DOCKETED	
Docket Number:	18-MISC-04
Project Title:	Vehicle Grid Integration Roadmap Update
TN #:	226038
Document Title:	2018 Workshop
Description:	N/A
Filer:	Cody Goldthrite
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	12/7/2018 8:35:57 AM
Docketed Date:	12/7/2018

CALIFORNIA ENERGY COMMISSION

In the Matter of:

California Vehicle-Grid)
)
Integration Roadmap Update)
_____

WORKSHOP

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET

FIRST FLOOR, ART ROSENFELD HEARING ROOM

SACRAMENTO, CALIFORNIA

TUESDAY, OCTOBER 30, 2018

9:00 A.M.

Reported by:

Gigi Lastra

APPEARANCES

STAFF

Eli Harland Electric Generation Specialist, Siting, Transmission, and Environmental Protection Division

Matthew Fung, Mechanical Engineer, Energy Research and Development Division

Noel Crisostomo, Air Pollution Specialist, Fuels and Transportation Division

Laurie ten Hope, Deputy Director, Energy Research and Development Division

PANELISTS

Kenneth Rohde, Idaho National Laboratory

Joshua Eichman, National Renewable Energy Laboratory

Celia Dayagi, Siemens

Jacqueline Piero, Nuvve

Sunil Chhaya, Electric Power Research Institute

Oleg Logvinov, Charging Interface Initiative (CharIN)

Barton Sidles, Hubject

Byron Washom, University of California San Diego

Doug Black, Lawrence Berkeley National Laboratory

Samveg Saxena, Lawrence Berkeley National Laboratory

Carlo de la Cruz, Sierra Club

Eric Borden, The Utility Reform Network

Rick Kubin, Grid Democracy

Peter Klauer, California Independent System Operator

Carolyn Sisto, California Public Utilities Commission

Stephanie Palmer, California Air Resources Board

Ray Gonzalez, California Energy Commission

PUBLIC COMMENT

Eric Borden, The Utility Reform Network

Obrie Hostetter, Hubject

Vincent, Kitu Systems

Steve Davis, Oxygen Initiative

Dean Taylor, Southern California Edison

Jeremy Whaling, Honda

Pamela McDougall, National Resources Defense Council

Karim Farhat, PG&E

Matt Coldwell, California Energy Commission

Holmes Hummel, Clean Energy Works

Ryan Hardy, Honda

Richard Schorske, EV Alliance

Unidentified Male 2

Erick Karlen, Greenlots

Francesca Wahl, Tesla

Steve Davis, Oxygen Initiative (via WebEx)

AGENDA

1

P R O C E E D I N G S

OCTOBER 30, 2018 9:00 A.M.

MR. HARLAND: Hey, good morning, everybody. We're -- we're going to get started here. So if everybody can find their seats, we'd appreciate that. We'll probably have a few folks straggling in too. I noticed that there's -- that there's a couple of folks at security gate. So. But we're going to -- we're going to get started. We've got a lot to get through today and we want to be able to cover all the topics in-depth.

So again, my name is Eli Harland. I work here at the California Energy Commission and I'm helping facilitate the update to the Vehicle-Grid Integration Roadmap. Thank you everybody for coming back for day two of our workshop. I'm going to go through a couple of housekeeping items before passing it over for some opening comments, and then we'll get right in to our first panel.

So just like yesterday, in case of a -- in case of emergency, please follow Energy Commission's staff diagonally across 9th Street to Roosevelt Park. That's where we'll gather if there's an emergency.

For those that are on WebEx, please keep in mind that we're going to keep your phones muted. If you could help us and keep your phones muted as well, we would

appreciate that. We are broadcasting today's meeting through the WebEx system. We're recording this meeting. We will post that recording shortly after the workshop. We're also transcribing the meeting and so that transcript, once available, will also be posted for your reference.

So I'm going to invite -- invite Lori ten Hope, Deputy Director of the Research and Development Division here at the Energy Commission to make some opening comments for us. And then after that, we'll get started with the -- with the panel. So Lori.

MS. TEN HOPE: Thanks, Eli. So it's my pleasure to welcome everybody to day two of the VGI workshop. And I'm just going to provide some brief context to remind us why we're here and why transportation is so important. So I'm just going to remind us of some important statistics that kind of set the stage for why VGI can assist us in achieving our policy goals.

So nearly 40 percent of our GHG emissions come from transportation. And if we think about the emissions from refineries, that number goes up to -- hovers around 50 percent. So in California, it's a really significant contributor to -- to GHG. It's also, motor vehicles are the largest source of air pollution. About 90 percent of the diesel particulates and 80 percent of the NO_x comes

from our transportation sector.

So we've made -- we've made improvements in air quality, but there's a lot more that remains to be done and given the context of the contributions to climate and the unhealthy contributions to negative health impacts, transportation is going to be a core focus of our energy policy for I think a long time to come. I think we've -- we've made some important strides that we can -- that we can build on, but there remains significant challenges and barriers to fully realizing the potential of low carbon fuel.

And the first, you know, we're obviously here today to talk about electrification of transportation which holds the promise of reducing GHG, but also at the same time as our electricity grid is serviced by more and more renewables, that generation source is cleaner and the impact on all of us is reduced. But particularly in disadvantaged communities that are primarily measured in terms of the negative environmental impact on some of our citizens that are most vulnerable to pollutants and pollutant impact.

So if we can be successful in really overcoming some of the challenges to electrification and grid integration, we'll see local benefits as well as global benefits from the leadership position that California can

establish.

So some of the -- some of the barriers you spent yesterday thinking about what those -- what those barriers are. You know, and I think one of the really significant opportunities for this -- for this group today and for the roadmap in general is to articulate what -- what some of those solutions are. From technology solutions from the innovators in the room and more complicated are what aspects need to be standardized and how do we think about interconnection so some of the -- some additional values can be unlocked for both the customer using an electric vehicle but also from the grid operator who sees electric vehicles as a perfect complement and an asset in the operation of the transmission and distribution grid as opposed to an unpredictable invisible load on the grid.

So I think we have some really exciting and perfectly framed conversations this afternoon and the panels that are structured. The first is on -- is on customers. What do customers need and want and what are the value streams that might speak to a customer? What kind of software, communication and control, and standardization is going to help provide the customer with the right signals to charge at the times that are one, going to be an asset to the grid, but two, are going

to provide a revenue stream to that driver and, you know, make the cost effectiveness of electric transportation, you know, more appealing?

And on the other side, provide visibility to -- to the grid operator. And so this -- this is an area that really requires all of our thinking. I mean, innovators can innovate a technology, but if you're talking about interoperability that depends on price signals, it depends on regulation, it depends on innovation, and a sense of certainty for people who are going to make investments, it really takes this kind of partnership and brainstorming that we're having over these two days.

So I'm looking forward to the panels and we'll kick it back to Eli to introduce our next panel. Thanks so much.

(Applause.)

MR. HARLAND: Okay, thanks, Lori. So I will -- we're going to do technology panel this morning first and customer panel will be in the afternoon.

So I'm going to go over the schedule really fast and the workshop objectives again quickly. But while I'm doing that if we could have our first panel members join us up at the table that would be great. Moderator Matt Fung will lead the charge for you all.

And so -- so yesterday we went through the, you know, we had the showcase update and we also went through and did a couple of panels in the afternoon. Today we're breaking this up so that we have the Technology Needs Panel is going to be this morning and the Customer Experience Panel will be this afternoon.

And then we'll close the workshop off with -- with a public comment opportunity. Similar to yesterday's format, there's going to be plenty of time during each of the panel discussions to engage the audience. So we'll see how -- how many public comments we have. And then we'll also hear closing remarks from each of the -- each of the agencies and entities that are working on updating the roadmaps. So we'll have closing remarks from the California Air Resources Board, from the California Public Utilities Commission, as well as from the California ISO later on this afternoon.

So just a reminder that -- that the -- the objective for the workshops are for both days is to really uncover these -- the actions or the information that staff would need to develop actions for overcoming the issues and barriers that were laid out in the original matrix. And I do encourage folks if you have a specific action you'd like to articulate, that would be really helpful. If it's not specific and you're just

providing us the information that we would need to formulate those actions, that also works.

So with that, I want to pass it over to our first panel. I'm going to pass it off to Matt.

And Matt, I'll begin queuing up the presentations in the order of the agenda.

MR. FUNG: Thanks, Eli.

Again, my name's Matt Fung, I'm with the California Energy Commission's Research and Development Division. I focus mainly on vehicle-grid integration through the EPIC program.

So I want to welcome everyone here today for the second day of the VGI Roadmap Update Workshop and the Technology Needs Panel.

I first want to spend a minute or two to set the platform for this Technology Needs Panel. Yesterday we discussed the policy and economic potential of VGI work. Panels talked about importance of value, flexible rate design, emerging business cases among other topics. And today's technology panel will focus on what -- what are the VGI enabling technology needs to create seamless cyber secure and customer friendly transportation solutions, and how can we address the technology barriers preventing us from accelerating VGI to enable further commercialization of zero- emissions vehicles and its

supporting infrastructure.

So through today's panel we'll discuss topics such as how important low cost cyber secure measures are to VGI, which charging use case will be most -- most benefit from embedded metering, what standards and methods of communication are needed for which use cases, and how industry researchers and policymakers can advance to name a few of the topics.

So during this morning's session, I'll ask that we all keep in mind that we're not just limited to light-duty vehicles but to also consider those barriers, solutions, and actions that impact other sectors such as medium, heavy-duty -- or within the medium, heavy-duty sectors as well.

So first we'll -- Josh Eichman is first up on the agenda, but.

MR. HARLAND: Is -- is Josh -- Josh present? No, don't see him, but. So we'll go through the presentations and maybe we'll get Josh towards the end of that.

MR. FUNG: Okay. So we'll move on to Ken Rohde.

MR. ROHDE: Good morning.

MR. HARLAND: And Ken, you also have the -- I also gave you the presentation navigator there.

MR. ROHDE: Power, you gave me the power.

Excellent.

Well, while the presentation is being pulled up, I'll just briefly introduce myself. My name is Ken Rohde and I work at the Idaho National Laboratory. I've been there for almost 20 years now. But I've been working specifically in the Cyber Security Research and Development Department since 2004 and that's where we've been specifically charged with doing cyber research on the critical infrastructure sectors in the United States and worldwide, actually.

But my official title is senior cyber security researcher which I guess is as nice of a way as the National Lab can say I'm an old computer hacker. But that's essentially what it is.

And so the presentation that I brought today is a collection of slides from -- from some of the work that we've done over the last few months, specifically with DC fast-charging system that we have. This is the beginning into work that we are just getting started and are going to be carrying on for the next three years, moving into extreme fast charging. So this is -- this is a 50 kilowatt station that we're going to be showing you specifically, but a lot of the work that we did here will translate into the 350 kilowatts, 1 megawatt high-power stuff that's in tomorrow's -- tomorrow's research.

So here's a horrible little block diagram that shows how our 50 kilowatt station is laid out and we envision most of them being produced in the future and today. And specifically you'll notice that there's a whole myriad of communication protocols that can potentially be coming in and out of the device in order to support a lot of the functionality. But then inside of the DC fast charger, there are power electronics that are used for converting the AC to DC power and that's specifically what we target in this research. So keep that block diagram in mind.

With all that communications coming in, there's one component in there that is specifically responsible for all those communications, and that's what we targeted was that communications module.

So the reason -- and let me give you some background here. So the reason that we did the test -- this test the way that we did was we are operating under the assumption that -- that utilizing some remote connectivity means we're going to be able to compromise this charging station, okay, whether it's OpenADR that we target or 15118s or whatever. Pick your protocol or your remote communications mechanism.

The problem in this particular case and in a lot of cases we're assuming is that communications module is

going to have influence in the system that is beyond what we think it really needs to be. And that might be a confusing statement but what I mean is, is that communications module is not segmented away from those critical power electronics components that are in the charging system.

So if I can compromise that communications module using some form of exploitation, then I have a means in which to influence the power electronics that are also in that charging station. And in the future, I might be able to influence the cooling components of the system or whatever the case might be. So that's the method in which we did stuff.

There we go. Okay. So assuming that we had that communications module compromise, what we did was we played around with the system enough, did enough reverse engineering of it in order to understand how those power electronics were being managed in the system. This system has five big power converter modules, each of them operate at 10 kilowatts for a total of 50 kilowatts. And there's some handoff and coordination that goes off between these electronics and that's what we're manipulating with in this particular graph.

So we started actually directly controlling the power electronics in such a way as to try to force them

into a lower state of power in order to influence the total harmonic distortion and also the power -- power factor, power quality of the overall charging station.

