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CALIFORNIA ENERGY COMMISSION

In the Matter of:	
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IEPR COMMISSIONER WORKSHOP

CALIFORNIA ENERGY COMMISSION

ZERO-EMISSION VEHICLE RESILIENCE AND THREE REVOLUTIONS IN TRANSPORTATION

REMOTE VIA ZOOM

SESSION 1: Energy Resilience and ZEVs

WEDNESDAY, JULY 15, 2020

1:00 P.M.

Reported by: Peter Petty

APPEARANCES

CEC COMMISSIONERS PRESENT:

Patty Monahan, 2020 IEPR Update Lead Commissioner
J. Andrew McAllister, Commissioner
David Hochschild, Chair
Karen Douglas, Commissioner

STAFF PRESENT:

Heather Raitt, Assistant Executive Director, Policy Development
Jonathan Bobadilla
Noel Crisostomo
RoseMary Avalos, Public Advisor's Office

PANELISTS:

Bjoern Christensen, Next-Dimension
Ryan Harty, Honda
Jackie Birdsall, Toyota
Tim Shannon, Twin Rivers School District
Joe Callaway, AC Transit
Jana Ganion, Blue Lake Rancheria
Desmond Wheatley, Envision Solar
Susie Monson, FreeWire
Michael Pimentel, California Transit Association

ALSO PRESENT

Dan Sperling, UC Davis

PUBLIC COMMENT:

Jaimie Levin
DeLisa
Charlie Botsford

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P R O C E E D I N G S

JULY 15, 2020 1:00 P.M.

MS. RAITT: So this afternoon session is on Energy Resilience and Zero-Emission Vehicles. And then Sessions 2 and 3 are tomorrow starting at 9:30 in the morning.

These meetings are being recorded. We'll post recording and written transcript on our website. Also today's presentations have been posted on our website.

We're working on making our IEPR Workshops more engaging and so we'll be taking a poll to get a better understanding of who is attending today. We will also be using the Q&A function in Zoom with the capability to vote on questions posed by others. So attendees, you may go ahead and type a question for panelists by clicking on the Q&A icon. Before typing a question, please check to see if someone else has already posed a similar question, and if so, you can just click the thumbs up to vote on it. And the questions with the most thumbs up clicks are uploaded to the top of the list.

We'll reserve just about five minutes at the end of each panel for the attendee Q&A. And so given those time restrictions, we're unlikely to elevate all questions received.

So now I'll go over how to provide comments on the material on today's workshop. There is an opportunity for

public comments at the end of each session. In Zoom, click the raise hand icon to let us know you'd like to make a comment. And if you change your mind, you can just click it again and your hand will go down. And for those who have phoned in, press star 9 and that will raise your hand to let us know you'd like to make a comment.

Alternatively, written comments after the workshop are welcome and are due 5:00 p.m. on August 6th. And again, the meeting notice gives you all the information for providing written comments.

So with that, I'll turn it over to Commissioner Monahan for opening remarks.

Thanks.

COMMISSIONER MONAHAN: Thanks, Heather.

So welcome everybody to our series, our IEPR workshop series on transportation with a strong focus on zero-emission transportation and some focus on near zero-emission transportation. But we're really setting our sights on how to -- how do we make sure that the transportation sector contributes to the state goal of having a carbon neutral economy by 2045.

And that pretty much means we need to electrify as much as possible in the transportation system, and that can be either battery electric vehicles or fuel cell electric vehicles. And this set of panels in the afternoon is dealing

with a really important topic, well, two important topics.

First, how do we make sure that our transition to zero-emission vehicles and zero-emission transportation helps make our energy system more resilient? And there's primarily a focus on the electricity grid, but there's all sorts of ways that battery electric and fuel cell electric vehicles can help deal with power outages, help us integrate renewables more effectively and provide other grid services. So that's the first panel.

The second panel is how do we make our vehicles more resilient, and that's especially important when the power is down. So the power is down and there's a -- and you need to get out of a situation, you know. What are the flexible technologies that would allow a driver of an electric vehicle, a zero-emission vehicle, to be able to, to get to where they need to go.

So really important series of topics and looking forward to the discussion.

I know Commission McAllister is also here today. Commission McAllister, do you want to say a few words?

COMMISSIONER MCALLISTER: Yeah, absolutely. Thanks, Commission Monahan, really appreciate your leadership on this.

I -- hopefully people can see me here. You guys hearing me okay? Oh --

COMMISSIONER MONAHAN: Yes, we hear you and we see you.

COMMISSIONER MCALLISTER: Oh great. Okay, perfect.

Yeah, so, I, you know, as all of you know, I oversee our energy efficiency efforts and sort of load forecasting and some of that analytical-type work, and I think this is an area where, you know, the electric grid just is front and center as a key resource for meeting our carbon neutrality goals. And buildings and transportations are really siblings in this. And, you know, buildings need to be all they can be on the grid and transportation needs to be all it can be on the grid, and they both contribute to resilience and to, you know, our quality of life and our health in the best of times, but certainly emergency response and resilience when that's needed as well. And we have a lot of really great technologies to help us in that endeavor.

But the fact that we're all knitted together in this electric grid means that all the pieces up and down the chain have to work together in concert in a big orchestra that sounds nice and not a cacophony, which is something we absolutely want to avoid, certainly in emergency situations.

So I think having these as resources that are coordinated and really firing on all cylinders at all times, particularly when we need them most. Transportation, buildings, and all the pieces of this puzzle really have,

really are key, and so I'm really excited to see how this particular topic can contribute to that whole.

And really want to thank again everyone -- Noel and the staff and Heather for putting all of this together, and Commission Monahan for your leadership. So, thanks a lot. Looking forward to hearing the presentations.

COMMISSIONER MONAHAN: Great, thank you.

We also have joined on the dais Chair Hochschild. Chair, would you like to say a few words?

CHAIR HOCHSCHILD: Thank you, Commissioner Monahan.

And Commissioner McAllister, I liked your analogy very much about the symphony. So the Energy Commission will do our best to be the symphony conductor and create some good music in the years to come.

You know, I would just say looking ahead, this nexus of the clean energy grid and clean transportation is critical. They actually need each other and it's also a template for other states. We obviously adopted the 100 percent clean energy mandate, a year and a half ago that went into effect. We're already at 63 percent carbon free electricity and retail sales, on our way to 100 percent. And now there's 14 states that have adopted 100 percent clean energy standards and I expect many more in the next few years to join. And for this to be a success, we need to be intelligent about our charging protocols. And so this is

also a model for other states. So all of this, I think, is -- you know, the stakes are high not just for our state, but for others that are watching closely.

With respect to EV manufacturing, I'll just point out that we do have 18 zero-emission vehicle manufacturers in California today. It's our leading export from the state and it's growing. And looking at the investment coming in around the world, it's extraordinary what's happening. And really credit especially to Tesla, which is now more valuable than the world's, you know, probably, certainly than all the other U.S. manufacturers combined. But then, you know, probably seven of the ten EV manufacturers, I mean, just an incredible year, and I think the signal's been sent and, you know, we're going to zero-emission transportation and it's got a great nexus to help support us in getting to our 100 percent clean energy goals.

So really, special thanks to Commissioner Monahan for putting this together and to all the staff, and look forward to the discussion today.

COMMISSIONER MONAHAN: Great. Thanks, Chair.

We also have Commissioner Douglas, so we have almost a full contingency of our commissioners.

Commissioner Douglas, would you like to make a few opening remarks?

COMMISSIONER DOUGLAS: Yes. Hi, good afternoon

everyone. I just wanted to say that I'm also looking forward to this workshop very much, joining my commissioners -- my colleagues' comments, the other commissioners that spoken. And I'll look forward to joining the discussion as well.

Thanks.

MS. RAITT: Great. So I think with that, if we are ready to move on to the first panel, unless -- sorry, Commissioner, if I jumped in ahead of you there.

So the first panel is on zero-emission vehicles and community energy resilience, and it's moderating by Noel Crisostomo from the Energy Commission and we have Jonathan Bobadilla from the Energy Commission who will help moderate the Q&A from attendees.

So go ahead, Noel. Thank you.

MR. CRISOSTOMO: Good afternoon, everyone. My name is Noel Crisostomo. I'm an air pollution specialist in the Fuels and Transportation Division and working on electric transportation planning and grid integration.

I'll be your moderator today and I want to spend a few moments to set the table for the first panel on zero-emission vehicles and community energy resilience, which we'll discuss how automakers can work with individuals and fleet EV drivers to lever their battery or fuel cell electric cars as mobile storage resources during times of energy emergencies.

In November of last year, during the widespread public safety power shutoffs, NPR reported that an Intrepid EV driver, Clarence Dold from Sonoma County, found an interesting solution to using the energy source in his EVs during the PSPS. Clarence connected his Nissan Leaf's battery with jumper cables to an AC/DC inverter to a series of heavy-duty extension cords to power a TV, refrigerator, and lights. Spending $200 on this setup, every few hours he would check the energy he had consumed, and if it dropped too much, he would drive five miles to a public charger that had not been de-energized. Among the cacophony of generators rumbling around his neighbor's houses, NPR concluded that these setups for EV drivers could be quote, "the secret sauce to surviving what's becoming the new normal in California."

We at the Energy Commission know that there needs to be safe, clean, and simpler resiliency solutions for all, not just EV owners. And so working with our sister agencies, we are investing in technology and working on changes to interconnection policies to support automaker efforts for vehicle-to-grid, so that cars, electric school buses, and other types of vehicles can more seamlessly offer energy resilience to drivers, emergency centers, and other critical loads.

Our DER research roadmap and vehicle grid integration roadmaps highlight not only the potential for energy storage

to be used while installed within the vehicles themselves, but also be repackaged as resiliency and reliability resources during their second lives when they're no longer suitable for transportation.

So we have assembled an expert panel that has been working over the past decade to realize this vision. As shown on this slide, I'll introduce them sequentially and each will give a brief presentation.

Starting with Bjoern Christensen, managing director at Next-Dimension. Next-Dimension advises clients focused on e-mobility and vehicle grid integration, including the U.N. Development Programme. Previously, Bjoern was chief strategy officer at Nuvve where he worked on EPIC and European Commission funded VGI projects and was CEO of Siemens Venture Capital.

Bjoern, the floor is yours.

MR. CHRISTENSEN: Thank you, Noel. Let me jump into it.

California is a world leader in e-mobility. So how do we use this position to enhance energy resilience through use of zero-emission vehicles?

Next, please.

California was first to mandate the catalytic converter in 1981 and also adopt the zero-emission vehicle regulation in 1990. And this has already had a large effect.

Above here, you'll see Los Angeles in 1975 and you see a picture from this year. Also today we have approximately 750,000 EVs and plug-in hybrids on the road in California, and our 2030 goal is 5 million.

Next, please. Next, please.

So the question is, will California also be the first to introduce the electric, the energy resilient vehicles or ERV? ERVs provide resilient mobile power when and where it is needed in disasters through export of energy from their batteries.

Next, please.

The ERV idea is pretty simple. Cars sold in California must contribute to reduce air pollution and greenhouse gases. EVs could provide emergency power. Inexpensive technology is already available. So why should EV technology not help California to provide energy resilience in case of natural disasters or public safety power shutoffs, both for homes, businesses, and communities?

Next, please.

Let's go back one year, not to forget the PSPS. California governor declares statewide emergency over wildfires in March 2019 because of the large fires we had in 2018. And on the right side, we see a picture from Oakland -- from the business district, or a shopping district where the power has been shut off and put police cars

patrolling the area. So the question is, is this going to be the new normal in California? Hopefully not.

Next, please.

We have learned important lessons from Japan's earthquake, 9.1 on the Richter scale, and the subsequent tsunami in 2011. Millions of people were without power for an extended period of time and there were substantial damage to persons and to property. This experience led a number of Japanese car OEMs to introduce bidirectional EVs and plug-in hybrids for energy resilience in case of natural disasters. And it also led to the introductions of vehicle-to-home application being introduced in the marketplace in Japan.

Next, please.

Now bidirectional power flow is already in a few inexpensive EVs. It's nothing new. And also in trials with school buses. Here to the upper left, we see a Nissan Leaf providing a microgrid vehicle-to-home emergency power to a house. And below we see bidirectional school buses providing community power.

It's important to notice that all EVs are already born bidirectional. Acceleration and regenerative braking transfers energy from the battery to the electric motor, and from the electric motor back to the battery.

Next, please.

So the car manufacturers are not by themselves very

soon going to start introducing bidirectionalities in the cars. They are too preoccupied with the transition to electrical vehicles. So how can we incentivize common factors to adopt ERVs? Proposed here is to use ERV credits in analogy with CARB zero-emission vehicle credits. Here's a screenshot of the California Air Resources Board, and we can see here in blue, part of the text is to reduce greenhouse gas emissions. We could add a text saying including making communities more energy resilient.

And on the right, we could augment the zero-emission vehicle definition with an energy resilient vehicle definition. Under the ERV regulation distinct vehicle designs are considered energy resilient if the vehicle can provide emergency power in case of natural disasters like earthquake or wildfires or as a result of power cuts to prevent wildfires.

Next, please.

Now all the players must come together to help California implement the energy resilient vehicle regulation. The car manufacturers, utilities, the regulatory bodies, and the emergency responders so we could get to bidirectional electrical vehicles, and of course, EVSEs, which I have got covered here. And then have clear rules for interconnections, not only for DC, but also for AC. And ease of how we could do microgridding, in case of PSPS.

Next, please.

So in summary, California faces dual existential crises -- wildfires and earthquakes, and we must all chip in and help. ERVs will mitigate the damage caused from natural disasters by providing emergency backup power and, of course, transportation. Currently, there are only a few Japanese EV brands that support bidirectional power flow. The automotive OEMs are unlikely to move soon towards bidirectionality because they are preoccupied with the transition to electrical vehicles. The California ERV approach should be tied to the credit incentive of zero-emission vehicles.

And lastly, it's important to establish a policy framework required for automotive OEMs to justify the business case for EVs and EVSE bidirectionality.

Thank you very much.

MR. CRISOSTOMO: Thank you, Bjoern. This is an interesting idea and we'll hear from some automaker panelists on their reactions during discussion.

Our first automaker representative is Ryan Harty, manager of environmental business development and engineering at American Honda Motor. Brian is responsible for product planning and business strategy on all aspects of vehicle grid integration, including smart charging, vehicle-to-grid, as well as renewable power procurements, among other projects.

Ryan, take it away.

MR. HARTY: Awesome. Thank you, Noel.

So next slide, please.

I think everybody knows that cars are usually parked. And to us as automakers, we want to improve the value of this product, not just to the customer, but to society by making, taking advantage of the fact that it's there for the purpose of doing other things. I think as Bjoern mentioned, there's a lot that can be done with EVs. It's a very large energy storage resource that's, frankly, sitting there for most of the time. And if we look at the car parked and where cars are parked, about half of cars don't even leave the home in a typical day. So it's an incredible energy storage resource that's just waiting to be exploited for the purpose.

So how do we in society, how do we as automakers, find solutions to improve the value of this product both to the customer and society?

Next slide.

