehicle and fleet charging. And UI is really excited right now to be engaged with the Connecticut DOT, DEEP, and our partners at Eversource to evaluate potential pilot projects that will help support Rick's program of electrified transit buses in New Haven and Bridgeport. Those will be funded through, as DEEP mentioned earlier, the VW funds that were provided. So I think New Haven is going to have 12 buses.

So the objective of our pilot project is to look at charging technologies, systems, practices, really the door is wide open at this point. We're going to have to narrow the scope eventually and probably pretty quickly, but we want to look at everything that's out there because we're on the leading edge here. I think DOT is on the leading edge, and UI, and I know Eversource we're excited to be on this path with them to identify some ways to help them be successful in electrifying their fleet.

The timeline for implementation of these pilots will coincide with delivery of the buses to CT Transit and getting them online. So

we expect that to be somewhere around Q4 2020. Right, Rick?

RICHARD HANLEY: Yes.

RICK ROSA: So again, we hope to be able to report back to you folks on this and with some very successful news. And that's it for me. Thank you.

(Applause.)

MS. SAVIDGE: Thank you, Rick.

Chris Nelder.

CHRIS NELDER: The few, the proud, the remaining in the room. This is going to go by pretty quickly thanks to Rick's very helpful explanation of demand charges, so I won't have to explain anything about them.

So before we dive into important considerations on rate design, I just want to point out that Level 2 chargers are fairly inexpensive and can provide grid services by managed charging. So we can use time-of-use rates to steer the load of Level 2 charging into the valleys of a load profile pretty easily, that is not easily done on fast charging.

While Rick showed you a number of slides where fast charging is considered to be

sort of in the 50 kilowatt or maybe 75 kilowatt range, we should note that the chargers we install today are more like 150 or more, even 300, 350 kilowatt charging stations. So the issue of demand charges is becoming more urgent as the size and the speed of the charging stations continues to rise.

So DC fast chargers are very expensive, and because they can't easily do managed charging, you want to be able to roll up to a DC fast charger and get as much charge as possible as quickly as possible. The whole concept of managed charging kind of falls apart unless we're going to add a lot of storage along with DC fast charging depots, which also adds cost, which basically makes it harder to get to the point where you're breaking even on your network. So this is challenging.

In case you're not really familiar with what these costs are, if you were to install a Level 2 charging station at home, it will maybe cost you $1,000. If you're going to install a whole mess of them at a workplace parking lot, maybe it's $5,000 a unit. If you're going to install 150 kilowatt charging station for a public

depot, you're looking at at least $150,000 per unit. And on a program basis in terms of installation costs, managing the program and so on, it could be more like a quarter of a million dollars per unit. So understanding that the costs are very, very different for Level 2 and DC fast is really critical here.

So the problem with demand charges, as Rick pointed out, is that while utilization rates are low, while we have chargers that are used maybe 5 percent of the time or 10 percent of the time, at best, in those locations, demand charges constitute a very large part of the bill, so much so that there's no business case for owning and operating them. So that's why we call it a market failure right now. We have to fix that if we want to achieve our transportation electrification objectives. The fix to that problem is almost certainly in rate design. However, as Rick explained over the slides on the resolution in New York, that is not the approach that New York took. They chose to go with an incentive instead.

Charging depot loads will be significant as we move up to 150 kilowatt loads, or even more, and that's just light-duty vehicles.

When we're talking about buses, when we're talking about public charging depots, or even when we're getting to truck stops, it's a whole nother ball game. Tesla, for example, has applied that its Class 8 tractor, semi-tractor, so we're talking big trucking now, those vehicles might pull 1.7, 1.8 megawatts per vehicle. So imagine what a lonely truck stop trying to serve 10 or 20 trucks at a time looks like with a 40 megawatt load attached to it. We have no idea how we're going to do this.

Utility investment is clearly necessary. They're the only ones with a balance sheet and the ability to recover capital over various long period of time at very low interest rates that could even begin to contemplate serving this load, especially at the very high load levels that we're talking about for transit bus barns and truck stops and that kind of thing. Either that or we need all sorts of capital, state participation, federal participation, what have you, that can really provide very low cost capital over very long periods of time.