And this graph was generated when we were operating at a -- in a way that was as nice as we could do it. And what we found was it was the vehicle that was more often than not that was disconnecting and shutting off the charging session. The charging station was happy as far as we could tell when we were controlling it and causing -- causing it to do bad things. But it was the vehicle that would give up after a while and disconnect itself.

And so this is -- anyway, so we could create THD and power factor levels that were worse than this but the charge would only terminate after 30 or 40 seconds instead of running continuously over the whole duration of the charge. So that was one of the major things that we were able to accomplish.

And what we're still waiting to see is the kind of the so what? We have an RTDF system available to us at the lab that is actually modeling a portion of the PG&E grid. The trick is getting access to that RTDF system is difficult. So we might end up modeling this on a portion of the grid there to see. But if not, if one of you utilities that has a model of your own that would

like to do this, please see me and we'll send some data your way and get you an idea of what's going on. So but we don't know. So what we don't know is what is the overall effect to the grid in that particular case?

The next thing we did was the system provides -- ours has a great big red emergency stop button on the front of it which I guess is a safety requirement for most of these systems so that if your car is on fire or something, I don't know. If somebody runs up and punches the emergency stop button and -- but that sort of capability is also available to us electronically which was cool. So we found the messages that were responsible for telling the system to just shut off, immediately shut off. And you can see from the graph what we can cause is to go from a full 50 kilowatt load down to standby power in a very short period of time which if you calculate it out, that's about 2.6 megawatts a second which is relatively fast.

So this might be more of a concern potentially. But like I said, we're waiting for a utility company to come and talk to us, tell us whether or not we're right or wrong in our assumptions.

But one of the things that we envision is like with the EV -- or the Electrify America types of deployments of these stations where you're going to have

six or eight or ten of these 350 kilowatt stations in one place, if I can do this over a cyber means and wait for six or eight or ten of those stations to be charging at full load and I can remotely tell them all to turn off at the same time, that's a pretty significant transient so that's something that we're kind of curious about.

Can't not talk -- not -- I've got to say the nots right. Can't not not talk about wireless power transfer as well because this is an area of research for us. This is exciting because wireless power transfers getting to be at higher and higher charge rates nowadays. We're seeing medium, heavy-duty vehicles being charged today clear up to 250 kilowatts over an inductive set of charging coils.

This is an interesting area for us to be looking at because we're wondering how many of these things that I just showed you on the conductive charger might be possible with -- or even worse with a wireless power transfer. It's a -- to me, it's a more complex situation and yet it's fantastic because all of these communications or a lot of these communications are now happening wirelessly. So can we disrupt and cause the similar -- similar effects on the system with that. Kind of fun.

Noel asked me to talk specifically about this

because Noel saw these slides at the Evian grid -- was it Evian grid or which presentation?

MR. CRISOSTOMO: I just read a lot.

MR. ROHDE: Okay. You just read a lot. All right.

But this diagnostic security module is a DOE project that we started a few years ago. This was under the grid modernization laboratory consortium where they're trying to do a number of things to modernize today's grid. And one of the topics that the vehicle technology's office and DOE specifically asked for was for us to talk about security with electric vehicles to building integration.

So if you have a large building and a small fleet of vehicles that are electrically charging connected to the same power sources as that building, what kinds of things can we do and can we help to prevent it? So this project is specifically enhancing the vehicle, the charging station, and the building energy management system so that we can monitor all three components for quote, unquote "cyber events" and then report that to the building operator, the person who has control over the power being delivered to those charging stations and ultimately to the vehicle.

So you can see kind of some highlights in the

over -- overall view of how that works. Now this -- this project was not intended to be product, this was intended to be a showcase to show the automakers and the EVSE manufacturers and everybody how -- how this security information can be exchanged. We're hoping that this will be picked up and adopted in future standards and whatever the case might be. We're not planning on selling this as a product. So. That, we're actually going to take to the cyber auto challenge next year. We're going to let all the hackers at the cyber auto challenge try to pick on it and we'll see -- see how well they do.

So this is my last slide. So just a reminder. So what we're currently looking at in today's research is the high-power charging and that's specifically and most likely going to be targeting the medium and heavy-duty vehicles in the near future. We're working with both CharIN and also the NMFTA for helping to develop security requirements for how -- how this charging is going to be done. I think that's very, very good work. I think the trick is going to be developing a set of requirements, it's not going to be too daunting for everybody to be able to apply. And then the wireless or inductive charging as well.

I think that's all I have for slides. So thank

you.

(Applause.)

MR. FUNG: Great. Thank you, Ken.

So I think Josh is here so we can -- Josh is here and we can go to his presentation.

MR. EICHMAN: Thanks. I apologize for the tardiness.

Thanks, Ken, for stepping up to take over while I was out. But I'm here now.

So I'm from NREL, the National Renewable Energy Laboratory. And my name is Josh Eichman, I'm a senior research engineer there in their transportation group. So the facility is in Golden, I'm actually based out here in California.

We've been doing a lot of work in the space for both monitoring vehicles, collecting data, determining how these vehicles operate in today's and future scenarios looking at infrastructure, and a number of different topics. But what I want to focus on today is really just two areas. And the first being data availability and its application, particularly as that relates to the VGI space. And then the second is kind of what I'm calling kind of the modeling environment or ecosystem.

Just one slide so this is all you have to look at

for me today. But again I think -- so with respect to, you know, the common question is well, how do vehicles affect the grid? How could they? We think manage charging kind of an uncontrolled charging. These are the words that people are stirring around. But I think it goes back a lot further than just that question. There's decisions that are made a long time before that that affect those results. So I thought I'd walk through at least in our perspective how that chain connects together and some of the important features along the way that you have to -- you have to make these decisions, again, on the technology space for both the vehicles and the charging infrastructure that then affect kind of the broader question of how vehicles affect the grid.

So we just walk through kind of from left to right on the slide that you see here. There's I think it really starts with this vehicle choice, and of course there's different versions for different people. But in the vehicle choice modeling space, there's decisions that are made by customers and by OEMs and integrators as well about the size of these vehicles, the types and preferences. So we take in all these customer preferences and some of the regional variability and then we get out information about what kind of vehicles are people interested in, what are the resulting sales for

those vehicles.

So then we can carry that to our next step so now we have these, you know, decisions about electric vehicles, are people picking them or are they not and why? And then so that feeds into the vehicle simulation step. So there's a lot of activity going on here, again, in terms of the data and data availability. All that data has to be collected from all the different vehicles we use existing but we also use some model data coming.

And then you take information about kind of the technical performance that you expect from those vehicles. What's the motor map? Like an electric motor map. And then the duty cycles for those vehicles. How are they driving? If it's a medium, heavy-duty fleet vehicle, it's much different than a residential vehicle or a light-duty vehicle.

And then we can take that information to determine kind of what's the efficiency of that vehicle and the resulting electricity demand. And you can see down at the bottom there's a few different examples of models. I think most of those are NREL but just to give you a sense for like the real breadth that goes into these activities.

Okay. So now if we have this, you know, we know the electricity demand, the efficiency of these vehicles

that customers would prefer and customers have chosen. And then now we move into maybe the more familiar territory, it's infrastructure rollout modeling.

So with that, we'd take, you know, additional datasets on travel surveys where there's GPS data and then also what are the opportunities for charging? Level 1, Level 2, DC -- what are the -- what are things that you have options of and the power think about extreme fast charging versus Level 1.

And so we can take that information. There's a number of different models, again, that then give us where should this infrastructure be? When are vehicles going to be there? And how much of a charge do they need?

And then that's really what I think we need to get into the VGI space to understand what kind of flexibility those vehicles are going to have. If they're very inflexible, then we're not going to be able to help the grid at all, consider it uncontrolled charging. If they are flexible, then we can do more smart charging.

So then the final step and the one that I think is the immediate question, now we move into some of the -- what are the grid impacts? And looking at the box on the far right, I have it kind of separated into these two groups. Obviously both of these are transmission and

distribution level so it can be the higher voltage grid or the lower voltage grid.

But there's planning that needs to be done and then operations. So when you have planning, think more of the 20, maybe even 50-year time period. How many vehicles are getting rolled out? And are we building new generation to meet that? Can renewables do it? Do we need new storage, for instance, to support that? So those are the kind of the questions that it answers in terms of the operation space.

Then it's, you know, the day to day, hour to hour type thing. And then you think, okay, now we can get down to the details of smart charging. So that's the tools you can answer smart charging with.

And then the final, the customer optimization is what I'm calling it. There's probably other names but this idea that, you know, each customer wants to get the lowest cost of electricity and -- or get the most revenue out of it. So you can think customer being home -- like, someone has a home and charge it at their home or multiunit dwelling and have to find some place to charge. How do they get the lowest cost to operate their vehicle? You can also think a fleet manager, in the case of some medium and heavy-duty vehicles. However we have, you know, a collection of vehicles and they're very

interested in reducing that cost and very motivated.

And then you also have the infrastructure owner. So if you have like a DC fast charger, you have to figure out what your pay structure is for that, how do you recoup the investment that you've made? So that class and models can look at that, kind of a business case assessment for any of those groups. And what we have going into that are things like the retail rates and then have the grid set up with the grid mixture, any incentives and credits like low carbon fuel standard, for instance.

And then outcome. Then finally we get to the, you know, grid impacts. And that can be a, you know, very high renewable penetrations. So we can look at basically any future scenario that you would want with very high renewable penetration.

So if they for this entire chain, again the -- just to reiterate the point that I like to make is that, you know, we ask about the questions at the end but there's a lot of decisions that have been made throughout this chain to -- that build up to the final answer that we're looking for. So if you change the range from, you know, a 60-mile vehicle to a 1,000-mile vehicle, we're asking much different questions at that point. So that's why I think it's important to keep in mind all of the

steps leading up to that final step about what a smart charging provide? Well, what kind of vehicles do you have? What kind of charging?

And then to add on top of that, you can see some of those boxes in the upper right. I think that each step in this chain, we have to also look at what are the impacts potentially from policy. You can see also there's different vehicle classes, charging strategies, how autonomy affect each of these steps. Because it can radically change how that step is modeled which affects everything downstream.

And lastly, cyber security. Now we're more aware of that from NSTOC. So. And then I think the other thing I'd like to add is from the data perspective, the results are only as good as the data that we put in. So for -- if we're looking to either look at what policies and what research can be done, there's a need for data there. And I think in the light-duty space, there's more knowledge with respect to we have these travel surveys and there's a lot of information that's done there to kind of statistically represent the vehicles that we have which then helps us look at future vehicles in the medium and heavy-duty space that's much limited -- much more limited datasets.

But some of you may be familiar with Fleet DNA,

it's hosted out of NREL and collects mostly duty cycles which aren't full travel surveys, but just the duty cycles like a daily operation for a few vehicles within a fleet. There's no way to tell that this fleet is representative of the entire -- the entire California fleet, for instance, it's just, you know, this small set of vehicles.

So I think there's -- there's still need to continue developing those. Any of these projects that people interface and do this data monitoring, I think data sharing is really important and it can improve all the steps along this chain to get us to a better solution.

So I think I'll end there. And thanks for your attention.

(Applause.)

MR. FUNG: Thanks, Josh.

Now we'll move on to Celia Dayagi, I hope I pronounced the last -- that was correct. From Siemens.

MS. DAYAGI: Is that better? All right.

MR. FUNG: You kind of have to --

MS. DAYAGI: Is that better? Oh, I --

MR. FUNG: Yeah, speak like right into there.

MS. DAYAGI: Yes, you did pronounce that right. Celia Dayagi from Siemens. Good morning.

Thank you, first of all, for having us here. Very excited to be here. Very excited about everything that's going on. I don't know that I'm going to be able to move my slides forward, I think they're only in PDF.

MR. HARLAND: Do you want to try it?

MS. DAYAGI: Maybe.

MR. HARLAND: All right.

MS. DAYAGI: Excellent. Good. So, yes, to -- the data information I'll share just for starters are a couple of the observations that we have had at Siemens in global eMobility. We've also been a part of the Hubject communications protocol working group for quite some time, excited to be a part of this process.

Globally, Siemens has employed over 130,000 installations for eMobility so we bring some of the lessons here today from that but also of course are continuing to learn and continuing to evolve with everything that is going on here and across the globe.

The -- just like Josh was -- no. So as Siemens a lot of our customers are the utilities, a lot of our partners are the utility companies. We're not only looking at charging an electrical vehicles from the charger perspective and all the functionalities that a charger may have and pretty lights and whatnot, we're more so looking at it in a partnership with the power

companies that are globally our partners and are considering the grid infrastructure from distribution transmission planning but also the medium voltage and low voltage space. We're very much working with our partners also on the large undertaking that comes along in construction projects of making charging possible all across the globe.

So here's just a couple of the components that we work with our customers on in order to really drive eMobility forward in the adoption of. Our goal is always to -- and I'll talk about this later on. As well as the presentation, our goal is always to foster, of course enable open standards, best practices across the -- across the industry.