The bidirectional capability of EVs, you know, really opens up the ecosystem of possibility. And my group at Honda has been lucky enough to be exploring these values since 2011. What I'm showing here is the Honda Smart Home U.S. that's at UC Davis, and it was built to explore that question. So how can we meet California's zero net energy goals, including the energy used for transportation?

So this is a zero net energy home that has 10

kilowatts of solar PV that provides 100 percent of the energy, all energy flows in the house, for heating, cooling, hot water, cooking, lighting, plug loads, and transportation, all from the alternate solar PV input. We -- in addition, it has energy storage, both thermal energy storage in the slab in boreholes behind the -- the home, and in a stationary battery, 10 kilowatt hours, a half of a CVD battery stuffed into a box, and also 20 kilowatt hours from the CVD.

So we're been operating since 2016 in what we call V2H mode, where the vehicle can back up the home, and doing complete V2G bidirectional power flow to the car since 2018 at the Honda Smart Home. And one of the really interesting values for this is that the car can completely -- oh sorry, the home can completely isolate from the grid in the case of some grid outage, providing -- still able to charge the car, provide all of the energy needs of the car, and balance itself as a microgrid, providing 100 percent energy security, both for living and transportation to the customer.

So these are some of the really cool things that we can do utilizing the bidirectional power capability and energy storage of the cars. And for fun, we developed what we call Power Exporter 9000 for the Japan market. As Bjoern mentioned, Japanese OEMs got together and under the guidance of Japanese government to really figure out and standardize how to, how to use cars for energy storage and resiliency.

And so we developed Power Exporter 9000 for the Japan market, and you can essentially take your Clarity EV, Clarity plug-in hybrid, Clarity fuel cell car and take 9 kilowatts of AC power out of the car for whatever you happen to want to plug into. And so that's been a great project and enlightening about what, what you can do with the vehicles.

So next slide.

Now if we want to scale this image up, you know, you really need to thing about massive renewable energy generation. While using the incredible flexibility of EV charging and the storage capacity of EVs in order to mitigate the intermittency of renewable energy generation. I'm including a, an artist's rendition here. This is of the Boiling Springs Wind Farm where between two large virtual power purchase agreements, Honda has contracted for 60 percent of all of the electricity that Honda uses in North America supplied by renewable energy.

The challenge is, of course, mitigating the intermittency of the power. How do you supply an energy system of electricity to plants and operations and people customers a day and also to transportation? But the incredible flexibility that is afforded by EVs and seasonal energy storage that's afforded by converting electricity, renewable electricity, into hydrogen for transportation really enables us to use transportation as the backbone of

the flexibility resource of the, of the renewable energy generation system.

Next slide.

One of the other things we're very interested in is, you know, how can you use this bidirectional flexibility to improve the value proposition of installing EV charging? And we think there's a role for workplaces, multiunit dwellings, and any area where the business of installing EV charging is challenged to use the values of energy storage to improve that value proposition for a site host to install EV charging. And I would really like to explore that further and deeper in the discussion today.

Thank you very much.

MR. CRISOSTOMO: Thank you, Ryan.

Next we have Jackie Birdsall, senior engineer in research and development at Toyota North America. Jackie works on fuel cell system design, including controls and storage tanks for hydrogen for a variety of Toyota projects, including the Mirai, Project Portal, and the UNO.

Did we lose Jackie?

MS. BIRDSALL: I'm still here, Noel.

MS. RAITT: We can hear you now, Jackie. Do you want to turn on your video? This is Heather.

MS. BIRDSALL: It says it has, the host has disabled my video.

MS. RAITT: There you go. Now we hear you and we see you. Go ahead.

MS. BIRDSALL: Oh, perfect. Okay, great. Well, you know, nothing goes perfectly.

Thank you, Noel, for the introduction and thank you to the Commissioners and the staff at the CEC for the opportunity to present Toyota's perspective on this as well.

So when we think of energy resiliency, we also think of electrification, as Commissioner Monahan mentioned, and also energy diversity, as well as renewable generation. And so, following those themes, Toyota has pursued what we call a portfolio approach of electrified options for our vehicle fleet to provide our customers with a choice when it comes to driving zero-emission vehicles. And that includes fuel cell electric, battery electric, plug-in hybrid electric, and hybrid electric.

Our goal is by 2025 to sell 5.5 million electrified vehicles globally, and that's one step on our path to get us to what we call Environmental Challenge 2050, which is a reduction of our fleet average C02 output by 90 percent, compared to our 2010 models. And we believe that this strategy will not only allow for energy resiliency, but also improve areas of our infrastructure that would support our consumers and our local communities. Really, the discussion we're having today.

And what I mean by this, is -- improving our infrastructure, is by one, having a, seeing an increase in renewable generation of electricity and hydrogen, and then also kind of similar to what Ryan mentioned, a new value proposition for vehicle-to-home, vehicle-to-grid, or some other power takeoff capability to provide backup power when needed.

If you'd go to the next slide, that'd be great.

So starting with renewable generation, I imagine most folks on the workshop are familiar with SB-100. We talked about it earlier here and the strong leadership our state has shown in decarbonizing our grid. Well, similarly, we'd like to see a decarbonization of the hydrogen fuel supply. And I imagine that it may be less well known that in the U.S., we currently produce 10 million tons of hydrogen every year and the majority of that comes from seeing methane reformation. And we can shift that to renewable generation as a means of storing energy created from renewable and distributed sources, and also using directly as renewable fuel.

And as a pathway to get there, we support a technology neutral approach, such as the LCFS and levers such as grants to support new renewable generation and to ensure that all pathways are maintained as we move to 100 percent renewable.

And one example of this potential is a trigeneration

system that we're installing at the Port of Long Beach. Once it's up and running, it's a high temperature fuel cell that will generate 2.35 megawatts of 100 percent renewable electricity, 1.2 tons of 100 percent renewable hydrogen every day from California based biogas resources. And one essential lever for the success of this project was the recognition of directed biogas as a viable pathway for the BioMAT program.

If you'd go to the next slide, please.

And then speaking to a power back, or backup power, or power takeoff, we already heard a bit about the work that was done based, because of the result of the tsunamis in Japan. We have used our Prius Prime, our Sora fuel cell bus, and our Mirai to provide power takeoff capabilities in Japan. And to do so, we have a CHAdeMO connector and a Honda inverter, and that's to supply essential services as a result of the effect of the tsunami. But now also in Southern California we're using two Mirai to provide up to 18 kilowatts of silent zero-emission power to support our healthcare workers at a COVID test site. And we believe that these are just some examples of this capability that could be applied to all different types of essential workers, of residential applications.

However, we need a compensation mechanism for vehicles to be V2G capable so that the customers don't bear

the burden of the additional costs associated with that. And we also see a need for all associated codes and standards, for example UL 1741, to be modified to facilitate that interconnection.

So with that said, I'll go ahead and wrap up. I hope that I gave you some ideas about how we can improve our resiliency and I look forward to a great discussion with the rest of the panel.

Thank you.

MR. CRISOSTOMO: Thank you, Jackie.

Next we have Tim Shannon, director of transportation at Twin Rivers Unified School District. Tim is an expert on school bus-to-grid projects and his fleet has integrated AC and DC V2G systems and participates in the Energy Commission's Electric School Bus Replacement Program. In addition to utility connected projects, Tim is also exploring off-grid resiliency.

Tim, go ahead.

MR. SHANNON: Noel, thank you for the wonderful introduction. Sorry for the not too great video.

Yes, my name's Tim Shannon. I'm the director of transportation for Twin Rivers Unified School District. We are the largest deployment of electric school buses in the nation at this point. We currently have 30. We have to thank the CEC for providing five of those 30 and five more

coming with the addition of another 22 on top of that.

We are currently in the process of looking at vehicle-to-grid charging. We're working with SMUD, Sacramento area Metropolitan Utility District, our electric provider. We are looking to do a pilot project, but basically it's just to lay down the groundwork to have a functional V2G component to our bus fleet. We currently installed five Nuvve chargers that, and we are going to look at an AC V2G model. And with that model we will also be looking at and adding some DC V2G so that we can see what works best.

And also since AC charging is really the preferred method for school buses because of their duty cycle, we're going to really promote that within our district. Hopefully we'll have 50 V2G chargers in the next year and a half and that will allow SMUD to do some grid stabilization and grid balancing, and plus provide us a reduced cost in electricity. We're even locking in a price for a long-term venture with them.

Some of our other things we're looking at, we're looking at adding stationary battery, so it'd be solar to stationary battery for that, that day that we don't have power for whatever reason SMUD is offline, we can still operate those clean school buses to get kids to school. But also we would utilize not only the electric school bus for,

let's say, a re -- to power a reunification center, or an emergency center, but also look at having those stationary batteries there for us on a rainy day, but also to power a school site, you know, so on one of those occasions that we didn't have SMUD power.

I will tell you that it's been quite an adventure for Twin Rivers with electric school buses. We have found that they are the most lucrative, reliable mode of school transportation. We're looking forward to getting back to transporting kids here in the near future. We work with quite a few manufacturers, you know, all the big players. We're also involved in doing, working with a charge management company to do charge management to look at how much power we bring, take from the grid, how much power we put back to the grid, and what those economic opportunities are for the school district. And basically, it's for kids and community.

But it has been a pleasure to be able to be a front runner on all this technology and then also share what we're doing with everybody. And it's quite the experience for a lot of people, and hopefully we can mirror this all over the state and then all over the country.

Noel, I'm not going to take up the whole five minutes, but we'll save those for questions down the road.

MR. CRISOSTOMO: Thank you, Tim.

And thank you all panelists for your great detail.

Before we get into our discussion, I'd like to offer some time for dais to ask any questions. Commissioners, go ahead.

COMMISSIONER MONAHAN: Thanks, Noel. And I encourage all my fellow commissioners to turn on their video and to unmute if you have any questions.

So this is a fascinating panel, as I thought it would be. And first, I just want to thank Tim Shannon for his leadership at Twin Rivers School District. It really has been like a flagship -- the school district, in terms of leaning in on zero-emission technologies and really trying to figure out how to unlock some of the value of vehicle-to-grid technology. So just thanks, Tim, you in particular.

I have a lot of questions. I'm not going to ask all of them because I don't want to dominate the whole afternoon.

But Ryan, I am really interested in your, in the fact that you have tested out at UC Davis, this, like, how do we, how do we basically liberate a home from the grid and use bidirectional energy storage to be able to do that.

I'm wondering, can you just -- I want to go visit this project -- but can you give us a sense of what are some of the, like, big lessons learned in terms of what are the costs that need to fall for us to be able to capitalize on that opportunity? And are there any policies that would help

get us there as well?

MR. HARTY: Jackie mentioned a couple of the policies that need to take place. Of course, the UL Standards need to take into account that these are vehicles that are doing it. Automobile manufacturers self certify to federal motor vehicle safety standards, whereas the people who attach, you know, electrical equipment to homes have to get UL cert, you know, UL listed equipment to install there. So when your inspector shows up from utility, they're -- they got a checklist and it says look for the UL sticker. And they look at this car and they say oh, there's no UL sticker there. So, you know, we need to fix that level of detail on utility interconnection permits.

We also need a tariff. So every utility needs to develop a tariff for -- to value the bidirectional power flows. So if we don't have that tariff, if you don't have the interconnection, you know, lineup in place, it doesn't matter how much power you push back to the grid, the user's not going to get compensated for it in a meaningful way.

And I think we've got a great opportunity here, the VGI Working Group through the CPUC has been developing, you know, that list of use cases and establishing estimated value for different use cases and to develop tariff's that then can express what the bidirectional power flows are valued at for the user, the utility, for society. It all needs to come

together and get expressed in that tariff.

So between the standards and the interconnection and the tariff, I think if we can make progress on those things in the next couple years, I think we'll have a pretty robust ecosystem and industry for V2G and V2H connected homes and cars.

COMMISSIONER MONAHAN: So I also have a question. I -- I am, you know, we hear a lot about battery electric vehicles being a storage possibility and less than from the fuel cell world, I think just because there are fewer of them right now. But I'm curious, what are -- what are the big differences when we are thinking about energy, you know, drawing energy from the vehicle to your home or to a critical facility? Can you walk us through the differences with fuel cells vis-a-vis batteries.

MR. HARTY: Sure. So for the case of the battery car, with a DC off-board inverter, you can essentially create a microgrid behind that home. So you have a transfer switch that's isolated from the grid in the purpose, in the case of a grid outage. If you've got home solar and the system is appropriately engineered and grounded and safe and, you know, meets all the codes that need to be established, you can still charge that car and use the car as a microgrid and use that energy storage battery of the car to balance your home loads and, you know, manage the grid, and manage your

microgrid.

In the case of a fuel cell vehicle, you'd be able to use the hybrid battery onboard the car in some instances for that. But your, you know, set of hydrogen in the car may diminish over time and then, frankly, hydrogen's a precious commodity. And so there's some challenges to that. But the energy storage capacity of that tank and system is kind of huge, and you could back up a home for a really long time with a, you know, a, you know, residential microgrid with a fuel cell vehicle and DC off-board inverter in that capacity.

And maybe, Jackie, you'd like to address that as well.

MS. BIRDSALL: Sure, Ryan. Thanks.

Yeah, I mean we definitely, you know, we're using the Mirais for power takeoff in Japan to demonstrate backup power for the residential areas. We are seeing the capability for a vehicle to provide the fundamental services for up to a week off of this fill. And just a reminder that the five-minute fill. So they can go back to a station, refill in five minutes, come back and power their homes for another week.

And the capabilities there are even more exciting when we look to heavy-duty applications. So for example right now with our Portal trucks. If we're looking to power some, you know, large or essential service, if we have, you

know, we've heard of these major unfortunate natural disasters, but that means there's going to be a lot of people coming to a community center. That community center's going to need power. Well, there's a great potential there, again, to bring in a heavy-duty truck, take some of that power off, and then go and refill again in a matter of, you know, 15 minutes with hydrogen.

So that is certainly an advantage. But yeah, if you're looking for microgrid, we've seen the same thing where using that battery is, makes a lot of sense. And the battery is significantly smaller on a fuel cell vehicle, as you know.

COMMISSIONER MONAHAN: So one last question. I mean, part of the reason why the automakers are not investing in this technology is because the degradation. The battery's the most expensive part of the vehicle, this is going to cause some degradation.

What's your sense in terms of the receptivity of light-duty vehicle manufacturers? Because I think in the heavy-duty world, we're seeing a little more receptivity to this. What's your sense in the light-duty world, and your reaction to Bjoern's idea that we should be getting CARB credit for -- CARB should be getting some credit for this, this technology?

MR. HARTY: In the case of the degradation, we've studied it in depth. We've published a couple of papers in

Society of Automotive Engineers journals on the modes of battery degradation and how it relates to -- to, you know, V2G usage. So the couple of things that really, the battery really hates. It really hates sitting at a very high state of charge for a long time. The battery really hates being cycled from high state of charge to low state of charge, and it hates high temperature.

So if you develop your V2G system and you avoid those things, so you avoid having it sit at high SOC, you avoid high temperature with a good, well-developed, well-designed cooling system and you don't cycle it top to bottom, if you just pick a nice healthy window that you've established through testing of the middle of the SOC range of the battery and you cycle within that range, then you essentially don't affect the long-term degradation of the battery.