And we should also note that fleet electrification, especially when we're talking

about buses, entails and steep and treacherous learning curve. Fleet operators of transit buses are not familiar with electricity. They don't know anything about the charging equipment that's involved. They don't know how to manage their fleets yet to accommodate the charging cycles and how they're going to cycle vehicles on and off the chargers and when and how far the vehicles are going to be able to go under different weather conditions and what that's going to imply for the managing charging of their fleets. There's a whole lot of very complicated questions here that transit bus operators are just beginning to grapple with. And I've heard some pretty wild horror stories from them already, you know, we bought some buses, originally they were hybrid, we decided to make them all electric, we got the first ten delivered and we put in the charging stations and, oh, crap, nobody told us we needed a $2 million substation to support it. This is not uncommon.

So we really ought to be very careful and deliberate and thoughtful about how to support fleet electrification.

A VOICE: Now you tell me.

CHRIS NELDER: We're all learning together.

So getting back to public DCFC, this is a critical part of the network. We're not going to have rapid adoption of electric vehicles, even just personal electric vehicles, until people have the confidence that they can go out wherever they've got to go and know that if they need to charge up somewhere, without spending eight hours there, that they can do that. The same way that you have that confidence now with your gasoline vehicle. So this is commonly called range anxiety. I'm not sure that's really the right word for it. It's more about the availability of charging where and when you need it without having to spend hours there.

So it's critical that we have this DCFC public charging station available. These networks are absolutely essential if we're going to have the deployment of electric vehicles that we want. However, that also means that the tariffs have to support the DCFC infrastructure because, as I said a moment ago, it is currently a market failure.

So because most existing tariffs are not designed for DCFC operators and are not

suitable, let's understand why. First of all, they don't accurately reflect the true cost of service in many cases. The demand charge, the theory of demand charge, how it's applied and why it's applied under a conventional tariff, as Rick explained it, is not wrong. It just doesn't apply very well to DCFC.

The way the demand charge is implemented is not all consistent across utilities. That's more than evident if you just look at the rates in the State of New York that we saw a minute ago.

And we lack appropriate price signals for the effective integration of EVs onto the grid. If we want to have grid managing charging, then we need to have proper time-of-use rates that can steer that load into the valleys of the load profile and away from the peaks.

Also, DCFC utilization does vary by host type, and increasing utilization can ease issues with demand charges. So we need to be very conscious about where these things are being deployed and how they're being used.

And then we need to understand how to create tariffs that create a better business case

for DCFC owners and operators.

We did a study for EVgo, which is one of the larger networks of the DC fast in the US a couple years ago where we tried to understand what are the effects of demand charges on their rates. And we did some modeling in another recent paper called From Gas to Grid where we looked at five representative states -- you probably can't read that legend up there -- but it's California, Ohio, Colorado, Hawaii and Texas. And we looked at typical rates in those five states to understand what does it cost to charge up an electric vehicle versus what it cost to refuel with gasoline. And that band in the middle there is the gasoline cost per mile.

So as you can see that clump of bars on the left, that's your DC Fast right there. In almost all cases, except for Texas, there was either barely a gasoline parity or more expensive than gasoline to charge up on DC Fast. Whereas, all the other blocks that you see, home uncontrolled, home time of use, workplace and fleet, was all cheaper on Level 2 than it is gasoline. So this shows you right here that not only is Level 2 cheaper than DCFC, as I showed you

in the first slide, but we have a problem with DCFC being too expensive. If it's more expensive for people to charge on DCFC than it is to refuel with gasoline, we can't expect them to adopt EVs.

Here's another look at the demand charge question. On the left there you've got three blocks from -- these are all California, so San Diego Gas and Electric, PG&E and Southern California, those are their conventional tariffs. And we looked at four different scenarios for how EV adoption might go in the future, and we analyzed those tariffs under each of those four scenarios. And what you can see there is in most cases under the conventional tariffs demand charges caused the cost to go way above that of ICE parity or gasoline parity, which is the green line across the middle of the chart there.

On the right those two blocks show what recharging would look like under the proposed new rates from San Diego Gas and Electric and Southern California Edison, which were specifically designed to address the demand charge issue, and voila it was cheaper than gasoline.

So what are some of the goals that can help us solve this problem from a rate design

perspective? First of all, let's understand what we're trying to do. Charging should be profitable. If it's not profitable, nobody is going to deploy it.

Charging should be cheaper than gasoline. We think that's typically about 29 cents a kilowatt hour or 9 cents a mile. Of course, it will all change over time as gasoline prices go up and down.