And then lastly, but certainly not least, to drive down a total cost of ownership for everybody to be able to own an electrical vehicle, operate it, and plan it to the grid.

Now just like Josh was talking about, there's also a couple of trends that we follow very closely that we've seen that definitely will factor into not just eMobility but mobility in a greater sense. So on a macro scale, we definitely are following connected mobility that's not just the eMobility and all the data that we're getting from the chargers, but certainly also from the

cars and from the OEMs themselves. We're seeing a lot more autonomous, a lot more shared, and then most importantly I think for everyone here the disruption in transportation as well as the disruption in energy, really what they have at the core and what they share is the electrification of the transportation sector.

So we're viewing that as the intersection of all of those global macro trends really coming together but electricity and the electrification of is really in the middle of it for us which is very exciting.

So for -- for specific topics for today, I think an open standards, again, that's what we support as Siemens but the -- the way forward for us and I think that's why we're all here is to define the best practices that should really be required across this industry and across this move towards eMobility.

I will show a little bit more detail about the different applications in which these open standards really or these best practices come to life. But just as a general overview, they should definitely include the communications from a data center to the EVSE. A lot of the touch points and cross points that you will see not just in this slide but also the pictures in the further slides are between the data center so really the utilities, the vehicles, and the EVSEs. The EV and EVSE

also need to be able to communicate, that should be a standard but is put in place there. And I think all of us have a pretty good understanding of what we would like for that to be.

And then lastly where I think we have had a lot of good -- a lot of experience, good and bad, is in the metering and the metering accuracy. So a couple of the points that I'll touch on later will also be about the submetering for EVSEs and what benefits that brings but also what challenges come along with that that we've seen in the marketplace today.

For the home application, the multiuse development application, and workplace charging, a lot of lines here. But first of all, let's consolidate the lines at the top with the clouds where you see one and two, really we would like to consolidate all of those lines, just say the utility data center and whatever EVSP is really involved in the network of charging should be able to communicate on open standards here whatever they're using, whether it's broadband or cellular. But this communication link needs to be established for sure.

And then in the bottom, the other places where standards really are -- are needed and also needed for looking forward to a VGI would be between the EV and the EVSE as well as the communication between whatever

networking infrastructure is located at the point of charge, and the back end of whatever is managing that charging asset.

So here those are really the main -- are there four? The main three areas where standards need to be considered and the standards that we really want to talk about.

For those obligations, then if we move into more of the public charging space, we're really just adding credit card standards as well as the roaming standards OCPI or OICP so that networks can also communicate across different territories or networks for that matter.

So those, again, are the main standards where we think -- or the main areas where we think standards really should be present and should be followed by -- by the industry.

The challenges and opportunities in embedded metering, so moving into more of the submetering category. I think you guys are aware of the broader Siemens metering and submetering portfolio that we have for commercial and industrial applications. We've also adopted that submetering technology into our EVSE product. And therefore in the EV or eMobility market, we carry some of the lessons over from what we've done in the past in the broader commercial, industrial, and

utility space, but are also looking at the eMobility space there, particularly because it is a nation industry and there are some basic things that we all should agree on.

For this picture -- oh, I'm changing my own slide and not yours. Sorry. So for -- again, we're not moving into submetering category of the discussion. There's benefits, there's challenges, challenges especially of embedded metering inside the EVSE. And here's where I also talked about greater embedded metering technology that Siemens is developed not just for EVSEs but for other applications.

So the main, I guess, use cases or benefits that really we see in the embedded metering for an EVSE would be one, that it allows the tariffs or rates to be applied really strictly to the EV charging only. The second one would be that it does provide -- embedded metering does provide the data collection of an individual user, some people that are interested in the information of the energy consumption just by that EVSE in particular.

And then lastly, we think where the submetering or embedded submetering use cases more -- most beneficial would be that it does eliminate the utility meter that would otherwise have to be collocated whether that is installed with the EVSE itself or installed within a

switchboard or panel board or wherever you are embedding that meter into the EVSE and you're testing it for accuracy will get there. And the challenges, there's a big cost savings for the eMobility markets and the growth there.

Still not used to it. So now for some of the challenges, while I just went through the use cases and the benefits, there really are good benefits in submetering or embedded submetering. But the challenges and we've had some personal experience with this as well really are in the meter accuracy. We do think that the HB44 that you guys referenced specifically for this panel does provide a good starting point and for the accuracy standards and testing what it requires of manufacturers is adequate and is fine. But really it doesn't go into the communications or data integration requirements for communications.

It's easy to do but there are significant costs either in development in the actual EVSE technology or in the networking equipment that is then required in order for an EVSE really to communicate out this information and is the protocol through which it's communicating really standardized or not.

Then the biggest issue really is in the data integration for submetering. That to us is the format in

which it's transmitted. It is the back end to which it is transmitted and then what format it needs to be transmitted. It's the frequency, it's all of the really factors that come along with the data integration piece of this. So it's -- do they not clean an industry and therefore maybe submetering -- submetering is not yet set up for really the big growth. But to get to a point of the state of being reliable and accurate and collected that the frequency which is appropriate for the market, we do definitely support submetering within the EVSE itself and are looking forward of getting rid of some of these challenges and technology and also challenges in cost.

I think that's pretty much it. Yeah. So for the discussion today, definitely looking forward to some questions and all of the perspectives of the other panelists.

(Applause.)

MR. FUNG: Thank you, Celia.

And we'll go to Jackie Piero from Nuvve.

MS. PIERO: Okay. So what I (indiscernible).

MR. FUNG: Thanks, Jackie.

MS. PIERO: I generally talk loudly enough that I don't need microphones but I'll definitely use it today.

So I am here as the policy director of Nuvve.

And we're also here to present an industry perspective on the goings on in the VGI roadmap as a company that is pushing VGG. We also work with unidirectional smart charging, the -- can work with various DER, but we're really interested in cars. We're really interested in figuring out how to fully integrate them into the grid, and we think that bidirectional power flow is a very important piece of that.

But who are we? We are a startup, we're based in San Diego, but we are global. We have 30 people, 30-odd people, but we're actually operating globally. And it's partly because our main product is software platform, and so we're able to work wherever the resources actually exist. And this global experience has actually given us a unique perspective on what V2G actually is and on the fact that you really can't separate VGG or VGI from DERs.

The story of the two in terms of how they're actually being integrated into energy systems around the world is very closely linked. For instance, when we actually were doing an experiment in the Netherlands, we aggregated 13,000 unidirectional public chargers to participate in tenants' frequency regulation market. But it took 13,000 vehicles to bid a few hundred kilowatts because we had to hold that capacity for a week. And this was not just a car problem, this is a DER issue.

The market wasn't designed for very small scale aggregations of DERs to be participating in it.

In the UK, they're very, very aggressive about EV introduction, they're very aggressive about introducing flexibility to their grid, partly because they have to be. They're experiencing voltage spikes, they're experiencing loss of inertia and other grid problems that are only theoretical in other places. So it's absolutely necessary that they successfully integrate EVs into their grid.

They want millions of EVs just like California, but they've done their studies and realize that it will be billions in grid upgrades if they don't figure out how to intelligently integrate EVs into their grid. And V2G is a huge part of that.

That said, and they're very interested in storage as well. They're actually trying to remove barriers for storage to be working in markets. But behind the meter storage really can't exist in the UK in a lot of ways because they haven't figured out how to tax it. They simply say look, we can't separate the final consumption taxes form the actual usage of the home, so there's a regulatory black hole around storage and around an EV that would be providing services from behind a meter there. As badly as they want it, they're systemic

walkers.

And that brings us to California and some of the experiences that we're having here. We're -- one of the things that we've noticed as we've been participating in frequency regulation markets in PJM, in the Netherlands, in Denmark, we've been operating commercially in Denmark for the last two years. Working from behind meters and actually bidding into frequency regulation market. We've really come to understand the problems of use cases of working from behind a meter in response to external price signals.

And we're also realizing that there are many other ways to use the EV so at UCSD with CEC funding, actually, we are trying to figure out how best to integrate EVs with solar, how best to integrate it with a micro grid. How best to actually provide the services that will be associated with the requirements of interconnecting a bidirectional EV in California.

So I actually have this not to explain to this room what vehicle to grid is, I think everyone here understands he concept. I have this to show how hilariously simplified this diagram is. It's supposed to be simply that you are responding to a price signal or a request from some other kind of grid actor and you either have avoided cost value stream or a revenue stream. In

reality, we are working at the intersection (indiscernible) of multiple industries that have never been tightly associated before. Got the auto industry, got the electric industry.

You've also got the tech, the information industry. You've got financial actors that are actually working in ways that they've never worked before. And these -- these actors not only aren't used to working together, they don't know how to work together. They don't even speak the same language. I mean, automakers speak in miles and gallons. And electric industry actors speak in kilowatts and kilowatt hours. Tech speaks in bytes. Banks speak in money. And they're all saying okay, well, we see what our part is here so come about 30, 40 percent of the way.

But there's an area that is no one's job. There is an area that no one knows how to come to actually take on these new roles that they want to be working at. But they're not used to doing this, then there needs to be a translator. There needs to be something to unite these different actors and that is what this technology is about. It is about integrating the vehicles with all these other actors, all these other industries.

When we talk about vehicle-grid integration, it's not just the grid that we're integrating it to. And so

it's a much larger project when you start to think about actually going bidirectional and really figuring out how to monetize it.

Our platform is fairly simple in many ways. It's simply a matter of dynamically assessing the capacity that any aggregation has by every few seconds pinging every resource we have and asking what kind of car is parked there? What kind of battery does it have? What's the connection? Is it allowed to export? And actually assessing that along with every other resource we have. And being able to then take what appears to be a highly dynamic unreliable resource and rendering it -- rendering it reliable, predictable, dispatchable, which is what you have to have for the electric grid.

And I think it's interesting to step back. You know, a few people have talked about this study, about the actual potential in terms of resource size for V2G, V1G, and stationary storage when it comes to actually dealing with California's duck curve problem. There's nine times the potential value of V1G that you see with V2G when it comes to addressing the duck curve.

But to take a step further back, I would note that I think we still have less than 400,000 EVs in California. We're shooting for 5 million and that is an admirable and ambitious goal. But we have so far to go

between where we are and this, no matter how -- what combination of resources end up actually addressing the duck curve. This is such a long road and the Honda roadmap showed what all the twists and turns could be getting there.

None of us has a crystal ball and I think that we need to acknowledge how much could change between where we are now and where we want to try to get to. And we need to leave placeholders. We need to not try to make decisions that will push us there but rather, I think, leave as many opportunities as possible for us to get there.

An example of a placeholder that probably made no sense at the time but is actually enabling work to be done is in England. In their grid code, there's a very obscure little reference that says that -- it's a complex metering arrangement allowance that actually was put as a placeholder years and years ago so that peer to peer operations would one day be allowed. There was no reason to have this in the grid code when it was put there. There was no technology that was even being thought of that would actually be useful at the time when they put that there. But they put that there so that someday someone would have a chance to try something.

Try something like this where we've got DC

interconnections, AC interconnections of electric vehicles. A DC electric vehicle can be interconnected under UL 1741. It should be interconnected under UL 1741, but it's actually very confusing for a utility because they have no signposts, they have no procedural pathways, they have no regulatory guidance on how to do this.

An AC interconnection is in fact impossible right now for the very same reason. And we're not asking for utilities to be mandated to do something, we're simply asking for them to be allowed to do something. Give them the capability to explore because right now they don't have it and it's actually making it very difficult to take these steps.

We have, like I said, interconnectable inverters in our charging stations, in cars like Hondas, actually, experimenting with. These are inverters that meet Rule 21 requirements. They have four quadrant -- or they'll have four quadrant capabilities. They will actually be meeting smart inverter standards.

But what are we actually going to be able to do with those? Well, right now, you know, the (indiscernible) took a very good step in allowing EVSEs to be submetered for load curtailments. But look at all the other things if you think about the -- the entire

universe of capabilities that exist once you actually are compliant with a smart inverter standard. Just being able to do load curtailment with that inverter is a huge waste of a resource. It's a huge waste of this.

If we're talking about vehicle-grid integration, if we're talking about California's goals of climate change mitigation of millions of EVs, of leading the world in modernizing your grid, we have to actually say this isn't just potential, all of these things need to happen. We need to have those $1.75 billion in V1G potential fulfilled, and we need to have the $15.4 billion in V2G fulfilled. We need every tool that we can possibly access to make this happen.

If you read the climate change committee's last report, they pretty much told us that it was impossible to do this. We have to be overambitious, we have to try to access every single resource we have. This is the kind of thing that California excels at.