Now in the case of vehicle-to-home, maybe you do want to discharge that battery because you got a refrigerator full of food, you know, and the Costco is a long ways away. So, you know, it's just like customers driving to zero range on their car. That's just what happens. And the car's designed to do that, you know, a certain number of times in its life, and like Jackie said, it takes several days to do that if you're conserving energy at home. So it is what it is and we take that risk and price that into the value of the product as we introduce these new technologies.

MR. CHRISTENSEN: If I may just --

MR. HARTY: (Indiscernible.)

MR. CHRISTENSEN: If I may just augment what Ryan have said.

Nuvve has had V2G operations with 10 Nissan Leafs and 10 chargers from a company called Magnum Cap doing frequency regulation in Copenhagen and around for about four years now.

The trial, or the commercial application started on September 6th, 2016 and we have had about 240,000 hours, vehicle hours operations in a very, very demanding application. Frequency regulation in the Nordic, which is about 30 million people, including Sweden, Norway, Finland, and Denmark, has a relatively influx of volatile frequency. So, every second the frequency has to be measured and then you have react up and down in order to stabilize the frequency around 50 hertz.

And so we've been operating a fleet of 10 vehicles, as I mentioned the Nissan Leaf, with 24 kilowatt hour batteries. And we've been measuring the battery state of health over those four, almost four years now. And we have found no degradation that is not in line with what the, what Nissan's corporate research has predicted.

The vast energy degradation is, of course, with battery aging and then there's a component for the driving and fast charging, and there's a component for the V2G. And

we were very surprised that we didn't see other – a lot of battery degradation. So that's not something that at least for now -- and this may not be linear, we don't know, but it's something that we don't have any, any problems with right now from a practical application.

MR. HARTY: If I could add one thing to what Bjoern said. The, like, the power load of V2G -- maybe you have a 6 or 10 or even say 20 kilowatt, you know, bidirectional inverter in your garage or in the parking structure. That load is really small relative to DC fast charging and relative to driving of the car. And so the vehicle system is designed to take it.

MS. BIRDSALL: I would like to add --

COMMISSIONER MONAHAN: Great.

MS. BIRDSALL: -- one more thing as well. I'm sorry, Commissioner Monahan. It's hard not to step on people on these Zoom calls.

So back to the question about, about CARB credit. I'm not sure if that's correct mechanism and I'm certainly not going to speculate since I'm not a policy person, but I very strongly agree with the comments that Ryan made early, that the vehicle itself is not, you know, a UL stamped vehicle to be able to be used for power takeoff. And so that is a struggle that we have faced as well, that we could use further, you know, help with from a regulatory or from the

code aspect to make some modifications there so that it's easier for us to understand that business case and to say, okay, our vehicles are, you know, quick and easy. We can go in and, again, as long as we meet this code, we can go in and attach to whatever we're looking to attach to and provide clean energy, whether it be vehicle-to-home, vehicle-to-grid, or some random COVID test site.

COMMISSIONER MONAHAN: Great, thanks.

I -- do any of my fellow commissioners want to have any comments?

Commissioner McAllister, I think you're muted.

COMMISSIONER MCALLISTER: Yeah. I'm sorry. Can you hear me now?

COMMISSIONER MONAHAN: Yes.

COMMISSIONER MCALLISTER: Great. So, beautiful set of presentations. They really complement each other well, so thanks everyone for that.

I guess I -- so I'm not an expert on this piece of the grid, kind of interoperability. I'm focused, you know, tend to focus on appliances and buildings. We're doing a lot of work to figure out where we need standardization in those realms, and I guess I wanted to kind of ask about that in the vehicle realm.

You know, if you're the ISO, let's think about sort of an N minus one, a power line goes out and you need to

mobilize some demands on resources or just some distributed resources, and that includes, you know, a bunch of different things, and it could include vehicles. Is there, you know -- rates were mentioned, sort of, there needs to be a tariff. Completely understand that so that the -- the consumers have the signal.

If the grid operator sort of needs resources in response for an emergency or some contingency, and would really benefit from having some, you know, vehicles as an aggregated resource that they can call, are there any gaps in knowledge, or sort of gaps in any, you know, standard protocols for communications of that situation? Is there collaboration across automakers on that front? Because I'm kind of just wondering what that ecosystem looks like in terms of really leveraging these, this resource as a grid, you know, these vehicles as a grid resource for those kinds of needs, you know. Are there standard platforms through which that can happen efficiently and effectively, and what are you all working on together or as individuals to make that seamless?

MR. SHANNON: So I can -- I can kind of chime in on this. That's where we are with our SMUD project, is that we're trying to develop a set of rules that can be adopted basically globally, whether it be AC V2G or DC V2G, who controls it? Maybe we could get some parameters out there

that, you know, once we're done that say, okay, this works great for the heavy-duty space, this works great for the passenger car vehicle space.

Because in the heavy-duty vehicle space, we have a lot of, we have a lot of battery storage, especially in the school bus because of its duty cycle. But there are no standardizations at this point. And that's where we're at with working with our utility provider. But then we also, you know, will love to have input from the CEC on, you know, their thought on it and what we can do to leverage this standardization because it's just not quite there yet.

MR. HARTY: Yes, this is Ryan. If I could phone a friend, I would call Frances Cleveland to this discussion and have her give the explanation because she's far, far better at this than I am.

But I would just say that there, through VGI working group and through the Rule 21 technical committees, there's a lot of discussion on this subject. I -- I don't have at the tips of my fingers all the standards there, but the -- I think that, you know, standardization for those communications is important, but it depends on the use case and what you want to do, and, you know, where that product is, as Tim was saying. The answers will be different depending on the use cases and what the products are.

Are you calling, you know, school buses at 300

kilowatts or 150 kilowatts each? Or are you calling things in residential garages? And then, what time scale do you need the response for?

So, for example, at Honda Smart Home at UC Davis, we're responding to an open ADR 2.0B signal from PG&E, and that's a system that's been in use for, you know, for several years. And for demand response, turn things down, works just fine and, you know, we can deploy that.

If we want second by second, you know, frequency regulation and frequency response, you know, open ADR is not going to do that. So then, you know, what do we want? What uses do we want these to respond to, and then we can develop the system around that. But I think we have lots of choices for communication ecosystems to make it work.

Our job as the automakers is to make sure that the vehicle system is there and it works, and it's engineered to meet the needs. And that our vehicle user, the customer, that, you know, the vehicle does what they expect it to do and that it's charged when they want to drive somewhere, and that we develop a system that's focused on their needs. Because fundamentally, that's why somebody bought that car and why, you know, why it's in the garage in the first place.

So if you get too far away from that, then all of a sudden it becomes a barrier to adopting electric vehicles and we, you know, we're trying to do all this to make things

easier for people to adopt electric vehicles.

So anyway, that's maybe a long answer to your short question and, but I appreciate the dialog.

COMMISSIONER MCALLISTER: Great. Thank you.

COMMISSIONER MONAHAN: All right, Noel. I think we're just going to turn it over to you to continue the discussion.

MR. CRISOSTOMO: Great. Thanks, Commissioners, for your questions.

And also, looks like we have about 25 minutes to continue.

So Jackie had a great slide of the power takeoff operation to support the COVID response. And let's start here. So for everyone, I'd like to start with a quote from the CPUCs Wildfire Safety Advisory Board recommendations for the utilities wildfire mitigation plans. They found that a theme that emerged from the work was the need to prepare for compound catastrophes. They acknowledge that quote, "everyone needs to spend more time planning responses to catastrophic events," but raised that the confluence of the coming wildfire season and COVID sheltering requires us to quote, "proactively decide to protect human life and come up with plans now."

And so, given your roles as advisors, fleet managers, and manufacturers, how does this compound catastrophe affect

your thinking of resiliency and execution of it?

Anyone, like, would be able to start.

MS. BIRDSALL: Noel, maybe I can get us started.

So well, thank you for the compliment on the slide. I do want to point out there is a Honda inverter in that photo as well. And that is the, I think -- Ryan, you can correct me if I'm not mistaken, that does have the UL stamp.

MR. HARTY: No.

MS. BIRDSALL: No? Okay. That one, that is --

MR. HARTY: Japan model.

MS. BIRDSALL: It is, okay. Well, it's the inverter that we can use because our vehicle does not have that capability. So credit to Ryan and his team for making an inverter that we could use for that. So, thank you.

I think that, that the idea of these compound catastrophes do add another level of significance to the work that we're already doing and, in addition to it, urgency. I think when the first typhoon hit in 2011, we didn't have the power takeoff capability. And you've seen since then that, you know, from typhoon number 15 that hit last year in Japan, we were able to respond in a different way with, again, both the Sora bus, the Prius Prime, and the Mirai with power takeoff capabilities.

Now we've seen, you know, similar catastrophes occur in California and I think it has highlighted the need for us

to be able to utilize these vehicles that we also have in California for those same type of capabilities. And what that means is we're going to have to work with, you know, government and other industry partners -- and that's why I wanted to use this example of our work with Honda for this -- to be prepared to do, and to do so quickly is essential. And the key to being able to respond quickly is having streamlined and uniformed codes and regulations available so that we quickly know how to mobilize our units, how to attach them to an inverter, and how to safely and to code, provide that power.

MR. HARTY: I concur with Jackie, I think, and then maybe if I could add just one more thing to that is that, you know, when we're designing systems and communication and thinking about how people use products and what kind of value proposition you can get out of that. When everything changes, you still have to have fundamental value provided by that system to that user, to that customer. They become very dissatisfied very quickly and there's an awful lot of people. We saw, you know, vehicle miles traveled decline by 90 percent for, you know, April and May in much of the state.

And, you know, in the case of, say V2G, if that is part of the experience, part of the customer's experience, they're not as disappointed in the product if it's continuing to provide value to them while it's, you know, sitting there

parked in their -- in their garage doing things, or if they can rely on it in the case of parallel catastrophe.

And so I think, you know, when we're thinking about policies and we're thinking about products and design and we're thinking about how our customers are going to use things, really taking into account their whole lifestyle needs, including the potential for, you know, dramatic change in their lives and in the use is -- is an important concept. And when we think about things like that, for example, people who rent, people who want to move, people who are, you know, they change jobs, we can't tie their life to this infrastructure. It's got to be universal. It's got to work in all -- in all cases.

And so we -- it's challenging. We've learned an awful lot here these last few months about how these types of systems will interact with our customers.

MR. CRISOSTOMO: Bjoern or Tim --

MR. SHANNON: Noel, I could chime in --

MR. CRISOSTOMO: -- can you talk about your -- talk about your purchase of the fleet?

MR. SHANNON: Yeah, I --

MR. CRISOSTOMO: Tim, go ahead, please.

MR. SHANNON: Yeah, I -- so for -- for school district for what we need to do, we really do need to look at using these vehicles for emergency situations, you know, to

attach to a school building to be able to power it up if there's a catastrophe. Or in the event of, let's say, a community has a wildfire and they, they need power, they have no power there, we could provide a quick response to power up the facility. All those things are a key component in what we do as a large fleet, especially now that we're moving to electrification.

So we do need to standardize some things and look at things to be able to just, you know, drive up and plug in. And we need to look at vehicles that can do that. And it shouldn't matter -- it shouldn't matter what electric school bus it is, they should all be able to do that. So that is a very large focus in what we're doing as an option to just driving children.

MR. CHRISTENSEN: I think that the similarities between the COVID-19 and public PSPS events or other disasters is that we will all spend more time at home, and the car will spend more time at home. There's a difference, of course, in the case of disasters of PSPS events. We would need the functionality of emergency power from the car. Then we could be an exalted transport because we want to drive over from Oakland to San Francisco where they still have power and back again. So that's -- that's important feature that you need in that case.

If you look at the COVID issues, or other pandemic

that hopefully everyone will not see in the future, we will spend more time at home and the car will spend more time at home. And that means the car will become available for more services. And I think, so we should take a broader view as one service, of course, is very important, is the emergency response as we've been talking about. But there's so many other services that we can provide once we have our cars connected and it's bidirectional. It goes from the systemwide perspective, transmission-wide perspective, into the distribution system, and of course very important, behind the meter for the year for the user.

So I think the point that I see is that we need to get V2G really going and get, let's say, the right momentum behind it from the ecosystem. And then I think the true value of V2G will expand way beyond emergency response out into other services. And I'm just, come to think about the beginning of this year in Australia where they had some of the worst wildfires ever, and we must anticipate that this is not only California issue, but it's something that affects a large, large part of the world. So I think that would be great opportunity for California if we're first in pushing this technology.

MR. CRISOSTOMO: Great. Thanks, everyone.

I want to build upon that point. So you described how your thinking has to be a little bit flexible given the

twists and turns that we're facing in this shelter-in-place prolongment in California and the continued risk of PSPS. And everyone has mentioned the non resilience other values that can be stacked on top. And it's really worth highlighting an example from the U.K. in which a association of EV charging aggregators and V2G advocates reported that during the spring shutdown, vehicle-to-grid capable discharge unlike one-way charging vehicles or smart charging vehicles those dischargeable batteries could actually offer grid services despite -- the stack, despite the fact that they were not being driven.

So it really changes the game about how we think about this as a storage resource, especially given the fact that Ryan's chart showed that over half of the vehicles in the -- that's United States or California, Ryan -- actually are parked at home in the middle of the day. And so we don't need to necessarily think that smart charging resources only come at work. They can come at home, or be offered from home.

And so how do you think we can work together as the public sector with industry that to prepare for the whole stack of services and the value that we can liberate for the purpose of the accelerating EV adoption, creating a business case for charging infrastructure, creating new uses that we can't imagine yet. How do we provide that market signal for

investment today, so that we're prepared for the future in all of its permutations?

Let's start with Bjoern, because you've done a lot of work on V2G markets in Europe.

MR. CHRISTENSEN: Yeah, we've been working on V2G market in Europe since 2013 and we have been involved in a number of projects with vehicle-to-grid. And so mostly with the Nissan Leaf and we've been working very closely also with ENIL in the commercial deployments that I mentioned in Denmark.

And we've been looking at the kind of use cases, or what we call services, what kind of service can we supply and taking a very broad perspective, looking at it from the TSO's perspective, more from the gridwide perspective, like frequency regulations and the demand response and things like that. Looking at it from the distribution service operator. He's more interested in voltage control, reactive power, and things like that, and different investments. And very much also at the end user behind the meter. What kind of service can we do there, like a demand charge, time of use, and of course, eventually, emergency response services.

So I think that the case and all these services have been collected in so-called service catalog and I think we have done quite a good thorough job of doing that. It's not exhaustive, but I think there's a lot of those services that

from a technical point of view can be done.

The issue comes when you start looking at the business cases for these services, and that collides very often with regulatory issues. You know, for example, in Denmark we have something -- it's not the scheduling coordinated but it's another group called CPR, which is balancing the, balancing the grid. And so they're part of the picture in order to offer any grid services. And there are others.

So when you start looking at the value chain for these services, it sometimes makes it prohibitive. We can't -- it's doesn't make sense to make those services. So I think there is technical issues where I think we have a pretty good understanding. And where I think we still need understanding and maybe changes to rules is how easy is it to offer? How easy is it to interconnect? How easy is it to actually get approved to provide grid services from a grid service perspective?