Level 2 charging should be cheaper than DC fast charging because it's cheaper to provide service.

EV chargers should be on dedicated tariffs and on separate meters so that we can provide rates that allow us to steer the load of that charging where it's good for the grid and to reduce the total cost to the ratepayers. And we think that that separate meter could actually be the meter built into the charging station. A lot of utilities don't want to deal with the data integration aspect of that. But if you're not going to do that, then you're oftentimes going to require a customer to pay an additional $500 or something to install a redundant meter, and that just ups the cost for them and typically doesn't

pencil out in such a way that it's attractive to them. So let's understand that that's at least an option for a meter that's built into a typical charging station is good enough for revenue purposes.

Tariffs should offer an opportunity to earn credit for providing grid services through managed charging. So if I'm a user and I've allowed my charger to interact with the time-of-use utility rate so that it's avoiding charging when costs are high and it's sucking up power when costs are low, I should be able to earn a credit for that somehow.

And ideally the utilities should leverage their distributed energy resource management system -- that's what it's called in California, the DERMS, or whatever you call it in other states -- but just to understand what is the current situation with our grid, where do we have excess capacity, where is capacity constrained, and then let's promote the more efficient use, as we can, of the existing grid infrastructure by using varying rates or interconnection costs and doing levels of cost sharing now that could vary by location for make-ready investments. So really

trying to be thoughtful and optimize the spending required on the grid side.

So on rate design principles then we think tariffs should be time varying, so time-of-use rates, preferably dynamic, while still recovering utility costs.

Tariffs should have low fixed charges, and those fixed charges should reflect primarily routine costs, things like maintenance and billing, not just being a big old chunk of cost recovery.

Tariffs should reflect the actual cost of providing service and should charge more for coincident peak demand. So before we accept a utility's claim that the cost of service on a particular site is X, and that's why we need a demand charge, that should actually be demonstrated.

And we should avoid noncoincident demand charges. If demand charges are necessary, then they should be scale with utilization rates, and they should recover only the location-specific costs of that connection to the grid, not upstream costs because we don't want customers that can share capacity. For example, if I put a DC fast

charging station right next to a hotel on the same circuit, I'm essentially sharing the capacity that's already there. I shouldn't be paying for it anew as if I were a new hotel. And continuous-capacity customers, like hotels, should not be subsidized by short infrequent loads, which is exactly what happens when you have a DC fast charger that's paying a massive demand charge fee for a short, infrequent spike of electricity.

Cost shifts should be demonstrated and not assumed. And if a cost shift to low to moderate income customers is demonstrated, then that should be offset by investments in mobility services and infrastructure to support those residents. It should not be used as an argument to avoid investment altogether, which it too often is.

So I'm going to run you through a couple of quick approaches to rate design that are being floated around. And this is not a comprehensive list by any means, and I'm not actually going to talk about the ones that Rick just showed you from New York. But consider these illustrative rate designs that might be useful.

So here's one that we have proposed.

Take the demand charge out to begin with, but use a higher volumetric rate. So charge more per kilowatt hour at first, that's the indicative the diagram at the top there. As time goes on and as the market matures, moving to the right, you can scale down that per kilowatt hour cost and start to scale up demand charges. So in this way you're still providing the utility with cost recovery, you're still recognizing that costs should be imposed for costs imposed on the system, but you're not killing the case for owning and operating a charging network.

So while the market is young, there's no demand charges. You're shifting that cost over to the volumetric rate. And as the market matures and the utilization rates climb on your network, the demand charges start to scale up and the volumetric rate scales down.

And you can actually do this as a function of utilization rates. So here's a little indicative table at the bottom, if you can see it. Suppose that your utilization rate is under 10 percent, your volumetric rate maybe to start with is sort of like 20 cents a kilowatt hour, and your demand charge is zero. And then as you get up to

a higher utilization rate, let's say 40 percent, maybe your volumetric rate drops down to like 14 cents a kilowatt hour, and your demand charge is now 4 bucks a kilowatt. So you can see how this works. The idea is to scale with the utilization rate while doing appropriate cost recovery for the utility, yet not killing the business case for owning and operating a charging station.

Here's a proposal that was recently floated by PG&E in California. This proposal violates most of the principles that I just shared with you, but I think it's actually a really interesting idea. And, in fact, they have offered a whole slide back, if you want to find it, that shows that they have evaluated this new tariff under a whole bunch of different use cases and load profiles and figured out that in all cases it provides charging at a cost that's competitive with or less than gasoline, which is again a key point that we're trying to find here.