And so what I'm asking is that we don't accidentally close doors just because we want to move forward quickly. Which when we choose 15118, I get -- I get it. I get the idea that governments want to give regulatory certainty like I was asking for for utilities. But in giving that certainty where we would be using a standard that doesn't yet encompass the full range of

vehicle-grid integration goals, whether we think V2G is something that is going to be a near term occurrence or not, it is the goal. And so we need to leave the root for it to -- we need leave the space for it to actually enter. And 15118, people will tell you it's complete. In my opinion, it is not complete. V2G is not an add-on, it is an essential part of integration of EVs into the grid. That should be the goal.

One last thing. We actually have a lot of embedded meter use cases that we've lived through in various countries. And one of the biggest just overall matters is that a car, once you make it bidirectional, once you put an inverter in it, is not just a car. It's also a storage resource. But you have to be able to count when that vehicle is an end use device when it's driving and separate those energy flows from when it is acting as a storage resource. That's essential for the way that taxes are applied. It's essential for the actual compensation that will receive for various smart inverter functionalities that it actually has. And if you can't separate those energy flows, you wash out a lot of the actual potential that is sitting in that EV.

The electric system is all about counting things. It's all about physical flows. We have to be able to count and account for things that we're doing.

So a couple of recommendations. We absolutely think that interoperability should be encouraged but we don't want to prematurely mandate a communications standard when the industry is still evolving. There are various communications and plug standards, charging standards, they're still being used. Think if in 2010 we had mandated CCS, for instance. Its (indiscernible) would not have come out and driven the industry forward in California the way that they did. Allowing that different standard to exist here kick-started the EV industry in California.

We've got Tesla over here with their own charger. If something else had been mandated, who knows exactly how their rollout would have manifested? I don't know. But I do know that the lack of a charging standard did not hurt the EV industry in California, it allowed it to begin.

So again moving beyond load curtailment for EVSEs, we have to actually be allowed to count and be compensated for when we're actually able to export beyond a meter. I know that this is a huge ask. But this is something that we need to actually be thinking about. If you want prosumers, if you want active participants in the grid. If you want the IOUs to be active managers of their grid, we need to move beyond just looking at houses

as adjustable loads.

Also, again, we can't artificially separate EVs from other types of resources in market structures and in regulatory matters either, it needs to be recognized that these are, again, DERs. The story of DERs cannot be separate from the story of EVs. And we need clear regulatory and procedural and documentary pathways for interconnection of EVs.

I'm not being asked -- I'm not asking for a slice of the pie, I'm not asking for a mandate, I'm just asking to be able to plug one of these things in. Thank you.

(Applause.)

MR. FUNG: Great. Thank you, Jackie.

And then we'll now on to Sunil Chhaya from Electric Power Research Institute.

MR. HARLAND: Sunil, real fast. Do you want the PowerPoint version or the PDF that you submitted?

MR. CHHAYA: The PDF will be fine.

MR. HARLAND: Okay. Great.

MR. CHHAYA: I'm at Electric Power. This is out of Palo Alto and I'm focused on grid integration related work for over last 11 years working with the electric industry, power industry, and also with the car companies. My prior work involved working at General Motors around and a part electrical vehicles and advanced

software engineering inside. So.

Over the last decade or so, we have extensively looked at a wide range of use cases working directly with the auto industry to look at how to put the grid integrated technologies on the vehicles, vehicles being the central node for information, for mobility, and also for customer preferences. So this is the -- this has been the focus and we have focused on all of the above approach in terms of managing. So in fact, at the moment right now we have multiple projects looking at the entire gamut of vehicle grid integration and vehicle local and generic working organization type projects underway at the moment. So they stretch from 2016 all the way to 2022 time frame.

Looking at aggregated vehicle load demand management in the form of for open vehicle grid integration
platform. At least that's just the projects that I manage or I'm a PI on. So this doesn't include everything that EPRI does.

Vehicle to grid integration which is around on vehicle I think Jacqueline just mentioned the work that we were doing together with Nuvve and Kitu and Webasto as well as Chrysler and Honda and -- at the UCSD campus that just completed. And we have an ongoing effort with off

vehicle vehicle grid and implementation where we start looking at vehicles as a part of the ecosystem for the integrations.

So we are looking at EVs, EV storage in the local facility-type situation. And moving beyond that, look at building and micro grid integration of the electric vehicles expanding out to virtual wide data and micro grid project that we're just beginning with Gridscape which has multiple IOUs, multiple locations, and multiple DER assets that we're going to be looking at vehicle, smart charging vehicle to grid portable -- transportable storage and so forth in multiple implementations.

So focuses on looking at value, looking at use cases, looking at how electric vehicles fit into the broader grid management situation and also looking at what is the best application of each of the standards and how do they interoperate. So I think that as Jacqueline just mentioned, you know, you cannot separate these issues out. You cannot separate interoperability from standard from applications to value to use cases. They are to go all hand in hand. Because ultimately if they do not deliver a seamless functionality regardless to vehicle's location because state or customer references and utilities desires, they do not deliver value, then all of the effort is not really worth it. And it is

actually that I want to focus. I think Eric Carter was talking about the value aspect of it. So.

And the last project we are just beginning right now is the cyber security side for infrastructure that is -- that's going to be expanded. I was just talking to Lee. Lee at VTO last week, was talking about the -- this effort being expanded to include Sandia, INL, Argonne, NREL, as well as looking at multiple award of the same for 1919 and we -- the idea is to collaborate and come up with a broad set of technologies, standards, frameworks, approaches, and also verifiable way to test equipment, subsystems, and the entire systems. So that's where our focus is going to be.

So what are we learn from vehicle-grid integration what they've been doing over the last several years. One is that the hierarchy -- you know, it's not just vehicle and EVSE or vehicle and SS DMS. You have to think about the end- to-end system which includes utility or the ISO all the way down to the vehicle and the customer. So we cannot simply look at one aspect, you know, the four blind men problem we cannot have going forward.

And I think that these things need to be designed in or at least considered into the -- into any requirement that they impose and they all need to be

driven by value.

Second thing is that the multiple batteries that already exist for the information to flow from the grid to the vehicle. These pathways would depend on where the information decides and what is the most optimal way for it to get there. Vehicles, for example, all of them carry telematics systems, they carry 4G networks. They're part of 4G, every vehicle has an IP address, for example. You know, so one thing that you could do is to utilize that channel for what it's worth to send them information. The secure is direct and this is, you know, always available in "iBandwidth." Well, I say always in quotes because it's a cellular signal.

Second thing is that the control and management of many charging with the vehicle to grid as Jacqueline was just mentioning are different. One is somewhat of a slow moving function a day ahead, an hour ahead. The second one is responding to minute by minute, come by second reality of a surrounding system. Depending on how it is synthesized, you know. But for getting the maximum value out of the vehicle to grid type systems, you would need to implement it in a fast response-type scenarios. Which means that the sensors and the management systems need to reside as close to the point of interconnection. An interconnection itself is again a topic of its own,

found quite a bit of it.

So and the second thing is that the standards are necessary but not sufficient for that I was just for mentioning for integrated system operation. And it's just a starting point. You know, you need to look at again, as a system as a whole and apply standards and a fit as they provide value.

Cyber security, one of the questions that is close to the group is cyber security. Back in I believe six or seven years ago, I ran the energy policy act of – wast enacted one of the charter for Department of Commerce and the NIST was to clear the interoperability roadmap for which EPRI led essentially and cleared the first draft and it is in place.

The -- that was to go -- there's that, a roadmap established what is called the Catalog of Smart Grid Standards for cybersecurity. That is what is considered the benchmark for the utility industry to follow. And a standard that is not in the catalog of standard needs to -- needs to be brought up to the level that is required for it to be utility industry acceptable protocol.

And this is again already work in progress because things static in technology space but this is the guidelines. And the other thing is that you cannot retrofit cyber security into the system, you have to

design the systems to have the cybersecurity in mind upfront. You know, and the only way you find out is, you know, looking at all middleman penetration system production. And especially around customer private, you know, unless you have valuable information laid out.

You know, EVSE, for example, you know, the charging stations, public charging stations have not only the grid related information flowing through, they also have the customer references and information in direction flowing through. They also have financial data. So there are many ways that the old actors can cause issues around multiple systems get in the vehicle side and so forth. So it's a thing you need to look at together.

And CEC here can -- can definitely have an impact in a forward direction through active emphasis on cyber security as well as to provide some representation to the ongoing about to be launched effort through DOE, NIST, and multiple lab as well as the award is for 1919 that'll be beginning this effort to comprehensively address the EV infrastructure cyber security assessment and implementation.

So this is just an outline, I'm not going to read because I can't read and I'm sure you can't either. But the point of this is that we are looking -- this is for our own project, the EPRI project. The scope is to go

from requirements to design to assessment to mainstreaming of the requirements now hopefully resulting in a certification body as a stretch goal. But this includes competence such as EVSE vehicles, XFC equipment with integrated and ANL to look at subsystems in a vehicle and charging . At NREL we are looking at the comprehensive system integration where we look at platforms, vehicles, networks, and EVSE, XFC, and vehicles all back together.

And so one of the activity here that is going to happen that is going to be of interest to all of you, an invitation is what we are calling EV Infrastructure Cyber Security Working Group. You can say that about three times really fast.

So the -- but the idea is that this will be like a -- like a steering or an information exchange body that meets multiple times in a year and exchanges and receives information from this -- from this activity that is ongoing to provide insights and also take the learnings back to the respective areas of expertise so that they can implement that in a timely manner or use it as they see fit.

Standards and methods of communications to consider. How are we doing on time? So, again, as I was saying value defines the use cases that defining the

requirements, technical and business. And essentially the implementations that meet the requirements and also the system, look near the system.

So open standards. Emphasis always on open standards but we also realize that we don't live under a rock, you know, so we -- we have to look at the world as it exists not world as we would like it to be which means that we have to have interoperability, that is the most important part of the message I want to -- too many words here.

The second thing is that verification is required to decide, you know, how they -- how they interact, where they provide value, where the missing links are, and how would they map on to how we see the future evolving. Which means one of two things. One is that you cannot log downtime as Jacqueline was mentioning that was pretty good. Was that we cannot lock ourselves into a particular way of operating because we would be missing out on opportunities we'd not do and see today. So that's one thing.

And the second thing is that any standard that you put -- have to -- you must have, must comply, abide by certain basic principles, you know, which is they need to be defined, they need to be fulfilling some values in use cases and fulfilling, you know, enabling and not, you

know, and creating a size range of options that the market can be created and also enabling future development and implementations.

So I think that in that vein, you know, we held an in effort to create I think as a part of the VGI working group, it sells, you know, we can create certain areas of design of experiments that would be verified to a number of pilots. Because one of the things that is missing here is, you know, is my opinion versus yours, and we've done some -- a lot of technology development but what is missing is at-scale implementation and verification of basic knowledge that provide us datasets. Data and that can be analyzed to see effectiveness of any approaches one, A versus B. So I think that that is one of the things that we wanted to carry forward.

I think that I would like to read also the message we have been pushing forward which is that lack of standards is not really a barrier to lack of progress -- of making progress. The lack of clearly articulated value is. And I think that that is where the datasets will help to assess the value that is ready to help to see the customers, utilities, OEMs, and equipment providers working all together to figure out what is the best way to extract that value seamlessly and at scale without violating some of the things.

Embedded metering. Of course, you know, any metering essentially is the essential ingredient for the measurement and verification and any programs that will require you to have, you know, trust but verify type activities. You know, we are going to need metering in the essential component. The question is where should it decide, you know, where should it be? But I think it's going to be required.

And -- and if the charging is to manage and the discharging is to manage as well to the grid, and the data to -- for predictive load impact analysis and so forth and require you to have metering. I would go as far to say that metering is fine but you would need to also have a grid ultimately monitoring itself.

We have the SCADA which is monitoring the key points on the distribution system but we do not have anything downstream of that which is I think a big missing link. The information is to be processed where it exists in a time more fastest manner possible so that most value can be extracted).

So that's a lot of -- lot to say in one sentence but that's still the case. For as fast as responses comes to you, we need to have monitoring available at the end point so that this can be, you know, any abnormalities or any variations can be affected. You

know, a good case in point is, you know, have excess solar generation at the facility but a bunch of EVs in our V2G project. But if you monitor the flow of energy and define a power flow back and forth and the more meter are at a point of common coupling. You can then decide how to operate the loads locally to energy management systems and that allows, you know, you can take care of these.

So my point is always that if you can take care of the local ducks, in a local duck curves then you will have a less of an impact at a macro level, much easier to fix. So.

That's a lot to say on that topic but it's just big areas.