Behind the meter, I think it's a little clearer and much, much easier because you're not running into all those, all those issues. So I think it's -- the picture, at least from my perspective, is the amount of services that we can come up with is pretty well understood and there might, of course, be many that we haven't even thought about that. But I think we have a pretty good understanding of that. It's

issue is how can you monetize that, and how can you actually make money, and how does that fit into the whole regulatory and police regime in that specific region. And that, of course, is highly dependent on region to region.

So what we have experienced in Europe, primarily in Denmark, U.K, and France, is totally different from what you've seen in California. So I think it's important that somehow we come to a ease for charging manufact -- charging station manufacturers for the car manufacturers, and from the operators, like aggregators or service providers, or whatever we call them.

So it's a long, long answer to a short question.

MR. CRISOSTOMO: Thanks, Bjoern. That's -- no, it's, it's a great consultation of the working group efforts.

I want to prompt Tim -- and I know, Ryan, you want to get in here -- but, Tim, you mentioned that SMUD is going to have some dispatch control of your resource.

Can you speak to how you're trying to work through the questions and regulatory challenges that Bjoern has described?

And then we'll get to Ryan.

MR. SHANNON: Well, so -- so to be honest with you, with SMUD is that we're working with a third party also called Electrify. They're a charge management system. So SMUD has been really, you know, very open about doing AC V2G,

which is been a challenge for a lot of places. But that was one of the key components is that they had the ability to say turn it off, turn it on, how much power do we want, how much power that we don't want.

Fortunately, they're leading the way on all the protocols to get through those hurdles. All we have to do is say yes. The minute we say no, then the project is done. But, yeah, we're just -- it hasn't been too big of a hurdle. I think one of the biggest hurdles is, is the inverters on the bus, you know. Who regulates that, you know. We're, you know -- because the charger is a pass-through charger, you know, it'll power in and power out.

But for regulation, we would like to pave the way how SMUD's doing it. I think that that's going to be an advantage for a lot of people in seeing how it's done and its functionality. And that will -- there's, there are some strong reasons why SMUD's doing that, is that, you know, they don't want a lineman getting electrocuted because we're pumping voltage back into the system. They want to be able to say, you know, we're in control of the switch. I think those are, are major concerns.

Not sure if I answered your question like you wanted it.

MR. CRISOSTOMO: Very, very much. A good lead into Ryan and Jackie.

So Ryan, we've talked before and you actually made a little poster for us about two years ago, which really highlights the importance of being able to negotiate the utilities request with the needs of the automaker. As you were mentioning and Jackie mentioning, these are not electric devices in the normal sense. These are cars. They don't have the UL stamp.

MR. HARTY: Uh-huh.

MR. CRISOSTOMO: And you're also worried about your automaker brands. You don't want to strand your customer. You want to make sure they get where they're going.

Can you talk about the role of -- and I'll, I'll be your phone a friend -- J3072 as a way of protecting mobility amidst a utility dispatch request?

MR. HARTY: Good. All right. So I think -- I can take it, Jackie? Yeah.

The -- maybe let's, let's take a step back. You want to put yourself in the mind of a vehicle driver, right. They're excited. They see this nice car. They like the styling. They like the color. They're in the auto dealership and they're sitting down. They're negotiating the price of the car with the car dealer and the dealer says, oh, and to use this, you need to call Southern California Edison and get an interconnection permit. Have you done that yet? You know, they might have just lost the sale.

And so we can't do things like put an interconnection permit in between, you know, a customer and the sale of a car. So we need kind of a standard normal process, like, customer buys the car, they need to be able to use it. That can't be in question.

And so today it's not like that, right. So Rule 21 has just got to the place where utilities might interconnect a DC V2G system with -- with, you know, that setup. With AC V2G system, there's still a little bit of work to do. And the SAE J3072 committee in conjunction with the -- the working group is working through the issues to try to get agreement between everybody so that, yes, utilities in California will accept a, you know, an AC V2G system on a car and there won't be any barrier.

So then put yourself into the mind of the customer, you know, what's this worth to me? What am I going to get out of it? But if they see a fuel economy label on a car, they've got a good inherent sense of value. They know that, okay, I'm going to be spending about so much every month on -- on, you know, how much it's going to cost me to drive this car.

But for V2G, well, you don't know. How do you -- how do you explain that to the customer? Well it -- it depends on how far you drive, and it depends on how much you plug in, and it depends, and depends, and depends. So we've got to a

get to a system where, you know, in the customer's mind, it's, it's clear. The value is clear. If I -- if I get this car and I do these things, I'm going to -- I'm going to receive this value that's, that's promoted to me.

So how do you do that? So we need, you know, we need tariffs that value, like a, you know, retail electricity tariffs that value flexibility that the EV provides for managing charging. Should value of the carbon reduction that results from, from those things. And the VGI working group has done a really good job to try to disaggregate all those little values and figure out to whom those values accrue and the rough order of magnitude of what those values could be.

And I think that gives the -- some guidance to the system Bjoern mentioned about the creating markets, markets for V2G. As long as the -- the value that's expressed in the product in V2G or home backup, home resiliency, I understand what the value of that is versus installing a generator at my house or something like that. If the value exceeds the price that the customer's going to pay for it and it's clear, they know that they're going to get that, it's not in question to them whether they're going to get it. If the value exceeds the price they pay, which exceeds the cost of hardware, software, integrating of services, there's going to be servers running all over the place in order to provide these, there's going to be billing processes used. And suddenly

during processes that are going on in the background. All of that stuff carries cost. But as long as the value greatly exceeds the price that -- that people are going to pay for it, and that price can include the price of utility asking for service from it, if all of that exceeds the cost, then, you know, everybody's in business and everybody's happy.

But today that's not the case. We can't put a product in the market. Bjoern, in his opening remarks, you know, ribbing us automakers a little bit, but we can't, we can't put a V2G device in the market today because the customer will get no value from that. It's not legal to connect it to the grid.

And so, you know, we need to get to that place. So I think, you know, SMUD's policies, tariffs, standards, as Jackie was saying, and then getting to that place where you actually have a market that can express the values of it in a clear consistent way, that people know what it is, they understand the product and they understand the value. That's where we're trying to get to. It will take a little while, but we'll get there.

MR. CHRISTENSEN: And if I may augment --

MR. CRISOSTOMO: Yeah.

MR. CHRISTENSEN: -- excuse me, if I may just augment what you said.

And this is different from region to region in the

United States. So in May last year, there was a Senate Bill 12 in Delaware, where they're basically saying that any car that adheres to SAE J3072 can provide V2G services to the grid. So it's -- it's just shows that there is a lot of fragmentation on how each region is handling that.

MR. CRISOSTOMO: Thanks for that, Bjoern.

Jackie, you were expressing some concern about UL 1741 and I'm not sure if you had heard back from your reg folks Back East, but are you able to speak about how your, your EVs, ZEVs or plug-in hybrids, might see that perspective?

MS. BIRDSALL: All I know of related to that standard is that there's been strong work done on the DC side, or on the UL DC version of that. That's the AC standard, and again, that's one we're looking at AC power offtake that it starts to be an issue.

So I do understand there's work being done in that space and that will help to allow for a standardized application of the V2G, but that still doesn't address, I think, the point Ryan and Bjoern and Tim have all already mentioned, which is the business case. Who's going to pay for this? And especially when we're looking at light-duty customers. Are we asking them to supplement, you know, the resiliency of their own home? Seems kind of -- especially as we, with the focus on environmental equity, right. How do we

try to continue the high adoption rate of these vehicles, support the development of the infrastructure for both fuel cell and battery electric vehicles, but then also not put an additional burden of the cost on to the customers for them to essentially provide resiliency to their own homes. So.

And then I think the point that was just made about the regionalism is also a problem. There is no standardized, you know. How do you pay for if you have a fleet of vehicles hooked up to provide backup power? So yeah, I think the standardization is one aspect, but I think really it all comes down to business case and it all comes down to not putting that burden on the customer, because they're going to walk away from a vehicle if it's more expensive and they don't see the value there.

MR. CRISOSTOMO: So it sounds like we have to figure out a incentive structure, a way of paying for this kind of virtual mobile storage/infrastructure.

We did have a brief presentation during our workshop last week and we can point you to that if you'd like to comment on how we might liberate that value.

One last really fast question, and I want Ryan and Bjoern to speak to it, about battery second life. I know there's a lot of interest with the Energy Commission on this topic. So just a really brief primer and then quick responses from anyone with direct experience on B2L.

So it's well known that EV's batteries will have I think around 80 percent of their useful energy after their done with their mobility life, but then they need to move on new applications to avoid waste issues and resource problems.

And in May, MIT examined a hypothetical 2½-megawatt solar project in California backed by second life batteries concluding that it will be profitable if those batteries were less than 60 percent of their original price. But the degradation testing, repackaging, and integrating new controls makes it really challenging to pencil out, especially with new technology improvements. And so last week, our CalSEED program invested in three companies that could change this equation.

First, Repurpose, whose battery degradation testing could speed the process down from a day to a minute. Or in contrast, Smartville Energy, whose controls and electronics slows testing down of many different battery formats to several weeks, in which they could provide grid services. And then lastly, ReJoule, whose controls could be integrated into the vehicle's BMS over the life of the pack to actually prolong the state of health and streamline those checks.

And so Ryan and Bjoern, can you speak about how your experiences -- or, Jackie and Tim, if you as well -- very quickly about your experience with B2L projects and your reaction to these factors amidst the pronouncements recently

from GM and Tesla saying that they are designing batteries with B2L in mind.

MR. HARTY: Bjoern.

MR. CHRISTENSEN: Oh, I can start. You want me to start?

Well, yeah. We, when I was with Nuvve in 2017, we had a relationship with BMW and the BMW had 30 Minis, e-Minis that were equipped with AC propulsion technology. And it was kind of a prototype or trial project, and those cars were used since 2013 to driving and provide frequency regulation for the PTAM.

So in 2017 the batteries were decommissioned, and 12 of them we repackaged into two pairs of batteries in one container and we haven't been providing frequency regulations for the PTAM approximately for two years. That works. Technology works. But the experience was, let's say, quite daunting. The whole decommissioning project that we did together with BMW and EV Grid, then the repackaging, how to communicate with them with the batteries, how to make sure that the air conditioning worked in the containers, and so forth. There were numerous problems that we had to deal with. So.

And again, looking at the batteries, new battery prices, you know, for this first generation being a pioneer, we would never do it again. But, of course, if the car

manufacturers start designing from the start so that all the issues that we were, you know, that I mentioned here, we would not be dealing with. And then there could be some kind of standardization because every car manufacturer's for themself, for the battery technologists, and so forth. Then I think it's something that definitely we'd, with the, would be worth looking at from, you know, for the industry.

So I think it's something that we need to do, but our experience as being the first one on the block, you know, I think we have learned our lessons.

MR. HARTY: I think I would agree with everything that Bjoern has said, and second life battery is hard. I've led several second life battery investigations for Honda in the last ten years and they're all, they're all hard. And, as Bjoern mentioned, you know, integrating a second life battery that was not designed for that purpose into another purpose is very difficult. And so the original design might be a little funny shaped, and the battery's got lumps and bumps, and it's got a little snorkel for air flow exchange, and how do you package that into a rational packaging without having, you know, a whole lot of space consumed by just space around the battery, because it wasn't conveniently designed the packaging.

And then how do you integrate all of the pieces in a safe, you know, replicateable way and get your site level UL

stamp on it so that you can safely interconnect it through local utility. All of those things are challenging for second life battery.

Now going to, say, if you design in from the start, all of those, you know, functions in order to do that, you'd be a heck of a lot further ahead than we were, say ten years ago when the first cars were coming out and then trying to investigate second life for those cars then.

So it's hard, but the original premise is still basically true. The batteries that we've tested for second life have, you know, power and capacity that are great for some purpose. The integration step in order to use it for another purpose is a, is a massive challenge. And to my knowledge, I haven't seen a commercially viable replicateable business plan with that yet.

It doesn't say that it can't be done. It's just -- it's just hard. It's just hard. And there's an awful lot of difficult challenges with the EVs. So I'm looking forward to the -- a positive result from it.

MR. CRISOSTOMO: And I'm getting a sense that I'm going to get a hook from our virtual audience who wants to ask questions.

So Jackie and Tim, in one word each, what would you say -- new batteries or used batteries?

Jackie?

MS. BIRDSALL: New.

MR. CRISOSTOMO: Tim. Used or new?

MR. SHANNON: I'm going to say -- I'm going to say new because of what Ryan said about the integration of used batteries is going to be a challenge. We'll overcome it in time, but it's a challenge now.

MS. BIRDSALL: Wait. I thought we only got one word.

MR. SHANNON: I know. I stole some.

MR. CRISOSTOMO: With that, I'd really like to thank our excellent panelists from around the world experience and across the different types of ZEV fuels that we can hope to use in resiliency purposes very soon.

And hopefully you guys can keep up with us for the second panel, but thank you otherwise, Tim, Jackie, Ryan, and Bjoern for participating.

Heather, back to you.

MS. RAITT: Okay. Thanks all. Thanks, everybody.

And I would love to ask the panelists to please stay on because we're going to move to Zoom Q&A and Jonathan Bobadilla is going to moderate some questions for us that have come in from the attendees over Zoom.

So go ahead, Jonathan.

MR. BOBADILLA: Thank you.

This question's from Sarah Wang. How will warranties cover vehicle-to-X battery degradation?

I'm assuming vehicle-to-X means all the other uses that -- vehicle-to-grid, vehicle-to-home, et cetera.

MR. HARTY: Me?

MR. BOBADILLA: It's open to the panel. It wasn't specifically towards one person.

MR. HARTY: Okay. I think I answered that to an extent in the first couple of questions. But essentially it's our responsibility as automakers to take those factors into account when we design the vehicle and we introduce the product to the market with those capabilities and features enabled, and we'll design the system to respect the battery, to not abuse the battery deep cycle, you know, that charge discharge. Keep it within, you know, temperature range, not exercise it at very high SOC. And in our experience, batteries are, you know, happy and healthy to provide services within a reasonable -- reasonable range.

MR. CHRISTENSEN: This is the same with the Nissan that -- as I mentioned before. Nissan and EDF right now in France are rolling out a massive V2G and they just announced yesterday, they're going to install 100 V2G Nissan Leafs in the southern region of France.

So they have a agreement that if you operate the battery with a certain capacity in our kilowatt. If you operate it on -- within a certain SOC range and with the temperatures, as Ryan has said, they will warrant the

battery. So there are conditions, but they will do that.

And as I mentioned, we've been operating in Denmark more than 250,000 hours on Nissan Leaf and we have, Nissan has not seen any degradation that worries them. So I think as the battery gets better and better, I do not see that as an issue. Remember that the Danish applications of use case is probably one of the worst case that we can think of.

MR. BOBADILLA: All right. And moving on, unless anybody has anything else to add. All right.

And this question is from Carrie Sisto. Can panelists speak about where new tariffs are most required, CPUC, CAISO, and if both, what are the priorities for each jurisdiction?

MR. HARTY: That's a good question. I'll take it just from the, the customer perspective.