So what they've done here is they've actually used quite a high fixed cost. They're calling it a subscription charge. I think that's terrible branding, frankly, but it's basically a fixed charge $184 per 50 kilowatts of connected

load per month. And then they've got a three-tier time-of-use rate, 11 cents a kilowatt hour overnight, 9 cents a kilowatt hour during that very load usage period from 9 a.m. to 2 p.m., and then 30 cents a kilowatt hour on peak between 4 p.m. and 10 p.m. And that's it. It doesn't change by winter, summer. It doesn't change in any other way. That's it. So this is nice because it allows somebody who's running a network, you can plug this right into your spreadsheet under any load profile and know exactly what your costs are going to be for years to come.

So these rates are stable year round, sending charging networks and drivers reliable and appropriate cost signals. The time-of-use rate is actually matched to their system peaks, so you're doing appropriate cost recovery there. You don't have some dumb demand charge that's trying to rack up a big demand fee when you're actually way off peak. Right? And it allows profitable DCFC operation across a wide variety of load shapes and charging scenarios. So that's good.

I'm not going to go into big detail here, but here's a break list proposed by Southern

California Edison and has been emulated elsewhere. Basically they've said we'll just give you a demand charge holiday, so for the first five years no demand charges. Then, assuming that utilization may start to pick up because more people are adopting EVs, after five years we're going to start to slowly scale that demand charge back in, and then by year 11 we're back to our normal rate. In this case their time-of-use rate is again matched to the system peak, so again you're doing appropriate cost recovery, and your rates vary by winter and summer, reflecting system costs and sending networks and drivers reliable and appropriate price signals. Again, this rate should allow profitable DCFC network operation.

Finally, here's a proposal from Xcel in Minnesota. I won't walk you through the math here, but the concept is that it effectively calculates demand charges as a function of utilization. So as utilization rates are very low, your demand charge is very minimal, and then as the utilization rate climbs up and the same charger is used sort of like five times a day, now you're back to a regular rate.

Just a couple of indicative examples

of, you know, I think, progressive approaches to rate design for DCFC networks. Again, by no means a comprehensive list, and there are lots of other ways that this problem is being contemplated, but it is important that we solve it one way or the other.

And finally, here's a look at our three major reports that we've done on vehicle grid integration. And feel free to contact me with any further questions. Thank you.

(Applause.)

MS. SAVIDGE: Thank you, Chris.

Watson Collins.

WATSON COLLINS: I'm assuming -- are you going to make the slides available to everybody?

KERI ENRIGHT-KATO: Yes.

MS. SAVIDGE: Yes.

WATSON COLLINS: So I'll adjust my time because -- how are we doing time wise here?

MS. SAVIDGE: We have 18 minutes.

WATSON COLLINS: Okay. Push me through quicker if you need me to. I appreciate that. Great.

I just want to talk about DC fast

charging first. The EV drivers, I'll say battery electric vehicle drivers, how many of you guys have used DC fast chargers?

Okay. And how important was that -- just shout out how important was that access to those DC fast chargers to your purchase and your usability of the vehicles, utility of the vehicles?

A VOICE: Critical.

WATSON COLLINS: Critical. Okay.

And do you guys use these often or --

A VOICE: Yes, on trips, while on trips for charging.

WATSON COLLINS: Okay. So it's a mix of whether you use them often or not. Okay. I was just curious -- and another --

A VOICE: I'm compromised by distance. And it's free, so there's a lot of incentive to go, but it's a 20 mile drive.

WATSON COLLINS: Okay. Thank you. So it's pretty interesting that demand charge aspects that this panel was charged with is to talk about the demand charge aspects of DC fast charging and how that impacts fleets. So there's four parts I could talk about, and I'm probably going to

shorten up one of the parts just given the time.

The first part is around some survey-based research we did on demand charges of DC fast charging. The second part is a description of some of the options that EEI just published a report, and you'll see a link into it in the slides. I'm probably going to skip this analysis we've done on Plug Share data just for the sake of time. And then I'm going to close out with some of the technology developments and stuff that EPRI and myself are working on to address this problem from a technology perspective.