Analytical models. I think that data needs to be used to first of all, analytical models can provide some predictions as to where to look for and we've been doing quite of bit of looking around the grid impact assessment on electric vehicle loads. And also now the implementation or indication and I think that -- that is going to continue to how to be explored and expanded at the distribution system level especially because that's where all of the -- all of the craziness inside now. Somewhat of an -- and not visibly for predictions to be

accurate and for management to be useful, you're going to have to continue to expand these tools that that exists for DERs to include EVs. It's been part of this here.

Around values -- around value assessment, around planning, around implementation and distribution system management. All of them. And that-- so the tools can predict and provide datasets, provide some guidance as to where to conduct the experiments and the experimental data can provide them verification and policy systems.

And we have done quite a bit of work, continue to work with universities and labs and we are happy to provide additional guidance in that as well.

I believe that's the last slide. So thank you very much.

(Applause.)

MR. FUNG: Thank you, Sunil.

And now we'll move on to Oleg Logvinov, Charging Interface Initiative or CharIN.

MR. LOGVINOV: Good morning, everyone. I hope you have enough coffee today to survive seven panelists in a row, I know it's a challenge so I hope you're all pumped up.

(Indiscernible. Audience member speaks.)

MR. HARLAND: Exactly.

MR. HARLAND: That is a good point, too, Oleg.

We'll be building a break in here in a little bit, I think.

MR. LOGVINOV: So today present Charging Interface Initiative which is a global association of manufacturers, service providers, and basically all of the links of the constituents building this market, but this is my volunteer job. My day job actually is being CEO and founder of a small company called IoTecha. We're a startup enabling infrastructure providing components to go into (indiscernible) chargers, cloud support, everything it takes to essential build viable infrastructure capable of doing all of those wonderful things we talked about today.

But let's go back and talk about CharIN. I titled my presentation despite the name of the panel Fostering Global EV Adoption. Because I think this is a conversations that we need to have. It's not really about which technology we're going to use but how do we foster adoption? How do we make it faster?

Let's take a look at where we are. If you look at this chart, what we tried to compare is essentially growth of the automotive industry when a combustion engine was invented. And what it took to essentially take it from early adoptive type of technology into something that actually proliferates on a massive scale

and becomes a thing of every household eventually. And what it took is an agreement on standards. How to fuel those vehicles, how to get them on the road, how to get them essentially being supported by an infrastructure that is wildly available. We need to do the same for electric vehicle. We need to develop the infrastructure that is there that nobody has a concern.

And when I say infrastructure, doesn't mean just high power charging. Infrastructure means how do we integrate those vehicles into the buildings, into the homes, into parking lot, at charge at work type of application, destination charging. All of that is absolutely viable components of the infrastructure. It's not only enough to put high power charging on the street, we need to think about all of those elements enabling essentially and improving how we can use those electric vehicles in our life.

So what is CharIN? What is CharIN's mission? CharIN's mission is establishing combined charging system as the global standard for EV charging. I actually respectfully disagree with Jackie regarding whether we need standards or not. We do need a standard. Perhaps don't need to mandate it, but we do need a standard because if you look back at the computer industry at the very beginning, yes, there was a Mac and there was some

Ataris and whatever.

But really, if you look at the market explosions, it happened when IBM PC clones were invented and ISA architecture was created. So you can actually apply the card from any manufacturer into any motherboard. All of a sudden we started thinking market penetrations that nobody even thought about and computers became completely a component of our life, very accessible, very cost effective, very inexpensive, in fact. That was enabled by long distance holder standards based ecosystem. We need to create the same for electric vehicles.

And CharIN's goal essentially is the same. We're providing industry supports through various means to come together and create this very dynamic but diverse ecosystem that can provide charging for vehicles of all kinds. We're talking about motorcycles, (indiscernible) vehicles, buses, trucks, what have you.

Ken mentioned the beginning we just started a new effort, not just charging up to 350 kilowatt but also trying to define what is needed for heavy-duty commercial vehicles. As an example, Class A trucks, how can you deliver a megawatt plus level power to that type of infrastructure?

But also consider a (indiscernible) infrastructure that was compatible and interoperable was

already deployed after 350 kilowatt infrastructure. That's very exciting. It means that even if somebody is driving Class A truck across the country, there's a possibility to stop at capable gas stations and park through the conventional 350 kilowatt charger or maybe even less. Maybe it takes longer time, but if an emergency happens, you need power, you can find it.

That type of proliferation have also available, always-on infrastructure that can be sourced by multiple vendors, multiple service providers is the key to an ecosystem, a possibility to deploy something on a massive scale.

When CCS was conceived, which is by the way we're talking about almost ten years ago, it was conceived to support multitude of use cases with multitude of implementation scenarios. CCS was addressing, number one, secure implementations that allows a vehicle and a charger to create a secure connection and exchange information between the two of them in a very secure fashion. I'm not going to dive into the details of technology but if you're interested to know, please find me later and I'll talk about this element for hours. It's based upon communication technology called HomePlug GreenPHY.

And by the way, I'm one of the inventors of this

technology in a galaxy far away many years ago. So I can tell you a lot about how to work through what it does. It was created to support essential additional services leveraging. As an example, renewable energy leveraging AC and DC power transfer with the same communication, the same approach wireless power transfer, pantograph type of approach, integration with the grid, and of course by direction of power flow. Is it perfect? Nothing is perfect. (Indiscernible) is evolving, (indiscernible) will evolve. And I think was addition to 15118 that exists today, you already see some very viable implementation of bidirectional power transfer.

So CharIN is a global organization. CharIN today is spread across pretty much all of the continents, including North America, Europe, Asia. We have presence in many, many places of the world. I represent CharIN North America, I'm a spokesperson for CharIN North America. Today we have 155 members and the organization is growing. And by the way, it's important to note that their invasion as an alliance promoting this technology was born only three years ago. It was in 2015. While technology developed (indiscernible) has taken about ten years.

So when the industry felt that it's time to essentially make it public start to promoting the

ecosystem and calibration, that's when CharIN was born. And as I said in just short three years went from zero to 155 members. And if you look at the member of CharIN, it's many slides to look at, but pretty much you will recognize all of the major companies coming from automotive world and 16 out of 20 automotive brands are a part of CharIN. And you'll see service providers, you'll see utilities, you'll see energy companies, you'll see silicon vendors, you'll see technology providers like my company IoTecha and many, many other by diverse ecosystem players that create this ecosystem.

Why -- why do we need an alliance? Why do we need to work together? Why gatherings like this one that was organized by CEC so important? Community drives the development of ecosystem. Ecosystem is what creates and growth and economy of scale. Because if everyone can implement through the same standard, it creates healthy competition, it creates the pressure on those who would like to introduce products to market to reduce the course, reduce the complexity, make it more appealing. At the end, everyone wins. Consumers win, manufacturers win because volumes grow. So ecosystem is a drive -- ecosystem is a driver of technology progress.

So we started -- I took the role of spokesperson for CharIN earlier this year. And what we've done, we

started building a case system engagement. We created a conference which by the way Energy Commission was a part of, John Karas (phonetic) spoke there, Noel spoke there. Thank you very much for doing that. And for the first time we brought together a lot of players to demonstrate that actually electrical charging in a smart way is possible. It's not galaxy away, it's here, it's happening right now.

By the -- by the way, you mentioned the JAP project. And one of the demonstrations that we had done together with (indiscernible) in the context of this conference was using all the JAP was a use case based and supported by ISO 15118 on CCS. And it was a very successful demonstration. We show the three vendors came together basically a couple of weeks before the event and were able to connect all of the devices, make them talk, interoperate and enable end-to-end pricing information to be transmitted from the utility cloud all the way to the vehicle so the passenger of the car, the driver of the car can make an intelligent decision when to charge, how to charge, what prices to use, what prices not to use.

And as I said because of the interoperability, it was done just basically weeks, right, I mean when we came together. So that was a huge accomplishment. And driving this motorcycle was just a blast.

We had just another event recently in Detroit. And this one is a very important event, because it's not just a conference, it's not just us getting together, talking about something, feeling good about it, and then going home. This event was actually an interop testing. It was a multivendor interop testing of CCS 11518. AC and DC use cases. We had ten vehicles from multitude of vendors, we had ten charging stations, and we had test equipment supporting the same. And this actually is a first demand that marks our ambitious plan to implement twice a year conference and interop testing in United States on West and East Coast. And this is something I'd like to talk to you about also because that's an opportunity for collaboration.

So what is the task of the global adoption? Let's -- first a full (indiscernible) reality. We talk about technology, we talk about what technology needs to be considered and examined and so forth. You know, it's very important to realize that it takes four to six years to bring a new model car to market. I would encourage OEMs present in room to disagree with that. It also takes about nearly a billion-dollar investment with the same OEMs to bring the car to market. So essentially whatever you will see driven tomorrow was born six years ago and a billion dollars had been already spent to take

this car from the concept into market. We need to be very cognizant of that.

So when we actually talk to folks during the CPEC and CEC proceedings last year and we did a little poll what manufacturer is deploying what technologies, this chart which is by the way available on the website is very telling. Because what you will see from this chart is basically most of the manufacturer, vast majority is adopting 15118 as a way of charging for both -- actually for three, AC, DC, and wireless. That's substantial, that's momentum. That's something that indicates where we are going.

And given the fact that we have been doing ten years of development and six years of interoperability testing as an industry gives you a little bit of confidence that the industry knows where to go and how to accomplish what we need to accomplish.

Another aspect of it is the following. If you look at this chart, it's a very simplified representation of what we need to connect to. But the reality of the matter is we have vehicles of all kinds, right? Motorcycles, buses, trucks, passenger vehicles, boats, potentially, maybe even aircraft in the future. But then we have integration as home, we have integration with home energy management systems, and we have integration

with a grid, and probably many, many other use cases.

What's interesting is if you look at the previous chart, when I mentioned that most of the OEMs adopting 15118 and you look at this chart, if we keep 15118 as a constant, we enabling economy of scale, we enable OEMs to take four to six years to bring model car to market to go forward without any impediment, without any delay. At the same time, we're also enabling a very flexible and agile architecture where we can deploy the system charging communicated to X anywhere because we can talk to Alexa, we can talk to Google, we can talk to Apple Home and probably garden variety of other ecosystems if we would like to integrate our charger with. We can talk to 2030.5 in parts of the U.S., we can talk to EEBus TIC in France as an example, Echonet in Japan, and the list goes on.

I mean those are just representing protocols as I mentioned. There's going to be ton of them, more as we need to consider as we integrate into other system. We can talk to utility using OpenADR, MQTT and probably a ton of other protocols.

So what we need to consider is what enables an industry to move forward as quickly as possible? We should basically constant on the vehicle side so we can enable assurances. Essentially, vehicles can be

produced, worked, and interoperate chargers. But at the same time, we need to make chargers smart so they can talk to other ecosystems. And those use cases my hope is will multiple by thousands because as we start figuring out what electric vehicle is and what it can bring, I'm sure we'll find very interesting applications that we have not even considered today.

Just look back at the time when Google was collecting excess -- wireless excess foreign addresses. Nobody knew what they could be used for. But today without them, our assisted GPS probably would not work as well. Right? So use cases will appear by themselves.

When we started IoTecha, they even would call it IoT something is because I personally believe that electrical charging is a great example of industrial IoT. What is industrial IoT? What is IoT in general? IoT is intelligence, connectivity, and the ability to create multi demand interaction on the same platform. That's what electrical vehicle charging is, as has been discussed today at this panel. Electric vehicle is not just a portion of transportation, it's not just a part of an electrograde, it's not just a part of household. It's a part of all of the above at the same time. So we need to consider this multi demand case and create a flexible architecture that allows us to move forward.

So what can we do to help the adoption? Well, first of all, I think we need to encourage ourselves to move from the discussion with technology to how develop the market? We need to start working market developing activities.

I think a gathering that we had yesterday and today here is very useful because we actually have the ability to show each other what we're working on, how we can create new relationships, how we can start working more proactive fashion together.

It's very compelling to talk about technology because guess what? It's simple. I'm an engineer by training but I kind of as people say close to the dark side. I work on the market development side for the last ten years of my life. And honestly, technology development is much simpler. It's much more difficult to develop the market. Market is fragile and fickle most of the time. We need to be very careful with what to do with this. So let's talk about how we develop this market together.

Interoperability is the key. We need to promote interoperability. CharIN has been working for the last six years together with an industry to create worldwide interoperability test. And those tests have been moving around the globe, now we'll have the chance event that

will happen in Netherlands in a couple of weeks. What we would like to do? We would like to up the ante, if you will, and have twice a year West and East Coast events here in U.S. so we can actually help local manufacturers and service providers to come together and enable interoperability.

How? Well, let's build it together. What is an example? Together we can create a joint interop lab where everyone can place a charger, a car, a service and test them out at any given time. Interesting, right? But it can be done if we work together.