They need their residential electricity tariff to be able to express the value of bidirectional power flows if the system is going to be used for V2G. They need to provide value to them, and I expect that that would be expressed through -- through a tariff. If there is, you know, other things in the back end for what CPUC has to do, I'll maybe leave that for other, other panel members to discuss.

MR. CHRISTENSEN: Well, one of the issues that we have seen between regions is frequency regulation is very highly valued in, as I mentioned, in Nordic region of Europe.

Whereas frequency regulation in California has a very low value. So it, it's not one of those applications that I would primarily use electrical vehicles for. So I don't know if there's anything we can do or the policy on that, but that's certainly our -- the value of, of grid services is relatively low. Whereas in California, the value of behind the meter services can be quite high.

And so I think that would be a tendency for any service providers to focus behind the meter, like demand charts and the like. Whereas there would be probably hesitancy because also all the, all regulations that we have to face to provide the services. Maybe proxy demand response is one of the services that makes sense. But certainly frequency regulation as an example is not something that makes sense today.

MR. BOBADILLA: Thank you very much.

And question from Anna Bella Korbatov. As the speakers have said, there is work now being done on standardizing V2G and V2X interconnection standards, Rule 21, UL 1741-SA specifically. But SMUD and other municipal utilities are outside of CPUC jurisdiction. How can we make sure munis are also brought to the table and part of this discussion? How to ensure interconnection rules are truly standardized across munis and IOU utilities so that it doesn't create confusion for V2X vendors, OEMs, and

consumers?

And this question's open to the panel.

MR. SHANNON: So from a, from a -- this is Tim.

From a user that uses SMUD electricity and -- and we're, you know, we're doing, we're powered by a muni, I think that there's some flexibility there to develop some guidelines. But I think where the real pressure has to come on is it has to come on from the other utilities such as the PG&Es of the world to conform, because a lot of them don't want to conform. That's my opinion.

We seem to have a lot of flexibility and local districts around us that use. Other power providers don't have that flexibility. So I think we need to use the munis to give input on what can really be done, even if there's not a whole lot of money to be made from the, from the V2G that we could standardize it and help the other utilities see a value in that. Because the value has be, like we've been talking about, to the customer. Not necessarily for the utility, but to the customer as long as it's a win-win for everybody. But I do think that the munis can have a lot of input and I'm not sure that they need to be overly regulated. In my opinion.

MR. HARTY: Maybe if I could just say I think there's a role for the munis to, you know, to be laboratories and incubators of these technologies and some, some learning.

And, you know, bring all those learnings back through, you know, everybody in California, I think, is very useful.

MS. RAITT: All right. This is Heather Raitt. I'm sorry, I'm going to have to jump in and close this and, but thank you again, Jonathan.

And thank you, Noel, and Bjoern, and Ryan, and Jackie, and Tim. Really appreciate your time and expertise.

And before we take a quick break, I just would like to just do a really quick poll. And if you could all just take a moment to let us know what type of organization you're from. It'll just take a minute or less, actually. This will just help us as we're working to make sure we're doing as best of a job as we can in this new remote environment.

We'll just leave it open, just for a few more seconds.

So if you see something that is close to or pretty close to what you're repre -- what organization you're from, go ahead and click that for us.

And we can go ahead and close.

So are we sharing the results?

All right --

MR. CRISOSTOMO: Yes, we are sharing.

MS. RAITT: Okay, great. So anyway, so people can see. So we have, it looks like we have a pretty good distribution of people and most of the attendees are from or

representing a federal, state, or local government agency.

So thank you for that feedback and please go take a little break and stretch, and we will be back promptly at 2:45.

(Off the record at 2:37 p.m.)

(On the record at 2:46 p.m.)

MS. RAITT: So again, this is Heather Raitt. Thanks for joining today.

And we'll move on to our second panel and Noel Crisostomo will moderate for us again. And this one was on Energy Resilience for Zero-Emission Vehicles.

So, go ahead, Noel. Thanks.

COMMISSIONER MONAHAN: Well, actually, can I --

MS. RAITT: Oh.

COMMISSIONER MONAHAN: -- before Noel starts, can I --

MS. RAITT: Of course. Excuse me, I'm so sorry.

COMMISSIONER MONAHAN: We -- we -- I'm sorry. Sorry to interrupt, Heather.

I just wanted to -- we have a new member joining the virtual dais and that's Dan Sperling. So I wanted to just introduce Dan and give him a chance to say a few words before we start this panel.

So just a few words from me about Dan. I think Dan, in the world of clean transportation, is legendary. He has

been a thought leader on clean transportation for decades. His conference in Asilomar on transportation has been like a seminal meeting place for regulators from all over the world. And companies and NGOs come together and really collaborate deeply on how do we move the ball in clean transportation.

So it's very exciting to have Dan participating. So I just want to turn -- turn the mic over to Dan if he has a few words to share.

MR. SPERLING: Can you hear me? Yeah. Hi.

COMMISSIONER MONAHAN: Yes, we hear you.

MR. SPERLING: After an introduction like that, how can I say anything? But, thank you, Patty.

I'm going to lurk here and listen in, but yes, this is hugely important. And electrification of cars, trucks, and buses is really the number one strategy for reducing greenhouse gases in California and in the world in the transportation sector.

So thanks very much for all the great work you're doing at the Commission, and I'm going to listen in. If I get really aggravated, I'll say something.

COMMISSIONER MONAHAN: I hope you'll say something. But, and, you know, tomorrow's panel is going to be talking more about the three revolutions. And for those who don't know, Dan is the one who coined that term. So more on that tomorrow. That's the teaser for tomorrow.

All right, Noel, I'll turn it over to you now.

MR. CRISOSTOMO: Thanks for that no pressure setup. We'll do our best.

But again, for those who are just tuning in, my name is Noel Crisostomo. I am an air pollution specialist in the Fuels and Transportation Division, working on EVs and grid integration.

So we're continuing our workshop on ZEVs and energy resilience with a panel that examines resilience from a different perspective, how fleets and infrastructure providers are planning for improving the resilience and reliability of their charging and fuel supplies so that we can keep our ZEVs moving cleanly.

This topic builds upon prior IEPR workshops last week on microgrids, during which our colleagues led discussions from prior research projects to integrate controls, the microgrid applications across a variety of critical site types, and assessing their value to California.

During this workshop, leadership from the CEC, PUC, and Independent System Operator expressed concern about the near term impacts of relying on diesel generators in preparation for the implementation of the PSPS this wildfire season. CPUC's President Batjer highlighted the need for cleaner and quieter backup generation as an alternative to the shutoffs, while utilities continue to commercialize

microgrids under SB-1339.

Bloom Energy's testimony in that proceeding states that the demands for backup generators has spiked 1400 percent since the PSPS program began. A key concern for our zero-emission vehicle efforts is the fact that emergency generators are principally diesel fueled and that according to the Air Resources Board, quote, "operating an uncontrolled 1 megawatt diesel engine for only 250 hours per year results in a 50 percent increase in the cancer risk to residents living within one city block."

This challenge of energy scarcity and local pollution poses a stark contrast to our goals for millions of zero-emission vehicles, clean not only the tailpipe, but powered renewable and with 100 percent clean energy. California is committed to this objective, and so in coordination with ARB staff, which recently promulgated regulations targeting 100 percent zero-emission buses by 2040, we invited experts to help us understand some of the most acute clean transportation reliability problems that would be posed by the power's shutoffs.

In addition, we assembled charging infrastructure providers that can offer grid independence and rapidly deployable solutions that could scale upward from light vehicles into more applications. With careful planning and investment in these creative solutions, we can hope to

replicate the benefits of microgrids to offer resilience to zero-emission infrastructure, as we'll learn during this panel.

And so as shown in this next slide, I'll introduce our five panelists sequentially, where each will give a brief presentation starting with Joe Callaway, director of capital projects at AC Transit.

Joe is responsible for transitioning the fleet of Alameda County and Contra Costa County's transit district buses to fuel cell and battery electric vehicles. Joe has experienced setting up a variety of distributed energy systems to support the fleets charging and refueling needs.

Joe, please start your presentation.

MR. BOBADILLA: Joe, you're still muted.

COMMISSIONER MONAHAN: Joe, I think you're on mute.

MR. CALLAWAY: My apologies. This technology -- I might be able to build a hydrogen station, but Zoom gets me.

So good afternoon, it's a pleasure to be here with everybody today. Thanks to the CEC staff and commissioners for making this workshop available. It's a great way to share information and talk about what our needs are.

So my name's Joe Callaway. I'm the director of capital projects with AC Transit. For the last 13 years I've been working, among other things, to develop AC Transit's zero-emission bus infrastructure.

And, next slide, please.

Okay. So I'm not going to spend a lot of time talking about what we've done because I've only got five minutes, and I'd rather talk about what our needs are. But over the last 20 years, we've moved from demonstration project, small, almost science fair type projects into commercial operation with our zero-emission buses. We've employed a major change when, in 2010, when we built our liquid hydrogen stations. We converted from gas hydrogen to liquid hydrogen, which gave us onsite storage of from one, instead of one day, now, you know, 30 days.

And we also employed onsite hydrogen generation with an electrolyzer powered by PV solar. And also self generation of, in another 1.4 megawatts of solar, along with 420 kilowatts of solid oxide fuel cell.

Right now, we're moving forward to bring ten more, excuse me -- right now we're moving forward to bring 20 more fuel cell buses into our fleet, along with 20 more battery electric buses. And that'll be in addition to the ten fuel cell buses that we've recently commissioned along with the five battery electric buses that is our first entrée into the battery electric field. We've also increased our onsite storage.

So those are some of the things that we've been able to do with regard to making sure our operations continue.

But the things that we're thinking about now is, is that resiliency just can't be an afterthought. It has to be part of your core project planning. You know, we're no longer just a small demonstration project. Now that we're with these new fuel cell bus purchases and new battery electric bus purchases, our zero-emission buses will be ten percent of our fleet.

Our core business, our mission is to safely and effectively move people to the places they need to be. So when somebody gets on a bus stop and the bus doesn't come because we're in a PSPS, that's just not a good situation for them. So we have to find a way to be resilient. And, of course, the obstacle -- there are several obstacles, but the number one, you know, probably starts and stops with the discussion of funding. Funding for storage, funding for self generation, funding to move into a microgrid environment.

But funding beyond just our local needs, but also for our supply chain, for the hydrogen supply chain and even the electrical supply chain. Policies that mandate the hydrogen suppliers have some sort of a neutral aid agreement, much like public utilities have when they will power between utilities. So the consumer never gets left high and dry without -- without power. You know, we're looking at some other kind of more abstract things to do, like charging battery electric buses with our fuel cell buses, or even

using our fuel cell buses to power our hydrogen stations during a time of, like a PSPS.

And, of course -- next slide, please.

And, of course, there's a long list of challenges in order for us to perfect this transition. You know, let's face it, we're a public transit agency. Our goal is -- is our riders. Our goal is not our equipment. So we have to be able to do this in a way that accomplishes our mission.

So in California and, you know, we're all subject to this, we're going to have 100 percent ZEV fleet by the year 2040. Well, given that we run buses for 13 years, that means we will buy our last diesel bus in 2026. That's pretty quick. So to keep pace with that, like I said, we've ordered 40 additional ZEV buses, I'll be constructing two new battery electric bus charging facilities, and we'll be maintaining a, kind of a technology neutral approach to these buses while we're conducting some side by side surveys, some studies about the operating characteristics of the battery electric versus the fuel cells. That'll tell us how they fit into our fleet and what the best mix for our fleet is moving forward.

But the challenges, of course, come back to the funding. The funding gaps between the CapEx spectrum of public transit just can't fund that ourselves. The infrastructures and supply chain development, which is outside of our industry, and along with some of the

resiliency and, and sustainability questions that we have with -- with our public utilities.

You know, a couple years ago, we never would have put PSPS or COVID-19 in our business plan, but here we are. And, you know, when we have that rider on the street, they're not going to care that, oh, we've got a challenge with COVID, or we've got a -- it's changed our business a little bit. They just want their ride to the doctor, or to work, or wherever they're going.

So what we'd like to see in the future is for fuel supply chains for both electric and hydrogen to have policies that demand resiliency. When we build projects, it's got to be part of our core thinking and not an afterthought. It's got to be part of our, our key deliverable. And what goes with that also is sustainable maintenance practices, things that -- workforce readiness.

You know, interestingly enough, the fuel cell bus and the electric drive, the battery electric bus are both really similar. They're both electric drive motors. They both work on batteries. The only difference is not, the amount of batteries that are on board and how they're charged. So we have to be able to have a workforce ready to work on those sort of buses and facilities. So that's, that speaks to our maintenance practices on our facilities, our buses, and then, of course, the training for that.

Proud to say AC Transit has kind of written the book on fuel cell training, but we're just dipping our toe into the water for battery electrics. And so we're anxious to see how that will play out.

And Noel, I think that's my five minutes.

MR. CRISOSTOMO: Thank you, Joe.

We'll definitely get into how we can prepare for a resilient workforce during the discussion.

Now we have Jana Ganion, director of sustainability and government affairs at Blue Lake Rancheria. Jana leads the tribe's energy transition to renewables, while improving climate resiliency. She serves on key national and state efforts, including the Department of Energy's Indian Country Energy and Infrastructure Working Group and on the CEC and CPUC's Disadvantaged Communities Advisory Group.

Welcome, Jana.

MS. GANION: Thanks so much. Just a quick sound check. Can everyone hear me okay?

MR. CRISOSTOMO: Yes, we can.

MS. GANION: Great. Next slide, please.

So the tribal government has a wraparound climate smart resilient strategy focused on lifeline sectors. So we look at energy, water, food, communications, and transportation with the idea that if we do all these things well, the social, environmental, and economic benefits will

result.

The tribe's investing in lower carbon transportation in the following ways. So we have waste oil from the tribe's kitchens that is used to make biodiesel, which is then used in public transit buses. The tribe is transitioning its fleet to EVs wherever possible. We're working with partners to expand electrified public transit and increase adoption of EVs by lower income community members. And EV charging onsite is powered from resilient low carbon microgrids.

Next slide, please.

As a result of a pretty extraordinary public private partnership, including funding from EPIC and SGIP, integration engineering from the Schatz Energy Research Center and other key partners, the tribe has two microgrids that can island and power our needs onsite for as long as we need it. These microgrids power the EV infrastructure for the tribe. And importantly, our microgrids are based on solar PV plus storage with diesel generators used only in emergencies and eventually, we're going to phase them out.

Next slide, please.

So electrified transportation, as we've already heard, requires power at all times, but particularly in emergencies, and the microgrids demonstrated this value during the PSPS events of last year. Because we had robust power, we were able to provide EV charging for the region.

Many of the public charging stations were down elsewhere and, in turn, after they charged at the Rancheria, people used their car batteries to recharge refrigerators and freezers to keep medicines cold and food preserved, and for other uses throughout the community. So we saw not only direct charging, but vehicle-to-grid use as well.

And one other note, by increasing reliance on solar with storage, we're reducing our need for fuel deliveries. In our isolated and seismically risky area, it is not good resilience practice to rely on outside resources for emergency power.

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The -- the PSPS events in our region were relatively short, about 30 hours. If they had lasted longer, I want to bring up one key point. There would have been lots of other issues, but communication failures is sort of at the top of the list.