So what we've done in 2018 was we did the survey of 35 stakeholders to find out what's their philosophy, what are they thinking about, how important demand or different rate design options to commercial customers in their decisions to electrify. So it was a combination of workplace organizations, public charging, fleets and public transit agencies -- I don't think we talked to Rick here -- and some of the vehicle and equipment manufacturers and environmental groups.

And what we presented when we talked the rates, we talked about a two-part tariff, which is kind of how you pay your home bill for

your electricity at home, which is there's a fixed charge and a per kilowatt hour charge. We talked about a three-part tariff, which is that's when you layer in the demand charge. And then the fourth option we talked about with them was with that three-part tariff but with dynamic energy prices, so how you can set up dynamic energy prices. I think on that first slide it had a link to this report, and I think it's publicly available.

The consensus is, and there's some kind of interesting things in there, you know, really it's not -- it's a qualitative assessment, it's not a quantitative, because we didn't have enough people to do a real quantitative assessment here. But qualitatively we can say rate design is an important topic for everybody that we surveyed.

Most stakeholders expressed a strong concern about demand charges and EV adoption, which is kind of the survey I just did here. It wasn't about demand charges, but the DC fast charging access.

And there was also pretty good consensus around choice, that people wanted choice around rates. And so a lot of the commercial

rates for the utilities are driven by how big you are and you get put on X rate. And so there seemed to be a lot of interest in, you know, give me some options to make decisions.

And then what was interesting, though, is the fleet operators and the fast charging providers, you know, I thought that they were able to manage their charging and adapt to utility rate designs. It was kind of an interesting thing that also happened in this research. Some people just said I want some fixed price, and I want predictability around what the bill is going to be, like I don't want all this variability, I just want to like -- I'm going to buy some buses. I need to fill out the spreadsheet and do the financial modeling. So there's a little bit of variation over how do you want this billing to occur, which is kind of interesting. But there was also some hope that, you know, we're in the early stages of this, we're learning, we're going to try some different things over time. And it was kind of optimistic at the end, you know, that there was opportunities there.

Moving on to this Edison Electric Institute report I was mentioning, this was really

a pretty good survey document. And again, you know, folks that are going to look at this, there's a good link to the report. It was performed by Brattle, but Edison Electric contracted with them, and it's an organization that it does a lot of work with. And I almost consider them like a sister organization to us. They looked in two big buckets. They puts the options around how to address deployment of DC fast charging. One part of it is around rate design options, and the other part is around what the site host can do to reduce the impacts from the demand charges.

So the first option was -- and we've talked about this in previous presentations where you create a separate rate class. And I'll start out, all these things have pros than cons. And me taking about these, I'm not trying to endorse any of them. I'm just saying these are the options that people look at out there. And again, they all have their pros and cons, and with more time I could talk through some of the pros and cons of each.

The second one was to provide rate options, which we talked about in the past. Some

people just want a per kilowatt hour rate that they pay at their sites.

And the third option they talked about is experimenting, and it's also the experiments you were talking about with the subscription rate and things like that.

One of the options they outlined is place limits on demand-related charges. So some of the utilities were doing a calculation and capped the demand charges as a component of the bill based on some calculations they would do after the meter reads were taken and during the production of the bill.

They're also talking about temporarily reducing demand charges or replace demand charges with volumetric rate. And you see some of those as adoption levels increase, the incentives came down. So that's really what that is.

And also provide more detailed pricing signals. This one actually was pretty interesting because this gets at -- it creates complication by creating more things, which is what people said, but if you can give these very descriptive price signals and when you're going to contribute towards that annual peak and when you can manage

these loads in a way that impact that. So it creates complications, but it addresses some other benefits. Again, all these things have pros and cons.

On the host side you can install storage. And I'll talk about something when I wrap up my slides here about opportunities there.

Managing load to avoid demand-related charges. How can you regulate, modulate the charging so that you stay within the parameters that you're trying to stay within to clip that peak.

Develop stations for an existing user base. So this was kind of weird to me at first when I read this, but what they're saying here is you should be developing stations where an option is to develop stations where there's a user base that's going to use these things so that you don't have the one charge in a whole year or month that creates this demand charge, where you have enough utilization of stations, but that has its own consequences.

And then site charging stations behind the meter of large customers, and this is what I've been trying to blend in the EV charging loads

with the building. And again, that has its own pros and cons on the infrastructure side.

This is the part I'm going to skip through which is just you'll have these slides. Again, the only caution I'd say with these slides is they are from 2017 analysis, and this world is changing fast, and there's new data, and so things have moved along there.