So let's talk about it -- think about it. When you two focus on development of EV friendly policies. It's very interesting from my perspective is the discussion on time of use rates. I agree that they're important. But what happens as an example if we have a time of use rate and we have about a million vehicles, each one of them capable of charging let's say 10 kilowatts and the rate just changed at 9 p.m.

What does it do to the utility grid? Right? Let's think about it. Are we ready for the spike in power consumption even though it may be at night-time. So I think we need some kind of policies to promote friendly integration, incentivize integration, maybe technology diffusion and maybe some other things we need

to think about. Just a thought to put on the table.

And of course last but not least is education. It's education of consumers, it's education of manufacturers, it's education of service providers, it's a cross-education of all of us. Because we need to understand what we can bring to this market together? How are we going to integrate our activities? And also let everybody know what each one of us is doing because that's what creates the ecosystem.

That's kind of what I'd like to put on the table as a proposal. Bottom line is let's corroborate. Thank you.

(Applause.)

MR. FUNG: Thank you, Oleg.

Now go to Bart Sidles from Hubject. And after this presentation, we'll take a short break.

MR. SIDLES: Thanks very much. I'm going to do something that I want everybody else to do because everybody's been sitting for a second. So just stand up. There is going to be a break. But I know those seats because I was in them yesterday can be a little numbing and I don't want to have you falling asleep just due to the fact that your legs are numb because of having listen to me. So just take one second. And then we are going to take a break.

While you're doing that, thank you very much to -- - yeah, jumping jacks, whatever you want to do.

While everybody's standing taking a short break, thank you Noel, Eli, Matt, CEC for hosting everybody here. I think that really what we're doing now and after the panel is a discussion. But the discussion we hope is leads on to something because discussion can always -- can lead to another discussion, lead to another discussion.

So what I want to do is -- we're going to focus on a couple of the questions. But a little bit of background. For those of you who don't know, Hubject we are new to the market but it's not a new company. Hubject is -- we're very focused on enabling our clients. We're B2B platform. We want to enable our clients to offer a seamless charging experience. And that can go into many different areas of what that charging experience might mean.

But our vision is to have a seamless charging experience for everyone everywhere. And we do that -- we started in Europe at 2012 and we have the InterCharge logo which is on tens of thousands of charging stations. And so this is something that with our founders as you can see there is not, these aren't just small groups of people, they all have an interest of enhancing the EV

experience and lowering the barrier for EV adoption. It's very simple. And that's how Hubject was birthed.

We have our EV -- excuse me, our eRoaming platform very much focused on interoperability. We have connected over 350 business-to-business partners in 28 countries and connected over 100,000 charge ports. We have our headquarters are in Berlin. I'm in the office in Los Angeles. We have -- my colleague Obrie is here with me today is in San Francisco and we have another colleague in Detroit. And we just opened an office in China, having also just signed an agreement with a charging network there of over 20,000 charge ports. So that's all very exciting.

Focusing on ISO 15118, that's my area. We have the -- what we understand is the only global ecosystem -- ISO 15118 ecosystem in place. We have a VGG route and the whole PKI ecosystem with all the pools. I can go into more detail on that. And we also do a lot of consulting for companies to figure out their eMobility strategy on a global basis.

So what are we here for? So we're focusing on these three questions which have been outlined by the CEC. Everybody has those in their packets so these are really kind of the three that I've been focusing on.

So how are we -- how do we see needs to be

addressed? Really the first two -- Question 2 and 3 focus on cyber security and on the standards. It's very simple. And it's been discussed here with my esteemed panelists here. It's a lot of discussion on some of the standards. I too agree that, you know, standards are very important because it allows for companies that are taking a big investment to go forward to have some trust and investment security.

So as we see it here is really -- ISO 15118 doesn't answer a lot of those questions, especially on the security and on the vehicle on s standard side.

If we look at the security side, Sunil was -- was talking about this a bit, that cyber security is a huge topic. And this is not the be all/end all, this is -- ISO 15118 is a microelement of this, but at least it does deal with it.

So on the security side, the elements of ISO 15118 are one of the main things we always talk about is authentication. We talk about authentication, authorization, and billing. And the authentication is probably one of the most important element of ISO 15118 and the elements of the PKI ecosystem that are in place because they need to have that enormous amount of trust.

I was speaking with some OEMs here, making sure that well, can we trust all the parties that are in

there? That is the hierarchy and I can go into all of the PKI ecosystem structure according to ISO 15118 and the VD application guide, but the key thing is it takes us very, very, very seriously.

So we're looking at asymmetric keys, private and public keys, you're looking at all the contract information which is actually no -- no personal information is exchanged. The only thing that might be considered personal information is what is called the provisioning ID, the PCID which is -- could be the VIN number. But besides that, there's no personal information that it all stays on the mobility operator, the EMP, you know, whatever the acronym that you want to call.

But the information is encrypted in a hybrid encryption with the Elliptical Curve Digital Signature Algorithm. This is incredibly high level. And so I just wanted to point this out that this is an element of the ISO 15118 standard.

So when we move on to the -- on the standard side looking at how the standard that is ISO 15118 -- 15118 -- excuse me, 15118 that is out there, you know, it is talking about the -- an element of the use case of plug and charge which everybody knows. But moving beyond that because that's kind of the today, tomorrow is smart

charging and then it's the bidirectional and wireless I see coming shortly thereafter. But it's still something that we need to be talking about today.

So smart charging is a big element. What we're talking about here. I know that then there's kind of debates of, you know, is that included in the standard or not or how fully fledged is it billed out at least the standard itself. You know, this is much bigger than of us here. In 2008, 2009, colleagues from Siemens, from Energy got together and said how can we make a great charging experience? And this is how far back the standard is going. It's kind of what Oleg was saying, this is not something that just happens overnight.

And so the good thing is that this has been vetted by people way, way smarter than I ever will be on a global basis. You know, it's a top-down approach. You have market approach from certain standards. OCPP, OICP, OCPI, whatever, that's from bottom-up. This is from top-down. So this is, you know, smart really investigative, thoroughly looking at how things want to be applied so that this is for the future. Smart charging, wireless charging, these are all part of the standard.

I put this up here just to show that ISO 15118 can, you know, really is kind of a bit of a link between all of this. You have the private charging where you

have the -- the energy management system which can be connected in there. Public charging which we -- everybody kind of knows and thinks about and the implementation of plug and charge. And then the two of them together.

So the common link here -- which I'm going to come back to this -- is that bottom part which ISO 15118 is able to do all of this. It's able to allow for various technologies to optimizing the grid. Shaving, shifting, shaping, and some of the overload protection. So these are all elements that are at least considered and being able to take into consideration and the standard.

There's some questions as to how well thought out is it? Standards are evolving. Even though one is might be published, there are elements that are updated in the future. ISO 15118 is no different, it has not been let's say finalized but from the edition one which came out, and for those of you who might know about the -- the standard, it has various chapters to it. Use cases is dash 1. Dash 2 is the network and application layer. Dash 3 is more the datalink and so on and so forth.

So the dash 2 is more the element that is focusing more on the plug and charge and smart charging and wireless. This is actually a screenshot from the

edition draft, edition 2 which came out about a month or so ago. It was just published and fresh in the draft version I think last week.

You can see here the quotes from the actual document. The bidirectional electricity power transfer was officially added to the scope of the standard. That is for this edition 2 which is going to be hopefully published sometime next year. And then the same thing for wireless. So these are really being taken into consideration and this is a standard, again, for what we believe will be for the future.

Some of the takeaways, interoperability. Hugely important. We believe in that, and ISO 15118 allows for it. It integrates into, as Oleg was saying, all the different areas. Even further beyond if you're looking at not just the charging station but the Alexa or Google Home. The home charging, backend to the CPO's primary line of public charging structure. Great thing is that it also does not only AC but DC and high power. And the CharIN group, over 150 members. Hubject is a proud member of CharIN. Looking at how they can take this and transition it beyond just the -- the passenger vehicle.

We touched on the bidirectional, wireless, and of course the optimization. And again, the main thing is that this is all the common denominators ISO 15118. This

is all great. The standards are, you know, what they are. But let's move it beyond that. So I think this is what the objective is. It's just not talking about a standard. I'm setting a little bit of the foundation because I think it's important. It wasn't mentioned in the first -- if I remember correctly, it wasn't actually mentioned in the first conference call for the VGI that we had about two or -- two months ago. It wasn't in the -- it wasn't mentioned. That's why I'm stressing it a bit more because I think it's very important to make sure that it is very much included in the discussion.

When it comes to this and implementation, let's look at where people, other companies are right now that have made the commitment. In addition to a lot of the CharIN members, this is just -- this is not an exhaustive list at all but these are just ones of companies that we know and also have probably had some closer communication with. We actually have -- because of our -- it's investment into setting up a PKI ecosystem with a V -- with a V2G route certificate authority, huge investment in that. But we know that we need to advance this. We're taking our steps to advance it, we want to work with other partners to do this as well.

Here's a list of some of the companies either auto OEMs or hardware, software, other like-minded

companies that are interested in driving us forward. But when I -- I also like to take very practical examples of investments that have been made by certain companies.

Electrify America. Everybody knows them, they're investing an enormous amount of money. If people's seen Cliff Fietzek give a presentation, he's talking about ISO 15118 as a huge component of what Electrify America is wanting to do. Their charging experience is actually starting when you're taking the charge and putting it into the vehicle. You're -- they actually want you to do that. They're training you to do plug and charge before you do much interaction on the screen. So this is a great example of somebody that is saying, you know, it's not only that we believe it, we're talking about it, these are publically available screenshots of presentation that Cliff made I think it was an EPRI meeting just showing that their commitment as well to ISO 15118 and really carrying it through.

These are -- from our side, these are projects that we have worked on. These are real projects we're trying to get this going. There's a lot of investment as Oleg said from the OEMs. It's not a cheap thing. This isn't like saying oh well, let's just try it out. They need to go forward in the future. They have made a commitment. All of them are talking about making each

one of their vehicles now an electric model. You look at Volvo. I think Volvo is going to make every one of their electric vehicles in what is it 2025 is going to be electric.

Comments have been -- commitments have made by mostly OEMs. This is just -- this is just an example of some of the projects that we've worked on showing that we're moving forward. We'd love to move forward with other companies, we'd love to get the support by CEC, by other agencies to show their commitment of helping plug and charge, smart charging, wireless being moved forward.

This is -- love to see more of this. This is what when we announced the launch of our PKI ecosystem together with Daimler, EBee and Virta. EBee is the EVSE the actual charger, and Virta's the backend. These are things that can be done and I applaud what Byron -- Byron was here a couple of minutes ago. But what he's doing down in UC San Diego. You know, that's amazing work and there needs to be more of that getting 100 of EVSC -- excuse me EVs out there that are ISO compatible.

So moving on to wrap up here, the -- so what do we see? So how do we -- addressing questions 2 and 3, it is -- we just -- and a bigger picture including ISO 15118 making sure that that is part of the discussion. Mandate not, it's just a standard, I think, is very important.

And that this standard as I've tried to present here today encompasses all the very important elements of allowing an investment buy all the different players, OEMs, manufacturers, backends to say yes, we can move forward with this. It doesn't mean that their -- that other standards aren't going to be included along the value chain. OpenADR, SEP 2.0, 2030.5. You know, those can be elements that are included. But the one -- one link that we see that makes it great for somebody to be able to move forward is that ISO 15118 between the car and the charger.

Encourage other business opportunities. This is the way to go beyond just talking about the standards. To go into the business opportunities, act as a catalyst to help market, take some next steps.

Pilot projects. People might roll their eyes with some pilot projects, but I think in technology, it's still very important to have them and to encourage other sectors looking beyond just the passenger vehicle. Fleet, transit, marine ships, even maybe airplanes.

If we're -- then regarding Question Number 5 regarding the policymakers and research to be able to foster advanced technologies. We have three main suggestions here. One is to encourage having a worldwide standard which we've mentioned here, just specifically

answering the Question Number 5. And also making sure that this is -- this is a way to look at it from a global basis. That there's a standard that people around the world are able to look at, not just in the U.S., not just in Europe, not just in Asia. This is something that everybody would be able to look at, and that's why I was talking about the top-down standard of people looking at this from a true international aspect.

Government agencies, grant money. This is to jumpstart, this is really to help other projects get going. This is -- from small companies to big companies, everybody -- you know Ryan is saying from Honda, you know, it's expensive, you know, we need to -- we need to make sure that we're going through this path but everybody -- everybody gets a bit of a start by having some funds that are coming in and that's going to help the whole industry being able to advance forward.

And then the last one is the programs like EPIC should be continued, they are great. Those funding opportunities. And just being able to add to some more to validate some of the additional use cases that have been expressed and enabled by ISO 15118.

So with that, I want to thank you very much and look forward to continuing the conversation after the break.

Thank you very much, Matt.

(Applause.)

MR. FUNG: Thank you, Bart.