At about the 24-hour mark, cell and Internet service started to fail throughout the region. The Rancheria didn't suffer disruption due to microgrids and telecom investments, but loss of connectivity will impact charging station functions, even if there is power. So if communications go down, another concern is that the Internet enabled controls of the microgrids will also be impacted.

So as a colleague has said, if you're in the energy

business, you're in the telecom business, though you may just not realize it yet. And to that I would add, you're also in the electrified transportation business.

Next slide, please.

So a couple of design considerations that, and lessons learned. When grid connected, Level 2 and trickle chargers won't likely impact operations or economics, but super fast chargers could trigger demand charges and have other economic and operational issues. So you have to look at the super fast charging profile pretty carefully.

When islanded, super fast chargers, due to their larger power use and spikes, may be challenging, especially in smaller microgrids depending on the amount of generation you have available. In terms of how we value, fund, and operate microgrids, that in turn power EV infrastructure, the benefit stack is considerable. Lower pollution from both generation and tailpipes, greater reliability, resource adequacy, potentially lower costs, emergency power for charging.

In business as usual, these benefits may accrue to select stakeholders. In emergencies, the benefits may broaden significantly and accrue to the region, vulnerable populations, emergency response agencies, healthcare and business sectors, and others. And due to this layered benefit mix, we should explore desiloing and layering funding

sources. So typical grants and incentives can be paired with emergency preparedness monies, climate mitigation funds, disaster relief funds, and other things.

And I'll just echo something that Joe mentioned, is that if we want a fast transition, we need to address capacity. So especially in rural and under resourced areas, this is going to be an issue.

And finally, I just want to emphasize that for the benefits that these systems can bring, the transition to electric transportation should prioritize disadvantaged and vulnerable communities, and to some degree, public transit. As we deal with COVID-19 and climate amplifications, equitable clean, safe transportation has never been more important for those who have the least access to it.

Thanks so much.

MR. CRISOSTOMO: Thank you very much, Jana.

We'll get into how to help manage these charging impacts with our next two speakers, starting with Desmond Wheatley, president and CEO of Envision Solar International. Desmond has been CEO of Envision, a manufacturer of off-grid electric infrastructure, including for charging for over a decade. Prior to Envision, Desmond led multiple companies offering integrated building automation, energy management, and security technology.

Desmond, take it away.

MR. WHEATLEY: Well, thank you very much, Noel.

And thanks to everybody else. This is a very important subject, I'm delighted to be speaking about it and it's something that's been close to our hearts here at Envision Solar for that decade, by the way.

I think I'm certainly not alone in this call in thinking that Governor Brown's executive order to push for 250,000 publicly available charging stations in California by 2025 was a really excellent idea. We should do everything we can to get there.

But I might be slightly less in common with others on there in that I don't believe that if we're going to continue to do things that, you know, the traditional model of connecting to the grid that we're going to get there on time. So our whole focus is on producing rapidly deployed highly scalable EV charging infrastructure solutions. We're totally agnostic as to the vendor of the EDSCR the service provision which are rapidly deployed, can be deployed at scale quickly hit those kind of numbers.

And then crucially, most importantly where this conversation is concerned, operate if there's a grid failure or anywhere where you can't get to the grid.

Shift to the next slide, please, Noel.

So we do that, this is our mainstay product here, the EV ARC 2020. It's a product that we produce here in our

factory in California. It was invented here and it's manufactured in California, shift them all over the United States and internationally.

We have a tracking solar array with a patent tracking solution that puts power into energy storage solution up there underneath the array. All the energy storage and electronics and everything is 9½ feet above grade so the thing is flood proof, seismic proof, and it's capable of withstanding winds -- actually stand to withstand winds of 120 miles per hour. But we know it survived 185-mile-an-hour Category 5 winds in the Caribbean. And it's not connected to the ground at all by anything except gravity which allows us to deploy these things very, very rapidly.

Again, you can put any EV charger on there. We probably deploy more ChargePoint units than anything else, but we also deploy Blink, Enel. We do that based on our customer's requirements. We try and get them the best charger for their needs.

Next slide, please.

So installing grid-tied EV charging is a little bit more expensive and complicated than a lot of people give it credit for. There's an awful lot of work you have to go through between the permitting and environmental impact studies and everything. None of these things should go away, they're important, they're there for a reason but it is

expensive and time consuming. And then of course connecting to the grid results in utility bills and then that terrible centralized vulnerability if there's a grid failure, the charging doesn't continue to work.

Next slide, please.

The EV ARC, on the other hand, is deployed without any construction, without any connection to the grid, without any disruption or environmental impact. The charging experience is just the same for the individual. That unit you're looking at in the picture there is going to produce about 200 -- or generate, store enough electricity to drive about 245 miles in a given day. Let me put that in perspective, the average U.S. sedan drives 30.4 miles per day. So from a single parking space completely off-grid solution, we're deploying lots and lots of driving experience for people. It's completely off-grid and frankly delivers the lowest cost of ownership between avoided construction costs and never paying the utility bill.

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Fits inside the legal sized parking space. This is really important. But it doesn't reduce available parking anywhere at all because the vehicle parks on it. And it's ADA compliant.

Next slide, please.

You can move them around in a variety of different

ways. It is a permanent solution. Once this thing's put down, it's a 20-year product. We've heard them operating now since 2012 with absolutely no appreciable degradation in their performance, batteries and everything else is still working well. And of course the components that we're integrating today are better than they were back in 2012 when we first started making these things.

But you can move it around either with a forklift. We also have an ARC mobility trailer which is a specialized hydraulic transportation solution that we also invented and did and we manufacture these. And on some of our bigger customers like Google and New York City and others actually own the trailer as well and is able -- they're able to move around their own EV charging solutions.

Of course these are designed to charge sedans for the most part but we do have them charging light transit buses for the Fresno County Rural Transit Authority, many others across the country. And then we have a larger format which is for charging heavy-duty vehicles, full-sized buses, 18-wheelers and the like.

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This is all about resiliency, we're big believers in this. Our units supports when the power goes down. They're not just useful because they continue to charge your vital fleet vehicles, although that is a major important part of

them. And during PSPS, and blackouts in New York and elsewhere our units have continued to charge vital vehicles. We think that's very important, that's a big part of the value that they offer. But they're each of them also are equipped with an emergency power panel so that emergency first responders or anyone, frankly, that the host designates can connect and get lifesaving or other useful power from these units during those disasters.

So multiple layers of value here. And potential to reach into multiple budgets to pay for the thing too. You reach into your EV charging budget for part of it and also into disaster preparedness Department Homeland Security dollars to pay for the emergency preparedness side or resiliency side of it.

Next slide, please.

Most notably recently, our products fantastically, we're very proud of this. Some of them have been underutilized during COVID because of course a lot of people are working from home so workplace charging hasn't been used so much. In this instance here you're looking at City of Oakland moved one of their EV ARC units down to an emergency COVID test center. It had been operating on a diesel generator. You know, fumes and respiratory problem environment are not exactly the best thing to have. Noise. Medics having to refuel the thing. We replaced that whole

issue with this fantastic silent and clean solution. And frankly, transformed the whole environment. So it continued to charge electric vehicles but also power the COVID emergency center. Again, multiple layers of value for that municipal customer there.

And by the way, there's a news story there if you want to click on the link at some point at your own leisure, you can watch the news story.

Next slide, please.

Lots of other uses from a resiliency point of view. We're very proud of some of the fantastic brave first responders that have used our products to power testing and also some real live emergencies have gone on. So it's definitely a multiple layer, easiest, fastest deployed, lowest cost of ownership EV charging solution which can help us get to these fantastic goals that we have. Everybody driving on sunshine clearly is saying the clean goals of electric vehicles in a way that grid-tied power can't always perform. But also just having these additional layers of value for our customers very important.

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Just this last piece I mentioned, but the last that, you know, you're going to get in the telco business if you're doing this. We do produce an awful lot of data, the units are all connected wirelessly. We make that data available to

our customers. We're also able to manipulate, manage the products ourselves. We know where they all are, we know if they've moved. We're able to reboot them on the rare occasions where we do have problems with them. Most of the times we solve the problems without ever going anywhere near them.

But crucially to the last speaker's point, was a very good point, by the way. When the grid goes down, telco goes down too. Our units will continue to operate even absent the grid, absent telco. They did through Hurricanes Irma and Maria, 185-mile-an-hour Category 5 winds, continue to operating. And we're storing all the data on board too. So when we do get connectivity back, we're able to read what's happened with the units and get all that data out to our customers.

So no shortage of data there, even though the thing's not connected with a centralized grid or a centralized network, you're getting all the power you could need and all that data you need. You never get a utility bill, no cost of construction, no permitting requirements, no environmental impact. Just lots of driving on sunshine.

And if we're going to have an electrified transportation sector, we know that power outages are already costing U.S. businesses a couple of hundred billion dollars a year. When we have an electrified transportation sector,

which we should and I applaud that, then power outages will become catastrophic. We're the hedge against that. So some percentage of your EV charging should be locally generated and locally stored. And of course we have a product made in California that's ready to solve that problem for you.

Thank you, Noel.

MR. CRISOSTOMO: Thank you, Desmond.

It's a good complement to our next speaker Susie Monson from FreeWire Technology. She's the head of sales enablement and channel program. In this role, Susie works with partners like ET, municipal, institutional, and utility customers. She brings prior experience as vice president of operations and finance at Cabala Analytics and as a director of Sunrun.

Welcome, Susie.

MS. MONSON: Thanks. So just a quick sound check. Can everyone hear me fine?

MR. CRISOSTOMO: Yes.

MS. MONSON: Okay. Great. So really happy to have been included on this panel on this important topic, so thanks very much for having me here today.

You can advance to the next slide, please.

So as vehicles electrify and as our changing world is serving up new and unpredictable challenges, we really have to think broadly about power needs. What we're focused on is

how can we most efficiently match the source of power with uses of power in locations where it's most useful?

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So at FreeWire, we're considering customers' energy needs and energy management needs holistically. We focus on delivering flexible products for customers so that customers can construct the solution that works the best for them. And our belief is that products with minimal realistic footprints and low grid impacts improve customers' ability to adapt as their power needs change.

So like Envision, we are also located here locally. We're in San Leandro, California. And we design and manufacture right here.

If you can move on to the next slide, please.

So we have two product lines. The first is our Mobi product line and that has been out in the market for several years. Mobi's a fully mobile battery unit that can be used for a variety of power needs. We like to refer to it as sort of a like a Swiss Army Knife for power. So you can use it for charging cars or really anything that you might use a generator for more traditionally. It's zero-emission, it's quiet, it's completely mobile for rapid deployment. And has a 80-kilowatt hour storage capability.

Our newest product which we're just beginning deployments of in the next few weeks is called the Boost

Charger. So the Boost is a fixed charger. It's battery integrated. It's a DC fast charger. The innovation about the Boost is that it only requires a little voltage grid connection. So it looks from the grid perspective like a Level 2 charger, but from the vehicle perspective it's a fast charger. So the fact that it can plug in to a lower voltage grid connection can unlock a lot more locations for fast charging and also enables it to be relocated with relative ease.

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So in terms of improving resiliency per zero-emission vehicles, as many other panelists have talked about today, co-locating EV chargers with storage and/or distributed generation like solar would enhance resiliency and harden community infrastructure from outages. We think battery integrated EV charging systems represent a great solution for deployment within a solar plus storage project. By providing additional energy storage capacity, it can be islanded for a recharging vehicle or using it more flexibly to balance broader site loads.

As we're looking at our product roadmap, we have several features planned for improving the utility of our products in a grid down situation.

Next slide.

So we wanted to highlight some real life customer

situations and their challenges with regards to power needs and how storage systems allow them to prioritize their highest energy needs in a crisis.

So the first customer example I'll highlight is UC Davis fleet services. So UC Davis has one of our Mobi gen products. They have a few traditional EV chargers at their garage but limited electrical capacity. So it's not practical for them to add more fixed EV charging infrastructure. So they use a Mobi gen primarily for recharging several of their fleet vehicles overnight. But in their -- in an outage situation, they are interested in using the Mobi to back -- as backup power for supporting their garage and their gas pumps for the rest of their fleet. So they may, you know, prioritize their power needs differently, depending on their kind of highest and best use of energy in that situation.

Other shocks to the system like COVID are certainly highlighting new use cases for flexible powers needs as other panelists have alluded to. You know, some New York City hospitals, for example, had testing locations on the sidewalks outside of hospitals that they need to move the site to interior courtyards in terms of protecting patient privacy. And zero-emission option would allow them to locate more flexibly without adverse health impacts.

Lastly, I think, you know, what we're seeing with

remote work and shelter-in-place is that consumers are maybe increasingly concerned about reliable power at home and that could increase the attention on V2G or other home storage systems as backup.

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So a few, you know, potential policy recommendations to support this, support promoting resiliency, you can imagine sort of a core-like program focused on storage or other resiliency features. Some soft-cost reductions in terms of self-tracking interconnections or -- and including resiliency equipment or projects in other existing IOU programs or adders onto existing programs for resiliency features.

And I think my time's up so I'll wrap up there.

Thanks very much.

MR. CRISOSTOMO: Thanks, Susie.

And our last panelist will also represents the transit agencies. For sharing some solution providers is Michael Pimentel, legislative and regulatory advocate for the California Transit Association.

Michael previously held legislative positions in the office of former Governor Brown. And SV California High-Speed Rail Authority. Michael currently represents trans districts before various proceedings at state agencies including CARB's innovative clean transit rule and the CPC's

TE train work.

Michael, please go ahead.

MR. PIMENTEL: All right. Thank you, Noel.

And, folks, want to make sure I've got a quick mic check. Make sure you all can hear me just fine.

MR. CRISOSTOMO: Yes.

MR. PIMENTEL: Fantastic. So good afternoon, Commissioners, I'm Michael Pimentel, now actually deputy executive director to the California Transit Association.

As Noel mentioned, we are a nonprofit trade organization representing California's transit agencies.

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As Noel mentioned at the very start of today's panel discussion, in December 2018, the California Air Resources Board adopted through negotiation with my association and stakeholders statewide the Innovative Clean Transit Regulation. And this regulation seeks to convert California's transit bus fleet to zero-emission technology by 2040.

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And though it appears as though we've got actually earlier slide deck, the expanded rather than the abridged slide deck presented here.

MR. CRISOSTOMO: Apologies for that, Michael. Are

you able to use those slides that are loaded or?

MR. PIMENTEL: Absolutely. So, yes, we can just go ahead and click on through.

So folks, as I mentioned, Innovative Clean Transit Regulation was adopted in 2018. It is one that's looking to compel the transition to zero-emission bus technology by 2040. And it is the operating principle by which most the agencies are considering their transition to these low-emission or zero-emission technologies.

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Now I do want to say while the goals of the Innovative Clean Transit Regulation are certainly ambitious and ones that we fully support, it must be underscored that for transit agencies above all else, we are mobile providers. And in usual years, we provide roughly 1.4 billion unlinked passenger trips to Californians across the state. Now obviously that's changed quite a bit during the pandemic with ridership being down at most agencies by about 80 percent. For some agencies it's actually in excess of 90 percent. But today perhaps more than ever, we are serving as a lifeline for Californians who have no other means of mobility.