To close out, I have two slides to close out on the opportunity for development of technology solutions. There's a lot of pain points with DC fast charging deployment from the total cost of ownership, from the development complexity -- you know, I've been involved and everybody has been involved in deploying a DC fast charging site. There's a whole bunch of moving parts and complexities and interconnect, you know, requests for service from the utility, and so there's a whole bunch of complications there.

The grid integration becomes an issue, especially as we're talking about higher capacity charging. When we're talking about these 1.6 megawatt Tesla semi-trucks and you're going to aggregate them into sites, there's going to be much bigger demands placed on the utility grid

that are going to be concentrated in certain locations. So this grid integration thing is definitely a complication and, you know, where's the right places to put DC fast chargers so you don't create those bottlenecks on the grid.

When you talk to the hardware guys that make DC fast chargers, they haven't pushed the assembly line button and said, okay, I'm going to make 100,000 of these things in the next month. This is kind of all -- when you look at the DC fast chargers that are out there, when you look inside them, they're kind of handmade. I won't say handmade, but they're hand assembled. They make them in batches. They'll say I've got 20 orders for DC fast chargers, I'm going to make a couple.

And so why am I mentioning that? That impacts the costs of these DC fast chargers. If a production company and a manufacturing company can put these on an assembly line and start making them and pump them out, the price of these things will drop. And so we're stuck in this position of how do we get volumes so we can get the price down of these DC fast chargers.

You've got nonrecurring engineering,

this increase in power levels I alluded to earlier. And then also this utilization uncertainty. You know, people are building fast charging sites, they're making investments. These investments are measured in the hundreds of thousands of dollars. And if they're doing it with the expectation that users are going to use it and pay $10 a session, it creates that uncertainty there.

So when we look at the total cost of ownership, we think that there's a solid state architecture approach we can use to reduce the total cost of ownership, improve efficiency, reduce the footprint. We can make this stuff smaller with solid state equipment, make it easier to transport, improve expansion, all this stuff. You'll see my slides here.

So what we've done is -- and just a couple months ago we signed a contract with the Department of Energy we were awarded to develop a solid state architecture. And so what we do now is instead of connect -- having utilities, the customer that's installing a DC fast charger, install -- request a service from the utility and get 480 volt service and then have to do stuff

afterwards. This would create a direct connection. We'd create DC right away from the utility grid and provide a DC service.

And what you can do once you have that DC grid is you can integrate storage. We talked about storage of how that can help support these things. You can integrate onsite renewables. And when it's done on the DC side, if you think about it, you don't have to have a solar inverter making AC, going into the AC grid, then going back down to the DC fast charger. So you've saved that whole round trip. And so now we're going to connect this stuff right into this instead of making that round trip.

So this is a pretty exciting project. We've got equipment suppliers on the left-hand side of that graph lined up to do the work to develop these converters. We've got the technology providers on the right-hand side. This works for buses. This works for any kind of application very easy once you have this DC bus. We've got some national labs, supporting utilities, automakers working with us on this. And there's a couple other projects that were awarded during the process when we got this going,

including Missouri University of Science and technology and NCSU, North Carolina State U, also working on this.

So what we're going to do is -- and EPRI's role is we're going to try and make all this stuff interoperable. There's three projects that are going on to try and do the same thing. We want to make this interoperable because our objective is to try to create commercial scale for this. We think that there's -- you know, this is kind of like the forward-looking opportunities, higher power levels, how do we serve that.

I'll wrap up with the anecdote of why I think some of this is important. You know, to protect the names, I won't name names here, but I was at a conference a little while ago where the transit agency said that they wanted to put a bunch of buses in one of their sites. And they went to the utility, and the utility apparently allegedly told them that they couldn't get the electric service to serve the buses. And so, you know, I took that as a personal challenge of like we had to find technology solutions to address that, so that's never an answer that is given, that we can have technology solutions that can

serve that need.

So thank you. I think I'll end up with I have some sales data that I attached to the slides just as a follow-up for you guys. All right. Thanks.

(Applause.)

LAUREN SAVIDGE: Thank you, Watson.

So I think we have a minute left in the panel. Chris has to run.

CHRIS NELDER: I have to run to the airport, so my apologies. I won't be able to sit around for the Q and A, but feel free to follow up with me afterwards. I'm sure these gentlemen will have all the answers.