How about we take a five-minute break. We have an hour left before lunch. So try to get back here at 11:05.

(Off the record at 11:00 a.m.

(On the record at 11:09 a.m.)

MR. HARLAND: Matt, for this portion, would you like me to leave the questions up on the slide or would you prefer the participants?

MR. FUNG: We can leave the questions up on the slide.

MR. HARLAND: Okay. If you want me to go to the second slide, just let me know.

MR. FUNG: Okay. Just waiting on a few more of the panelists to come back from break.

Okay. How about we get started with the moderator questions. I only have a few questions because I think it's more important for the stakeholders to provide questions and feedback.

So I'll start with: We've heard today that VGI, electric vehicles need to be aligned with -- aligned and integrated with other DRs -- or DERs. And we've also heard that communication standards and communication

technology are tied to hardware to enable cyber security, data accuracy, as well as enhancing the user experience, or potentially new use cases like autonomous vehicles and even for existing use cases for all vehicle classes. So kind of the question I have is are -- is an end-to-end solution critically important? And if it is, what does it look like?

MR. LOGVINOV: I'll start. I think you're asking very, very big question but there's a very simple answer.

With every end-to-end solution we develop, it has to be developed in such a way that allows multi-stakeholder participation and allows many people to build on the foundations of same standards so we have a biodiverse ecosystem attached to it. That's the only way we can build it. And actually that would ensure that it is secure because security will become a selling feature. And that the competition innovation will take care of what we need to be taken care of.

MR. CHHAYA: I would -- I would -- we look at the Smart Inverter Working Group and the Rule 21 requirements in the way they have evolved. And that, you know, that is a DER asset class in which the smart inverters could be EV storage or even EVs.

But they're defined -- the way the group these classes so that these standards can be applied to the

appropriate end points. So one end point is always the utility or the aggregator. And the other end point is the resources. But the end point also could be a local energy management system and then the -- that can allow for the legacy and new resources to be integrated simultaneously.

So I think that we can have a similar approach to Rule 21. This is especially important as you -- the DER classes as you get more tightly integrated system and 2030.5 is the standard of choice in that case, with end-to-end implementation. We have tried that in medium-duty and light-duty scenarios as well as the DER classes and it seems to hold pretty well. It happens to be a part of the NIST catalog of standards today.

So I believe that is one approach that we can look at. 15118 needs to be in the mix. Certainly we need to define solutions that allow the bridging to happen securely. That says the most part.

MS. PIERO: One last thing. It's been interesting as we show up in different countries and territories, the perspective on security that we're getting. There's the exact types of security that we're described over here earlier. You know, actually the secure communications making sure what if an aggregation platform gets hacked. Can you enter through just the

charging station itself?

But then the other side that we get asked about is how can you actually -- once you've secured your own system, how can you be part of the larger grid's security and resilience? And in particular in the wake of the Ukraine electrical system hack a few years ago, European electric operators are saying look, our grid security is our national security. What can you do to actually help us in the event of a hack that happens at a higher level in the grid? How can you actually be a defense to stop the bleeding? Can you tell the difference -- can you do something to actually first help stop the spread of some kind of an infection in the electric grid? And what can you do in terms of resilience to bring us back as quickly as possible? How can this distributed intelligence actually contribute to the healing of an electric grid?

So it's sort of interesting to -- what will security actually be when it's not just us?

MR. FUNG: Thank you.

So my next question: It's been stated before, though, we have aggressive deployment goals that need to be accomplished in the near future with 1.5 million zero emission vehicles by 2025 as being an example.

One of the key technology barriers we find -- I mean, define solutions to is inoperability and

standardization. And kind of touching on what Oleg mentioned earlier. But knowing that technology development in time for automakers is between four and six years, what can we do today to accelerate inoperability and standardization?

MR. LOGVINOV: I'll be happy to start.

I think we need to separate standardization from interoperability. The standard is created as a first quarter storm. Right? But interoperability is not always attached to the standard because the standard itself still may have ambiguities. Room for interpretation, room for implementation that maybe extent is compliant in essence so standard's based in essence, but two different companies can implement in different ways. We see it all the time.

Go back to Wi-Fi days at the beginning. You know, dealing card was not working, with Netgear, vice versa. And we experienced a lot of those issues.

So what usually helps and helps in an immense way is that type of interop event that I talked about before. Interop labs. It's basically industry-independent organizations or gatherings where everyone can come in, plug in, plug in with multiple vendors. Work and kind of get the bugs out, so to speak.

So we need to help the industry to do that. We

need to helpful meaningfully, in the way that actually -- that's helped everyone in a comfortable fashion to get together just as much as possible, as often as possible. The ambitious goal that we have on CharIN's side is to do twice a year, East Coast, West Coast. So essentially, it's convenient for constituents on both sides.

If others can help and join this movement and we can create something that works and it's regular and it's known, that's the best contribution to interoperability we can make.

MR. CHHAYA: And to further to what Oleg was talking about is that the interoperability for implementing the same protocol in both tents. So, you know, you need to see. You know in the early days of SAE J1772? We had the issue of the car talks one way and connects and the EVSE's expecting to be seen the other way and they just wouldn't quite do it right.

We saw that recently with the V2G and the product we just finished, we brought the Pacificas over to Palo Alto and they -- we plugged in the same Pacificas that fit just fine with the robust EVSEs, modified but certified. They plugged the same vehicle to a different EVSE and the EVSE basically blow -- blew up. So we don't know what the problem was yet, still figuring out because we got those post mortem ongoing. But something

as simple as that wherein it's supposed connect and charge.

Then you get into the next interoperability which is between the standards. And this is where things start to get really complicated, you know. Utility doc may be 61850 or CIM. It may be OpenADR or may get to OCPP or get to the EVSE and you have a different protocol and so forth. You have multiple hob stock in different languages. And number one, how do you ensure that certain basic pieces of information get translated and end to end the same way.

Secondly, how does the customer references -- how does the customer preferences get factored into these? And thirdly, how do you make it secure from end to end?

So from utility all the way to the end customer. So this is rare. I think that it is important to have the requirements defined against which each limitation and use case can be evaluated the same way. So you get an idea as to what is necessary for the ecosystem to -- to be secure and viable technically.

MR. LOGVINOV: The demonstration project is also very important because they provide this playground for everybody to actually verify. Not just a specific link, but larger system. So Kim can come in and play with it and try to hack it.

MR. SIDLES: Sorry, just might add. So with the interoperability, I think that, you know, it's allowing players to continue to explore because it's -- it will be, you know, funding from organizations like CEC, other agencies to help enable. And I think that it's also, then, encouraging the market to evolve as well. Because we talked about, you know, certain standards that are coming from the top-down and then others that are -- that are more market driven.

I think that innovation is a great way of encouraging and advancing the interoperability because people will come in with certain ideas of ways of connecting and moving from the charging -- either the car, the charging station, and beyond. And so I think that fostering those ideas and encouraging them and people working -- companies working together and taking that step to see how one might be able to advance that good charging experience. Because at the end of the day, that's what people want. The EV drivers don't care about the standards, they don't know it, we don't want them to know it. We just something that is super, super easy. And that does take a lot of trial and errors. And it can be, you know, the investment and the return on investment. But I think that at least be encouraging and going from let's say necessarily a standard, mandated or

not in some cases. Maybe it's not to say only this but at least to say yes, this is the way that we want to go so that some companies that have to have requirements for investments to say at least, you know, they said it over there. They didn't mandate it but they said at least one of these two so we can at least go forward.

I think that is a really important step of going from discussion into that implementation and then allow almost the market to help make decisions on the interoperability opportunities.

MS. DAYAGI: From a manufacturer's perspective, we're not an OEM of cars but we certainly manufacture the electrical equipment and the EVSEs, and we also have to plan our roadmap out five to ten years. So yes, there are very big decisions that have to be made so it helps to not necessarily select which standard is going to be mandated or whatnot but to require the spirit of interoperability and then I think the industry itself will select what works for all of us and we test it then at the demonstration project or at the events.

MS. PIERO: It's interesting in England they're attempting to serve -- lay a groundwork for interoperability simply by requiring a certain level of smart functionality that will actually (indiscernible) out overlaying of different systems into EVSEs. So

rather than going so far as actually mandating a standard, they're more just sort of trying to set the stage. And I like that approach.

We're actually agnostic when it comes to both hardware and communications and software. But as long as there's actually a place for us to work. So you know, I think that that just sort of just making the platform having some sort of minimum operability standard is a good way to start.

MR. FUNG: Okay. Great. I think at this time we'll open up the floor to the audience to ask questions.

MR. CRISOSTOMO: I want to ask a question. Can I have the mike?

In Josh's presentation and then -- and then repeated through demonstrations that have been funded and kind of the manufacturing considerations, there's a good point that was being made around how decisions along each chain affect the eventual outcome for grid integration, whether it's a load planning benefit or a cyber security benefit.

So I'm wondering from like a technology roadmapping standpoint how we can really identify what key areas of new testing and research are necessary to prove out that good end point, the cyber secure end to end customer friendly charging experience.

And so I want to hear Ken and Josh's feedback on what the industry implementers were describing.

MR. EICHMAN: Yeah. So I think I'd say that while the decisions on that team affect the outcome and, you know, from the state's point of view, the challenges of removable integration, challenges with, you know, cost of electricity and for service markets, and many issues.

I don't think you have full flexibility to say, you know, go all the way back down that chain and force some type of behavior. So I think there's some limitations to that. But I do think being cognizant and, you know, some of those implications is helpful and then understanding better the path is probably a good way.

So from a roadmapping point of view you could go out to the end and say we want vehicles with, you know, that are always parked in a parking lot and always plugged in, but the reality of it is it doesn't work that way. So I think there's a mix that needs to be done.

But there are things that you can do like encourage larger batteries is going to give you more flexibility for charging. Encouraging more charging, more public charging, for instance, may give you charging at times of the day when you want it.

So I think there's other ways to go around it but some things may be off limits like some of the customer

preference just may be off limits unless you can change a customer's mind.

MR. ROHDE: I think one thing that I would suggest from a cyber security perspective and this overall environment is just a general word of caution, I guess, is that a higher level of complexity of things generally leads to higher -- higher probability of compromise. Right? And I think that's a concept that's pretty well understood by most people.

But keep in mind that everybody -- everybody in all industries, we cheat. Right? So we have standards and we have ideas for interoperability or whatever the case might be but in the end, we're trying to just get stuff to work, we're just trying to get devices that function properly. And so everybody cuts corners, everybody makes things -- that's how we end up with all the mistakes that we see in the cyber security world.

And so that's -- for that end to end type of testing and understanding how well the cyber security has been dealt with, that's a -- that's an incredibly difficult challenge. And that's -- that's where I think -- all of the folks that are in this room and on this VGI panel need to understand is that there is no standard for cyber security. 15118 is not a standard for cyber security. And so this is stuff that each -- each entity

involved is going to have to take on for themselves is responsibility for implementing cyber security into their own portion of -- of their -- of their product. So.

And I don't think that there's a sense in this room that -- or a misunderstanding in this room, but I still feel like stating security is often actually meaning stating reliability. Right? And when I say something is secure, that's different than saying it's reliable. And so I don't know if that statement makes sense but I hear it a lot in all of the sectors in which we play with, we say we're secure, we're secure, we're secure. But what we actually mean is that this is reliable and it's interoperable.

But anyway, so that's -- that's where I think, you know, based off of our history of working with so many vendors and so many sectors is that it really becomes an individual responsibility. Siemens has to pick up on their own cyber security. Everybody has to. And we've worked with so many vendors in the past that that's been the most important part is to have all of the individual entities helping them implement their own cyber security programs so that they're developing better products that will then work together. The end.

MR. SIDLES: Just to capitalize on that because I did bring up security, cyber security, that I totally

agree. ISO 15118 is, you know, cyber security is probably -- cyber security itself is probably not in the documentation but that authentication element is hugely important. So at least it does place its role with acknowledgment of the importance of security.

So, and that was my point. Not at all drawing the line that that's going to be because it is. I think I said it's much bigger and this is just one important part. But at least it's taking into consideration within the -- that standard. And the importance of the PKI and the encryption.

But I -- I also agree with your point is the authentication is not really the reliability. Then on in terms of the security aspect for enterprises, Hubject takes it very seriously, especially as a role of a root CA. As you know within a PKI in public key infrastructure, the root CA is the highest trust anchor. And because of our relationship and our certificates embedded, our root certificates embedded in EVCC, the Electric Vehicle Communication Controller which is the part where it's probably one of the most vulnerable aspects, especially when we're talking about charging.

We have -- we're going through security audits, TSACs and 27001 which is kind of the ISO security center. But TSACs is a specific one for the auto industry.

Again, very high bars to ensure that our systems have that security aspects. Not -- this has nothing to do with reliability. It is making sure that everything is properly done.