And I say all this, this conversation focused on resiliency because I think it contextualizes the balancing act that transit agencies that are inherently resource constrained, both from a staffing and a financial

perspective, must engage in as they strive to maintain transit service while also advancing state and local mandates to electrify which come at significant price tags.

Now I spend a lot of time with transit CEOs and COOs, as the staff lead for zero-emission bus task force. And I can tell you that for most of them, what keeps them up at night are their concerns about how the cost and the state of zero-emission technologies, as well as grid reliability, if not properly scoped into a project or addressed, could undermine their ability to ultimately provide service. And these concerns or considerations are further complicated by the reality that transit agencies are often called on to play a role in emergency response. Now for these agencies, if the technology does underperform, or the grid is compromised in any way, not only might they be unable to provide daily service, they may also be unable to assist evacuations when and if an earthquake or wildfire strikes.

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Now to address these concerns, transit agencies are planning for in building redundant infrastructure at the facilities. For most agencies, to date, this is net deploying backup generators that can provide between 1.5 and 2 megawatts of power. Enough power to -- to support approximately about 30 buses. Now this solution, however, is inherently imperfect because it relies on diesel and CNG

fuel, of course cutting at the air quality and greenhouse gas emission reduction benefits of electrification itself. And often that cannot be scaled by transit agencies due to the costs of the technology or depot space constraints.

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As an example -- as an example, Foothill Transit was a service territory that stands east in Los Angeles County, which is viewed by many in the industry as the leader in battery electric bus deployment is actively considering how to repurpose some of their CNG refueling infrastructure to accommodate affordable CNG generators. Now that said, they see this as a stop-gap measure. Depot space -- depot space limitations that I mentioned previously, they are cleared eye that this approach cannot be scaled and may be impractical, an impractical for a portion of their battery electric bus fleet that relies on opportunity charge.

Now for this reason, several others led to the range in battery electric buses, they are also exploring how they might complement the battery electric bus fleet with fuel cell electric buses. Now these fuel cell electric buses could provide redundant vehicles during a grid outage. Could more readily allow for onsite storage of fuel, which can also be used to power those vehicles in the events of compromise.

Now of course this isn't the only strategy agencies

are pursuing. Agencies like Antelope Valley Transportation Authority in Lancaster are proceeding with a development of microgrids. In the case of AVTA, these microgrids would be comprised of solar and -- solar and storage systems. And the system would not only address reliability issue but may also achieve some operating cost savings by allowing for peak shaving. And also address ultimately the sustainability of their operations as this system would be drawing on purely -- purely solar in renewable energy.

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So what can we do as a state? Now I highlighted how depot space constraints present a challenge to deploying battery -- sorry, to deploying backup generators at some agencies, particularly in urban areas. Now this limitation extends also to onsite DG, to onsite storage, as well as systems like -- like are necessary for methane reformation. And to break through this challenge, we need to -- we need to find ways to support large scale demonstrations of zero-emission buses.

I do want to note here that the CEC has heard a lot of the feedback from the industry. And through the leadership of Commissioner Monahan is now advancing several programs within the larger Clean Transportation Program to support exactly this.

Next, we must simply provide more funding to

transit agencies to deploy zero-emission buses and charging for refueling infrastructure. And as noted on your screen, these programs must actively be expanded to provide as an allowable expense, grid redundant infrastructure.

Now very finally, I do want to highlight that we must take certain baseline steps also to encourage the IOUs to be good actors in the space. And for our association, top priorities include requiring that the IOUs name transit and rail agencies and essential customers. Now this has no practical benefit in the case of PSPS, but this would allow agencies to be considered as a higher priority when or if we do find that the grid is compromised in some way.

And then very finally, with regards to notices, we are encouraging increase and perhaps earlier advanced notice of when a PSPS is planned as a way of making sure that transit agencies have the ability to make alternative plans for service delivery and can also scope into any evacuation order needs that they might ultimately have to respond to in the event of a PSPS.

So with that, thank you for -- for your time today. I do look forward to -- to the discussion in the Q&A.

MR. CRISOSTOMO: Thank you, Michael. And thank you panelists, all.

Before we get into our discussion, I'd like to turn it to the dais to see if Commissioner Monahan or others have

questions.

COMMISSIONER MONAHAN: Thanks, Noel.

And thanks to all the panelists, this is really fascinating.

I, you know, it -- from this panel, which is of course just a microcosm of the larger side of -- of issues. You know, there -- it seems like on the light-duty side we have some, Envision Solar, FreeWire. This is -- there's some, I don't know if you would call them solutions but there's definitely some ways to address, you know, to power light-duty vehicles when the power goes down.

With heavy-duty, it's much more difficult. And I'm just curious if any of the technology providers have been thinking or scoping out any -- any types of solutions on the -- on the heavy-duty side to address some of the issues that both Joe and Michael have raised.

MR. WHEATLEY: I can certainly take a go at that. This is Desmond Wheatley with Envision Solar.

What you saw was not that we have a lack of solutions, but a lack of time to present them. So we -- we have our solar tree product which is exactly the same technology as the EVR that I showed you there. This is much larger. We are currently in the process of deploying those for the Fresno County Rural Transit Authority to charge full-size electric buses. They can operate connected to the grid

or off-grid. They operate properly well without a grid connection and they will charge buses, or 18-wheelers, or any heavy-duty vehicle that -- that pulls up into a DC fast charging solution, either conductively or wirelessly.

So there's -- there's no end to the solution. And by the way, I'm fine with you calling a solution. This is a tried and tested product. We've been deploying these things for many years. We're in over a hundred municipalities across the United States of America. CalTrans is our biggest customer in California.

But we're in the worst possible environments. Nevada, top secret federal facilities. New York, Buffalo during the winter. Product works everywhere. So it's -- it's way beyond a concept. Tried and tested.

And for heavy-duty, I'll just add, for heavy-duty vehicles of course there's just a lot more generation and storage and so they -- they, you know, the resiliency side of it to just providing a lot more available energy for uses beyond keeping vehicles going. Certainly, our focus is to keep the fleets moving, whether they're government-owned or otherwise, or transit or otherwise. But it's certainly nice to have that extra source of power that renews every single day. We know where the sun's going to be for the next five billion years. That's what I call energy security.

COMMISSIONER MONAHAN: Desmond, did you say -- did

I hear you right that CalTrans is your -- is one of your major customers?

MR. WHEATLEY: In California I think CalTrans is our largest customer at the moment. We deployed DC fast charging for them, completely off-grid and rest areas. We also deploy a lot of Level 2 charging for their fleet vehicles. And then on the -- on the transit side, it's mostly buses. And we were just about to start on full-size buses for the first time. We've been doing a lot of kind of the mid-size vans and that sort of stuff, but mostly buses. Now it can be mostly full-size buses with a solar tree product.

COMMISSIONER MONAHAN: Thank you.

Jana, I had a question for you. I heard so much about the Blue Lake Rancheria. I -- it's, you know, really exciting what you have been able to accomplish. And I had a question about the charging. I appreciated your recommendations of trickle charge in Level 2 observing code when it comes to charging during PSPS.

Have you all considered having vehicles provide energy back to the grid as well as just being able to power the vehicles in a -- in a power setup?

MS. GANION: We've considered it. Certainly, it's on our list of things to explore. And I think that we're interested, especially because of the functionality we saw in

the PSPS events of -- of vehicle to grid use. Now the vehicle to grid use was constrained by the size of the inverters and how -- and how cars could actually function with sort of a little bit jerry-rigged kind of systems there.

I think that -- there's a lot smarter people than me thinking about vehicle to grid and grid to vehicle use, and it's not something that we've explored in depth. But I do think that especially when we're dealing with these larger batteries in buses, in our fire trucks, in our bigger equipment, like you were saying, heavy-duty, that that needs to be explored because we will want the demand response and the -- and the grid balancing control of that potentially when we're islanded.

So -- so maybe when we're grid connected it's not so important but when we're -- I mean, it's important California-wide, but it might not be important for our site. But when we're islanded, that could be really important for us.

COMMISSIONER MONAHAN: I wonder for both Envision Solar and FreeWire, can you illuminate us on how much the viewer business model would -- do you think is going to be services beyond the vehicle. So when there's a power shutoff or if there is just some need for powering equipment, or your home, or other things besides the vehicle, how much of your business model is built on these other uses or other

potential draws of energy?

MR. WHEATLEY: Go ahead, Sarah.

MS. MONSON: All right. This is -- this is Susie with FreeWire.

And I don't know that I would be able to quantify kind of the percentage of our business model. But it certainly is the case that we foresee the, you know, the Boost Charger for example as a -- as a general energy asset and energy management asset. It happens to be able to charge vehicles in a -- in an innovative way. But I think that we do think of it as an asset that could be deployed in a variety of ways. You know, demand response, et cetera, backup power for a site. And that that is part of the value and interest in -- in our technology.

MR. WHEATLEY: So I'll tell you from Envision's point of view, Commissioner, we are very much focused on transportation. We -- we think that we've got a gigantic mountain to climb here. We think there's nothing more important than electrifying transportation and especially using renewable energy to do that. Seventy percent of the U.S. greenhouse gas emissions comes from transportation of the generation of electricity. Our products solve for both.

And so having a rapidly deployed scalable solution is going to essential. Because as I said earlier, you know I think our entire industry has deployed something in the order

of 20,000 publicly available chargers over the last decade and Governor Brown's magnificent goal is going to set us a goal of having more than 50,000 per year deployed now between now and 2025. Clearly, we've got to have something beyond the siege mentality of digging up parking lots and extending the grid.

And then beyond that, the grid locally and California and certainly from a U.S. point of view does not have a sufficient capacity to allow for the electrification of transportation. I mean, we're about 30 to 40 percent short, actually. And we all know how long it takes to build centralized power stations, and transmission and distribution infrastructure, and how environmental impactful that is. It's not a plan to succeed, frankly, if we're going to continue doing this way. So we have definitely focused on building something that's incredibly robust, long-lived, zero unit cost for energy will survive and continue to power vehicles during blackouts and brownouts and everything else, and be able to be deployed at the sort of scale that we need.

And if you think about California in the future, we're just driving on sunshine and there's no unit cost of energy. The impact that that has to the local tax basis, average American spends $5,000 a year putting fuel and maintenance in their internal combustion engine vehicle. Just imagine if all that went back into local tax basis

because we were using nothing but locally generated stored electricity.

So the -- the disaster preparedness side of it for us is, I won't call it icing on the cake because it's vital to many of our customers. You saw that in the, you know, Oakland scenario powering the COVID test centers. We got -- we know that New York's emergency services have used the power -- emergency power panels. But transportation's the goal number one. And then if we can provide these other layers of values in a way that no other EV charging infrastructure can because again, every morning, we get -- we get a new boost shot in the arm and we can just keep doing that forever, frankly, no matter how bad things are. Earthquakes, hurricanes, flood proof thrown at our feet and everything else. So it's very important. Resiliency is very important to us, but transportation's the number one goal.

COMMISSIONER MONAHAN: Well that's -- that's all my questions.

I'm not sure, Heather, are there other members of the virtual dais here?

MS. RAITT: Yeah. Dan Sperling.

COMISSIONER MONAHAN: Dan, do you have any questions for the panel?

MR. SPERLING: You know, it's more of a comment if that's okay.

You know, it's been a excellent panel, excellent discussion. You know, those of us in state government and academia, we do all these studies that show total cost of ownership is going to be very attractive soon. And we can do all these forecasts, but the reality is getting from here to there, there's lots of challenges. It's a whole ecosystem we're talking about here.

And so all these, you know, I'll call them little ideas that are not so little, are really part of the solution, are part of the solution set. And we've got to figure out how to scale them up because they only make sense at scale.

And we also have to acknowledge that charging, selling electrons is not a business model. You know, almost anyone in that business is getting funding from local governments, retailers, employers. Someone that's subsidizing it. And so, you know, the focus of the Commission and CARB really is to be responsive to what we're hearing here in these presentations. Is figuring out a way of helping them scale up, supporting what they're doing, supporting experiments and, you know, in different kinds of ways. So this has been a excellent discussion.

MR. WHEATLEY: Thank you for that.

COMMISSIONER MONAHAN: Thanks, Dan. Great comments, as always.

All right. So I'm going to go off video and let Noel take over the facilitation.

MR. CRISOSTOMO: Thanks, everyone.

So let's jump into the questions. We have about 18 minutes.

Let's try to uncover how we could better value, these DERs. Everyone's highlighting the need for more intensive funding to make the model work. Dan just had highlighted the desire to support experimentation.

So I want to break this up into two questions. So we'll say that, so the first set of questions is for Susie, Desmond, and Jana.

So FreeWire's battery VAX chargers, the solar arc, and then the islands and microgrids are often perceived as niches and it's challenging to make these pencil in the conventional way of accounting. And so what are the key missing parts and how do we better account for those on our energy planning ledgers? Are there monetary values that we can place more holistically to understand the true benefit of resiliency and the technologies that you're pursuing?

For example, the speed of deployment. The option value of stacking those future benefits for grid services and avoiding grid impacts, whether they be system upgrades or de-energization and of course the social benefits. I know we talked a lot about that during your presentations, but how

can we better finance that in a way that scales the business model?

MR. WHEATLEY: Who do you want to go first, Noel?

MR. CRISOSTOMO: Let's do Jana, Susie, and then Desmond.

MS. GANION: Okay. So thank you. I think it's a great question.

First of all, I know this is a trite saying, but we needed all of the above. When I -- when we talk about microgrids, in our situation it's a behind the meter type of scenario. It was largely a research and demonstration project to prove up intermittently available renewable resources, and battery storage, and fancy microgrid controls, and load shed, and all of that. And -- and these have been extraordinary successful projects.

And I think to respond to your question, it is an open question whether or not microgrids will make sense behind the meter broadly or like we've seen most recently, we have a couple of boxes to check. We need these products that exist off-grid, definitely, to achieve our climate goals. But we also have just come out of a couple of public safety power shutoffs that in this rural geographically isolated region, even though they only went on for 30 hours, it caused a lot of social and economic disruption.

So when I think about the solutions that -- that

the CPUC and the CEC and technology vendors are going for now, I see sectionalizing and segmenting the grid further with DVR deployed so that we can meet those heavy-duty transportation needs, as well as ticking both boxes of the transportation and the power lifeline sectors for people and of course communications and everything else that -- that power supports.

So -- so we've heard across the board that there's also an issue of capacity. So if we want to move fast and if we want to achieve this resilience with zero-emission resources quickly and safely, you know, I look around and I see the vast majority of grid expertise and management, with the grid as the nexus, gathered within utilities and CCAs. And with the CPUC and CEC and research and development entities and technology vendors as key partners, having that appropriate capacity is no small thing. And I can tell you from personal experience that deploying a mini electrical grid to power all this critical infrastructure, including transportation, is not as easy as it sounds.

And so I think it is an open question about how we do microgrids, or grid segmentation with DERs going forward. Thank you.

MR. CRISOSTOMO: Desmond. Or sorry, Susie and then Desmond.