LAUREN SAVIDGE: But we're going to throw it to the audience for maybe one or two questions, if anyone has any.

(No response.)

MS. SAVIDGE: I can maybe kick us off with one, and people can start thinking. So we saw proposals or options in other states to either reduce or eliminate the demand charges, and with low DC fast charger station utilization rates right now. Is there kind of a level of station utilization where demand charges become more

necessary?

WATSON COLLINS: So the big challenge and why does this topic come up so much with electric vehicles. So I'm going to turn nerd for a second. So the typical load factor, which is the average load to the peak load, of the utility system is around 40 something percent, and so the rates are designed around that when you do the demand charge and they figure out these rates.

What we know from some of these early DC fast charging sites, you have utilization rates that are somewhere around 5 percent plus or minus a little bit earlier on, and so what that creates is a very unique load profile for the utility. The utilities don't have a lot of customers that have that kind of load profile, very unique because of that signature. So that's a bit of why this is something unique and why you see that.

The other part of your question is when -- which is another interesting thing -- is when this become not a problem. I think there's debate on when that happens. What I've heard anecdotally, and again I can't back this up with facts but I've heard this anecdotally, is Tesla, when the utilization rate gets up to 25 percent,

they figure out people are starting to get frustrated waiting for the fast charger ports to be available, and that's when they actually deploy more plugs at those sites. And so what's that say? That's actually below that 41 percent that the rates were designed around. So again, I don't have the good data to support all that, but I think there's a question, you know, that utilization it is better to get higher levels of utilization for the cost part of it, but I don't know if that's a good thing from the user experience part of it to be available when you pull up.

RICK ROSA: I would agree, Watson. So I think there's two points to be made. So the DC fast charging incentive that was just recently approved by the PSC in New York envisions a utilization rate that eventually gets to 40 percent. So that declining incentive that I talked about earlier, over that seven-year period envisions that at the end of that seven-year period we get to that 40 percent magic number. But, you know, you have utilization in terms of what Watson was just speaking of in terms of load factor, and then you have utilization in terms of

actual charging sessions at the DC fast charger. Right?

So the earlier example I gave where at the workplace charge where you had underutilized where it was only being used once a day, right, but you were maximizing the per plug charge every day. So essentially in those two charts where I showed the significant decrease in demand charges, that was 100 percent utilization rate. Right. We were totally maxing out the available charge sessions. So I guess I agree that there's no magic number, but from a purely cost standpoint and, you know, being profitable for a DC fast charger developer, I would think you would want to have as close to 100 percent utilization in terms of charging sessions as possible. But from a load factor perspective I agree that the number, like Watson said, we're not used to seeing load factors, you know, the utilization rates that are down that low. We'd like it to be 40 percent.

LAUREN SAVIDGE: Thank you.

Question?

RICHARD HANLEY: Okay.

RICK ROSA: You're not building a $2 million substation. I promise you.

RICHARD HANLEY: Let's talk about demand charges. For a long time I've been talking with Watson about demand charges. We worked on some of the first DC fast chargers that were in the state. And I did like the -- I just want to comment, the rate structure of where you're charging when the charger is new and the utilization is low and you actually charge just for kilowatt hours, and then you ramp down to the point, and then you start to ramp up the demand charge, I think that rate structure is very interesting. I think California has done something like that, and it's done very well out there.

One of the things you were talking about was the utilization rate. And just having on the EV a Tesla, one of the things that Tesla has done, they're sort of doing it old school as far as how you load balance chargers. Now on the screen that shows all the super chargers in the state, it actually shows how many stalls of each super charger are currently in use, so it actually routes you -- let's you pick a super charger that doesn't have as much -- or has the capacity to accommodate you. So I thought that was an

interesting thing.

And then the last thing I just make is a point. I thought today's session was great. I do a little bit of transportation history, and actually some of the last electric vehicles built in the United States from the first history of electric vehicles back in the early 1900s were actually built here in Hartford by the Pope Automobile Company, and it's good to see that this conversation sort of come back and start up here again. So anyway --

RICK ROSA: So it doesn't go away.

LAUREN SAVIDGE: Time for one more question.

ANTHONY JONES: Hi. My name is Anthony Jones. I'm legal counsel with FuelCell Energy. I don't have a question so much as a comment.

I appreciate the session on demand charges, and I think it's very useful. I would just like to point out that it seems that today there's been almost no discussion on fuel cell, hydrogen fuel cell vehicles. Almost all of the discussion has revolved around electric vehicles. And I think it's very telling that this is called an electric vehicle roadmap as opposed to a zero

emissions vehicle roadmap. So I would just urge the department to take into consideration hydrogen fuel cell refueling stations. My understanding is that there are only two in the state, so the same kind of range anxiety concerns that exists for electric vehicles also exist for hydrogen fuel cell vehicles. Thank you.

LAUREN SAVIDGE: Thank you.

TRACY BABBIDGE: Okay. Excellent point. I'm Tracy Babbidge. I'm with the department with the bureau of air management, formerly with the energy bureau but have moved over to the air side.

Just to follow up on the last comment and question, fuel cells and looking at hydrogen is clearly part of the EV roadmap. So Paul Farrell talked a little bit about it, but I just wanted to make sure folks were aware that that is a component of what we're looking at as part of this roadmap process.

How's everyone doing? You ready to leave? Good job sticking to the very end.

Just to close us out, I just wanted to reflect on a couple of things. I don't have any slides. I'm going to be really quick. But I feel

like we covered a lot of ground here, and I'm excited for our next steps. I think what's really helpful for us is to sort of reflect about our ambitious goals here starting with what our air quality challenges are and our aggressive climate goals, and really looking at holistically how we're going to accomplish that. I think we have a running start. When we look at the planning work that's already been done, the work that's been done through the northeast corridor study and the ZEV action plan, and the work through the GC3 and the pathways study, we have a really good solid planning foundation that we've started with.

So there are things we're doing well. I think looking at the CHEAPR program, we've heard a lot about how important incentives are and how we look at a sustainable funding source is something we're really going to have to keep front and center as we work through this process. A lot of issues for us to tackle. So looking at, you know, how we establish public partnerships and keep that going; what is the appropriate role of the utilities, I think we need to continue to examine that; customer issues and how we strategically plan to make sure we're addressing

consumer issues; pricing transparency, we need to make sure that the prices are transparent because it's not always the case where prices are transparent. Tom Ashley from Greenlots talked a lot about open access standard and the smart charging ecosystem, which I think we need to really tackle that and look at the complexities around that.

Nancy Ryan had some really interesting insights for us as we look at transportation transformation. We need to keep our eye on all the good work that's going on on the electric side from a grid modernization perspective, so we have these parallel paths, but we really need to look at how we're integrating that planning as we go forward.

We need to continue to look at best practices. What we heard about building codes from Massachusetts I think is helpful. And then Brett Williams from the Center of Sustainable Energy had some interesting remarks about the level of incentives and what we need to make sure that incentive programs are sustainable. I think he was looking at something like 90 million was the number that was thrown out.

I was happy that we had Julie Rege's perspective from the OEMs and their perspective on the consumer education that we're doing through Drive Change Drive Electric and the regional approach there.

And then I think Jim Fleming's remarks were also really interesting and insightful, and we need to make sure that fleets are part and parcel of what we're doing.

And then, you know, getting into the last panel looking at rate design, demand charges and the role of time-of-use rates, it's a really important area and something that we're obviously going to tackle and have a big impact on our ability to deploy EVs.

So we covered a lot in a short amount of time. I want to start by thanking our DEEP team. Keri, thank you for all your work in pulling this together, and all the DEEP staff for what you've done.

I want to remind folks that February 1st is our deadline for comments on the EV roadmap. And although Keri said we're going to have a draft by March, I think it's more like April. But we look forward to having you

participating in this process.

And I would love for all of you to join me in thanking our presenters. I thought everything today, the presentations were remarkable. Thank you all for your time and attention to the very end. So thank you all for being here.

(Applause.)

(Whereupon, the above proceedings concluded at 4:22 p.m.)

CERTIFICATE

I hereby certify that the foregoing 276 pages are a complete and accurate computer-aided transcription of my original stenotype notes taken of the Technical Meeting in Re: AN ELECTRIC VEHICLE ROADMAP FOR CONNECTICUT, which was held at the DEEP Headquarters, Gina McCarthy Auditorium, 79 Elm Street, Hartford, Connecticut, on February 8, 2019.

Lisa L. Warner, CSR 061
Court Reporter
BCT REPORTING SERVICE
55 WHITING STREET, SUITE 1A
PLAINVILLE, CONNECTICUT 06062