MS. MONSON: Sure. So a few different thoughts on

this. So first I would say in terms of -- of these being niche solutions, I mean, I guess you could say -- many people would say EVs are -- are a niche market at this point. And getting to -- getting to broader scale is certainly a part of these -- these solutions being considered less niche. And right now I think another reason we're -- it's considered niche is the -- is the financial reality, you know, in that our -- our products are expensive and, you know, battery technology is still quite expensive and doesn't -- doesn't pencil out without some incentives to -- to Mr. Sperling's point with regard to, you know, selling, just selling, selling the EV charging isn't going to -- to pencil out.

But I do think that there are a lot of benefits with regard to avoided costs which are hard to quantify and maybe hard to get people to attach to as specifically. And many of them are things that Desmond had also referred to.

So whether that is your operating expense is much lower because you're going to be able to avoid demand charges because you have some of your own generation offsetting it, or you have a battery that's acting as a buffer. Whether that's a real estate -- a real estate savings in that you don't have to tear up your parking lot and you don't have to dedicate, you know, 12 parking spaces to having a transformer on a pad, and instead you can have a solution that is more -- more space efficient.

And whether you just are going to be able to have a faster deployment that does have some flexibility so that if your needs changed in the future, you could redeploy to a different location. Those are all things that -- that, you know, those are -- you can think of those as costs that you're avoiding as opposed to like a specific, you know, upfront savings.

MR. WHEATHLEY: Yes. So I think this is an excellent question. One that we deal with all the time and have been for a decade now. It's getting easier, I must say, because we're getting more acceptance. You know, as a friend of mine that used to work for Governor Brown always liked to say everybody in government can't wait to be first to be second. And so it's really so very helpful now that we have, you know, these large customers like CalTrans and New York City and others, and a hundred municipalities showing that there's no risk here.

Noel, to your point. I would say that the genesis of the problem here where we're is concerned is that we are often viewed as a last resort solution. When you just can't dig up the parking lot enough, or pull enough cables, or spend enough money upgrading the grid and risking the centralized vulnerability and all that sort of stuff, then you come to Envision Solar. And this is completely upside down. We should be the first choice and only in locations

where you cannot use zero environmental impact, zero cost of energy, completely emissions free charging infrastructure should you consider the incredibly expensive and invasive process of extending the grid, which as I say, is already under capacity for the task at hand here.

There's nothing against the grid. The grid should be involved as part of this mix, but it shouldn't be always the first choice. The problem where the money is concerned is often that first of all, we deal with customers who are either only concerned with CapEx or OpEx, but not both. And so many of our customers, and I won't name any, don't really care how much electricity costs as long as they get their installation cost low. And similarly, we have other customers that want electricity to be really cheap and don't care how -- what the capital expenditures are.

And then we're in other environments where, for example, we're -- everybody's desperately trying to get the utilities to pay for so-called make-readies. And yet, and this seems to be welcomed as a great idea. Although it would be unique in any other appliance on the electrical grid where you have the utility paying to deliver power to that appliance. Imagine if laundromats operated that way. And yet they're not able to invest ratepayer money in solutions like ours.

And really does the -- does the ratepayer care

where their electron comes from, or the kilowatt hour comes from? I mean, just the fact that we're not directly connected to the grid infrastructure seems to be a terrible reason not to be able to use money sensibly in these circumstances.

So I think what needs to happen is we need to look at total cost of ownership. At the end of the day that's what affects ratepayers, taxpayers, and just general citizens more than anything else. We need to look at reliability and you're absolutely right, we should be factoring in what is the cost of downtime? You know, what is the cost of a blackout? We already know it's $200 billion dollars a year for businesses today, but when we have electrified transportation, I don't think anybody's calculated what that cost will be.

And what percentage of infrastructure must we have that is immune to these types of failures in order to maintain a secure transportation center. We know all these things. If we know all of these things, we can be certain that -- that nefarious actors out there know these things, too, and to the extent that they can negatively impact us, they will.

And then the last comment I'll make is to Mr. Spelling, I think it was, comment that, you know, selling kilowatt hours unless you're a large entrenched monopoly like

the utilities, it's not a very good business. You know, I think most people in the EV charging space are spending $10 to collect a dollar. We've got to come up with better business models in this. You're about to see us roll out with a driving on sunshine networks. That'll be free to the EV driver and funded in much more innovative ways and I'm really looking forward to that.

The transaction around fueling is going to change dramatically. And as long as we have no-cost for kilowatt hours, we don't. No cost per unit of energy, we're going to be able to deliver things to consumers that they've never seen before to the benefit of everyone involved.

MR. CISOSTOMO: Great. Thank you. All three of you.

To try to move toward public Q&A, and I want to give the last words to Michael and Joe in a related question. So we just heard the terms of what it costs several times and that -- that parallels a presentation that I gave during our workshop a few weeks ago on charging infrastructure investment where we're, as a state, I think trying to look towards the most cost efficient portfolio of solutions to enable electric miles. Whether that looks like fast charger, or Level 2 charger, or something like a Mobi or a solar ARC.

This really ultimately comes down to the total cost of energy. And so Joe, you've deployed several conventional

and alternative energy solutions that are now being considered by your counterparts across the state as part of the implementation of the Innovative Clean Transit Rule represented by CTA and Michael address transit agencies across California and the U.S. more broadly soon.

Given the grid light, or grid optional, or microgrid solutions that were just described by Susie, Desmond, and Jana, one of the key financial considerations or constraints that have been challenging and -- are the capital and operational expenditures that you're operating under structured appropriately to take full advantage of the solutions necessary to scale as quickly as we need.

Let's do Joe, then Michael.

MR. CALLAWAY: Okay. Well I think that's a really good question because one of the challenges we have is understanding what's vapor wear versus what's 90 percent ready. And in an emerging technology market, what's state of the art this year is not even functional next year.

So we have to manage our CapEx dollars such that we're buying, that we're investing in a way that -- that provides a long-term viability from the standpoint of, you know, things. In a lot of our normal equipment purchases, we think in terms of 20 and 30-year lifespans. And in our, you know, in our zero-emission infrastructure, we're thinking in terms of will it make 10 years because the industries are

going to change, the sources of energy are going to change. The how we use it is going to change. And so it's really hard for us to create a cost model that takes in about both CapEx and OpEx when you really don't know where the industry's going and whether something is state of the art today but tomorrow's goose egg, if you will.

So that's a challenge for us. We can't afford to invest in a trendy approach. We have to invest in a very sound stable approach and then we have to drive that -- that solution probably twice beyond its useful life in order to make it work for a public agency. So that's the challenge with us with regard to funding. I mean, well with regard to using the funding.

Michael, do you -- do you have anything you want to add?

MR. PIMENTEL: I think, Joe, that that's spot on. I think, got a take that maybe goes in a slightly different direction. So Noel, if I can just kind of take this as an opportunity to highlight what I think is just an underlying challenge for the industry. And that's just that public transit has historically and chronically been woefully underfunded. And we as a state, and as a federal government need to find ways to provide transit agencies with the resources they need in order to pursue what might be dual, if not tri-mandates.

We talked a lot about the need for transit service to be robust. The need for agencies to get service out on a daily basis. At the same time, we're also asking them to take on what is a enormous task of electrifying that fleet.

And to just put this into perspective, when the California Resources Board did their analysis of what the cost would be for this transition to a fully electrified fleet between 2020 and 2040, they had identified a cost of upwards of a billion dollars.

Now my association, my members think that that number is fairly low, but even if we were to take it as a given, I think one of the challenges that we're now faced with, particularly in light of COVID-19, is that in this fiscal year alone, California transit agencies stand to be in the red to a tune of $3.1 billion. And so I think we find ourselves in a situation where absent new money essentially being invested, probably from the federal government, our ability to advance all of these technologies in a way that is coherent, that ultimately doesn't take away from our ability to provide that core service, is going to be severely compromised.

And I think one of the things that we as a state need to grapple with is how can we then best utilize the resources that we have. And I think the structure of incentive programs has been one that has really encouraged

every agency to go out and buy a zero-emission bus. Whether it's battery electric or fuel-cell electric, we may have to find a way to consolidate some of those resources whereby we are truly doing large scale demonstrations so we can bring the cost down of the technology but then also start producing some lessons learned that can be socialized more generally with the industry.

It really doesn't serve any one any good if agencies are struggling together, struggling in tandem. It makes much more sense for we as a state to focus our investments, learn as much as we can, and then propagate the learning to a broader industry.

MR. CISOSTOMO: So there's definitely work to continue, with what I'm hearing. There's some ideas out as to how to kind of bootstrap our way and find the most effective uses, and I think we'd like to work with everyone to figure out how to bring in these advanced technologies and how to support the really struggling public agencies that serve a reliability purpose. Not only for transportation but as people we're brainstorming, eventually community, resilience, and services.

So we'll look forward to working with you on capturing these really wide variations of business models and unknown to the industry through the IEPR and beyond.

So with that, we would like to take some public

comments, but I want to thank Joe, Michael, Susie, Desmond, and Jana very much for a very insightful session and look forward to continuing it afterwards. Thanks.

MR. WHEATLEY: Thank all of you.

MS. RAITT: Thanks, and this is Heather. And if you could all just stay on for just another moment or two while we take a couple of questions from attendees.

And Jonathan Bobadilla, go ahead. We just have a couple minutes here.

MR. BOBADILLA: Okay. Thank you. This question is from Andrew Bennett.

Does the Boost Charger support V2G functionality if connected to the right vehicle?

MS. MONSON: So we are complying with the, I think it's the ISO 15118 standards on -- that would enable V2G. We -- it's a little, I would say it's still in the works. So at the moment, it does not. But when we do enable bidirectionality for the Boost within the next year, that would be available as well.

MR. BOBADILLA: Thank you.

And then this question is from Raoul and it's directed at Desmond.

Assuming that -- that as a solar panel on top of the structure, does that provide enough power to operate two EVSE, and at what rate?

MR. WHEATLEY: So the answer is that we do all three rates of charging. Level 1, Level 2, and DC fast charging. When we do DC fast charging, it has to be said that we actually interconnect four of the units that you see behind me, together. It's all above ground with a pre-engineered connection so there's no construction, and none of the permitting or any of that that we have to go through there.

Yes, it certainly generates enough to operate the two EVSEs that you see on there. We've got deployed all over the country doing that. The combination of solar and storage onboards will produce and deliver enough electricity to power up to 245 miles in a given day. Obviously, that can vary depending on insulation and -- and other things. But even in environments like New York City in the winter, we're powering New York Police Department cars with dual head chargers on the -- on these units. So it's a -- it's a very, very good functional solution and works well all over the country.

MR. BOBADILLA: Thank you.

Heather, how's our time looking?

MS. RAITT: Yeah, I think we probably better move on to public comment, but thank you so much, Jonathan, and Noel, and Joe, and Jana, and Desmond, and Susie, and Michael. Thank you for your time and your expertise. Really appreciate it.

And we could just go ahead and move on to public comment.

MR. WHEATLEY: And thank you.

MS. RAITT: Thanks.

All right. So just wanted to remind everybody that we are taking comments and we're -- please limit it to one person per organization, and we'll be limiting it to three minutes per speaker.

And so if you're on -- using the Zoom platform, you can go ahead and press the raise hand icon to let us know that you'd like to make comments. And if you're on the phone using Zoom, go ahead and dial zero -- excuse me, star 9 and that will raise your hand to let us know that you want to comment. And then you can just press star 6 to mute and unmute your line if you're on that phone.

And with that, I will go ahead and introduce Rosemary Avalos from the Public Advisor's Office at the Energy Commission who is going to go ahead and help us with the public comment period.

Thank you.

MS. AVALOS: Thank you, Heather.

I will first call on attendees using the raised hand feature on Zoom. Please state your name and affiliation and spell your first and last name. Also, do not use the speaker phone feature because we may not be able to hear you

clearly.

CT 11, your line is open. And you may need to unmute on your end.

MR. LEVIN: Yes. This is Jaimie Levin with the Center for Transportation and the Environment. My first name is spelled J-A-I-M-I-E. And last name, L-E-V-I-N.

And I wanted to comment on the -- the importance of heavy-duty vehicles in addressing the resiliency question that is posed with this IEPR workshop. I spoke about this in the IEPR workshop that I actually was a panelist at some weeks ago.

Michael Pimentel mentioned transit buses being an important resource in emergencies and natural disasters where you need to move people from one area to another and maybe considerable distances. And therefore these zero-emission vehicles are going to need that robustness to be able to go further than they maybe normally go in a -- their daily duty cycle.

But the other value that should be recognized, especially with fuel cell electric vehicles and buses in particular, is that as an example, the 40-foot fuel cell electric bus that we just launched in service in Orange County in AC Transit carries almost 600 kilowatt hours of usable stored energy. And we're also in the process of building articulated, 60-foot articulated fuel cell buses,

with over a megawatt hour of usable energy. And both those buses can be refilled or recharged within 6 to 15 minutes. And eventually it'll be possible to do that with a mobile fueler.

But you can imagine the resource capability of having a whole fleet of buses to serve emergency situations. And so it also behooves the state and the California Energy Commission to consider what, you know, buildings and facilities in our communities should be geared up to handle exportable power for these purposes.

Thank you very much.

MS. AVALOS: Thank you.

Next comment to DeLisa. Please state your name and affiliation and spell your first and last name. Your line is open, and you may need to unmute on your end. DeLisa. Go ahead.

DeLisa, go ahead and make your comment.

MS. DELISA: Oh. I'm sorry. It just hit the phone. No comment.

MS. AVALOS: Oh, okay. Thank you.

The next commenter is Botsford. And again, please spell your name and state your affiliation. Your line is open.

MR. BOTSFORD: Hi. Charlie Botsford, B-O-T-S-F-O-R-D. Charlie, C-H-A-R-L-I-E. On behalf of

myself.

Commissioner McAllister earlier had a question about standards, communications protocol for providing power back to the grid from EVs. I'm on the Society of Automotive Engineers SAE J3072 committee which is developing that standard. So it talks about communications protocol and also power flow requirements for the onboard inverters, onboard chargers for the, for electric vehicles. And part of that is IEEE 1547, and IEEE 1547.1 which is the testing requirements.

So it's -- it's pretty robust the standard required to put power back onto the grid. And we're working with OEMs and utilities, and charging, charger vendors, and putting a standard together. So I just wanted to answer Commissioner McAllister's question about that.

Thank you.

MS. ALAVOS: Okay. Thank you for your comment.

Reminder, dial star 9 to raise your hand and star 6 to unmute and then mute your phone line.

Are there any other comments? Please raise your hand.

Okay. Seeing that there are no more comments, I will hand the mic to -- back to Commissioner Monahan.

COMMISSIONER MONAHAN: Great. Well thanks to Heather, to the IEPR team, to the folks in the Field and Transportation Division, and all of the many others for

putting together this really fascinating set of panels.

And remember to come back tomorrow for discussion of the three revolutions, the intersection between electrification, automation and mobility as a service.

So hope you can join for tomorrow's discussion as well.

Thanks, everybody.

(Thereupon, the Hearing was adjourned at 4:10 p.m.)

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I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were reported by me, a certified electronic court reporter and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

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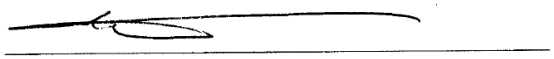

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