So there's many different slices of that security pie and at least from our side, we're looking -- making to ensure that we're keeping our part of the bargain of that. Our piece of the pie is properly cooked and going to be served well.

Clearly I'm getting hungry for lunch.

MR. CHHAYA: I was just going to add that -- so EPRI is setting up an utility industry-wide initiative around integrated grid cybersecurity. So, you know, my main point is that you cannot look at electricity and charging infrastructure ecosystem independently of the grid power delivery infrastructure. It's outside of that. So.

The power delivery, including transmission and distribution and use they need to work the same way. Plus, EVs to work the same as thermostats and water heaters and everything else that's connected to the grid behind the meters set up as well as the other DERs. And so what the trend that we are seeing in the other -- other elements of end use device segments is that instead of focusing on the standards per se, they're focusing on

information models. So they're looking at thermostats and water heaters from the kind of data that's necessary for managing.

So that there is some flexibility that exists. Because if we think that EVs are a -- EVs are a little bit of a complicated system right now. If you look at the other end devices like thermostats and water heaters and plug loads it's completely chaotic, there's absolutely no prevailing standard that they are following at the end device level. You may aggregator protocol such as OpenADR or whatever. NIST protocol or Honeywell protocol, or anybody else, it's all proprietary, which means that for a meaningful way to manage and have visibility into the system, you need to have somebody to get data out of it. So (indiscernible) additional data.

But in the cyber security, again, I need to emphasize that it needs to be one end to the other and one end of that needs to be the utility, not the EVSE, not the aggregator, the utility. And the other end needs to be the vehicle. And those are the two ends that I always emphasize. And you need to ensure that the packet that alternates at one end should reach securely at the other end and open only at the end within the vehicle, not anywhere in between, not penetrable. Thank you.

MR. BORDEN: Hi. Morning. Thank you all very

much for the thoughts and presentations.

I'm Eric Borden from TURN America Consumer Advocacy Organization in California.

I have two questions if we have time, if I may. First one to CharIN.

I just speak here, it says as many of us know there are currently three competing standards for fast charging. This is pretty suboptimal from a consumer standpoint and from an economic standpoint. So I'd be curious just to hear like what your -- what your plans are for global domination. How you expect to achieve that and what you think will be the thing that breaks the log jam, if at all, towards one standard?

MR. LOGVINOV: So I'm assuming when you say three, you mean GBT, CharIN, and CCS, right?

MR. BORDEN: Yeah, whatever the Tesla standard is called, yeah.

MR. LOGVINOV: Tesla is a proprietary thing so it's not a standard.

MR. BORDEN: So there's four, then. Okay.

MR. LOGVINOV: Four, yes.

MR. BORDEN: Sorry.

MR. LOGVINOV: So once again, it's proprietary. Well --

MR. BORDEN: Four to five.

MR. LOGVINOV: It's not uncommon to have many standards since the beginning of the industry. If you go back and you look at Blu-ray and these GBT, you go back, you look at Homer F and Wi-Fi and probably the list is very, very long list.

What is the deciding factor in any one of those cases? The deciding factor is an ecosystem, the growth of an ecosystem, and essentially the selection of the ecosystem that you would like to be a part of. That's okay (indiscernible).

You cannot help at regulations, you can help through any artificial means. It has to initially develop.

If you look at where we are today as an example, GBT, China, I don't think that we can talk much about it because China probably will do what China will do. It has been done with cell phones, it has been done with many communication standards. And it's pretty normal for a Chinese market to have its own standard.

But let's talk about the rest of the world where we actually have an opportunity to create an influence. If you look at the lengths of existence of CharIN as an example versus CCS and you compare the numbers and you will see the growth rates and market share, you will see that at the beginning CharIN was probably much higher

number in percentage points because that was there earlier and it was created much earlier than CCS actually mature to something reasonable.

But if you look at the numbers that actually published recently. Even if you look at as an example, even inside the other tables, you will see that CCS is outrunning CharIN very, very rapidly in actually different countries, like Germany as an example, where there are no CharIN registrations are within the month. So that real hard data.

Tesla. Tesla deserves a huge credit for championing this market and actually getting all of us to start moving forward with EV development. They develop something that was proprietary their own and frankly speaking they were right because nothing else existed at the time. You know, what would Tesla do going forward? It's hard for me to say and I don't want to speak on behalf of Tesla. But if you look at the numbers once again, shippable cars and what is happening with the market, you will see that Tesla is just one manufacturing company, just one OEM and there are how many models have been announced by other OEMs? I think it's close to a hundred by now, right?

So just take a guess and if you believe Tesla will dominate the market and would 50 percent or 60

percent, or Tesla will become one of the players along the side with Porsche and BMW, GM, and Honda, and Toyota, and Ford, and Chrysler, and the list goes on. Look at the table that I shared with (indiscernible) earlier. You know, how many OEMs have decided to go down to (indiscernible) 1-5 and 1-8 and how many decided to go to other directions?

So my belief -- and it's not just my belief, the numbers that you see today, the trends that you see, the growth of CCS ecosystem is exceptionally rapid. I mean, just the fact itself that CharIN alliance has grown from zero to 155 members in basically two and a half years, that says something.

MR. BORDEN: Thank you so much.

And then a different question. I wanted to come back to submetering and this may be a question for Siemens but possibly for others.

Submetering can occur either through the -- the charging station or through the vehicle itself but I'm wondering if there's anything you think the state should be doing to enable submetering either at the residence or at commercial locations or both.

MS. DAYAGI: Yeah. So our -- our view can be twofold. Right? So one, we have a lot of submetering that is done either in a panelboard or a switchboard. Or

we have submetering that is directly inside the EVSE. We think that the way forward for the eMobility market really is through submetering inside the EVSE because it does allow the EVSE to be metered separately therefore receive a separate rate of energy if so desired.

It also allows everybody to view the specific data just for that EVSE and the consumption that is being used for powering the vehicle.

So it's the specific data that was in the EVSE and the specific application of just that one metering point that's being done. So from -- I guess from a state perspective, it would be the state has already done a good I guess -- has done a big pilot on submetering and we're all I think anxiously awaiting those results. I think another more targeted submetering -- I'm going to call it pilot would be advisable. We're working on a couple of things at Siemens so if you guys are interested in hearing more about that one, then we can talk offline about that.

MS. PIERO: Yeah. I think actually also helping utilities to work through reconciling retail and wholesale meters. There's -- that was one of the major subprojects, as I understand it, within the L.A. Air Force Base project where they were actually bidding into wholesale markets using EVs. It's actually recognized

and reconciling SoCal's accounting. And actually enabling utilities through both their software, their analysis, and their accounting to be able to recognize what's happening in those submeters is very important and it allows you to move to having rates that actually encourage and recognize those three sources.

MR. CHHAYA: And we want -- what we're finding in the submetering is that the end points are easier to facilitate with a metering hardware. It is when you get to integrating with the enterprise metering and billing systems for M&V that's where it becomes really cumbersome and expensive.

So what could be useful is to institute standards around how to interface, how to get this data back to the enterprise billing systems. And right now it is the majors, you know, the utilities, applications of all the enterprises such planning programs there, SAP, Oracle, and so forth. They manage those systems so it is pretty cumbersome.

MR. CRISOSTOMO: Sunil, could you elaborate on that last --

MR. CHHAYA: Sure.

MR. CRISOSTOMO: -- that whole standards point where -- are you talking about having say, OpenADR take information, extract it through the vehicle or the

charging station back into the utilities' MDMS, Meter Data Management System, for subtracted billing along the lines that Celia or Jacqueline are describing so that you're taking one kind of format of information into OpenADR or OCPP for later settlements.

MR. CHHAYA: I think it is the later settlements and is related to getting this data back to the metering billing systems. We just set essentially for measuring the primary household end use meters, you know, the existing AMI infrastructure for metering and settlement.

Now we are adding an additional meter, essentially a submeter that needs to go and stream the data in the same way, (indiscernible) in total data into the same way. So the IEEEC I think 1219, the protocol that exists for metering that difficult end use all the smart meters use, that will be the data stream that is provided by this metering device. If we get a metering, insert a number and do the smart -- any of the EVSEs it provides the data stream. The issue is how do you get that into a Silver Springs network or how do you get in -- provide that network all the way back to the back office where you can then use it for settlement purposes.

And additional -- that additional data stream into the metering billing systems through the head end and all the way back to the -- back to the enterprise,

you know, where the database resides. Metering data resides.

-Additionally, the stream is expensive, seven figure, eight figure type deal, you know, so every time we had to make a change. So that is where if you have a way to standardize and maybe then because if you are not careful (indiscernible) but when we are going for new installations, you can start, it's including that as part of the setup.

But when we're doing the distribution resource planning or any of these other exercises, I think metering will be critical. Think ahead a little bit and see if we can institute that as a standard and design in the system. Design the stream of data in the system.

So that is a short answer to a very important question. We can get into more detail but it essentially indicating the dataset back into for settlement purposes for subject to billing or even for billing initial. And also for LCFS settlement.

MR. CRISOSTOMO: I guess building off your response, Sunil.

Bart, could you talk about how, say, an EVSP would do a similar extraction for roaming and potential inter-utility billing?

MR. SIDLES: So it's -- now we're talking about

data, we're talking about that earlier. And data is so important to be able to enable a lot of different use cases. And so I think it's important to say from what we discussed here with ISO 15118 and then a use case for that -- for the eRoaming, you know, they're two separate.

But to specifically to your question, you know, that's ultimately I think the end goal is to make it incredibly seamless for the EV driver through its EMP, eMobility service provider. That is the pers -- that is the company that has the end contact -- or the contact to the end customer.

And, you know, that relationship is very important and this -- this is -- brings on a lot of other -- points us to who that is. And of course in an EV world, the auto OEMs are now able to have that relationship and continue to have that with the EV driver rather than just selling the car and kind of servicing for an ICE vehicle as they are -- do now.

But, you know, it all comes back to the data that is gathered and shared from the EV through the EVSE in the back end for that the clearinghouse element of understanding how information is shared not only from a single network but from multiple networks allowing for the eRoaming aspect which is, you know, what CARB is looking at right now of addressing that issue. So that

it's, again, it's to make an easy experience for the end driver but ultimately what one wants to do is be able to go to any charging station and be able to charge and have that go back to one bill regardless of which network they're on. That's that -- the ease of really roaming.

But it all comes down to the information that is received, the contracts that the individual has, the sharing of information, how that's billed on which billing platform. I say platform, which relationship is it to the utility that they want to choose or is it to their car manufacturer or is to some third-party eMobility provider which, you know, you look at Uber. Uber could be one in the future of a huge access to EV drivers.

But I think that this is the discussion of having it as easy as possible for the -- the driver to have one contract and be able to have all the background information disseminate so that they are able to see one bill but be able to charge in multiple charging stations.

MS. HOSTETTER: Hi, I'm Obrie Hostetter, I'm with Hubject and I know that we've had quite a voice here today. However, we have been collaborating with multiple stakeholders all who support ISO 15118 and would like to see it be part of the VGI roadmap update. Some of them couldn't be here today so we've consolidated a few

comments from them. And so we will submit all of these publicly after the forum via the docket. But there's a few comments that we'd like to read on behalf of Audi, BTC Power, Electrify America, Greenlots, Lucid Motors, IoTecha, Porsche, Volkswagen, and Hubject.

And first and foremost, we want to thank all of the various agencies and panelists for coming together today to have this discussion and for allowing us to provide input.

We want to respond to Question 3: What standards and methods of communication need to be considered in V -- - vehicle-grid integration programs?

And for this we respectfully ask for the inclusion of ISO 15118 as a standard proto -- or standardized protocol to maximize VGI -- excuse me -- capabilities between the EVSE and the EV including ISO 15118 will enable plug and charge which will result in an easy and seamless charging experience for the end EV driver. And at the end of the day, that's why we're all here, we all want to see that ease of use. And it will done through an internationally recognized interoperable and secure protocol.

It will also pave the way to the other use cases of smart charging, bidirectional charging, and inductive and wireless charging. The later also will start to pave

the way towards autonomous charging. And as evidenced by some of the presentations here today and the fact that a lot of the large auto and EVSE manufacturers and charging network operators are beginning to include ISO 15118 in their vehicles and systems. We believe that the time is now for the state of California to really start to help enable this technology.

We would also like to respond to Question Number 5. And part of the recommendation is that we would like to see that grant monies from programs like ARFTVP focus on publicly funded charging stations that are ISO 15118 enabled and that funds from programs like EPIC -- EPIC could also be used to validate both business and financial models through some of the latter use cases of smart charging, bidirectional charging, and wireless charging.

We thank you for taking this into consideration and we look forward to working with some of the various government agencies on these topics. Thank you.

MR. VINCENT: Thank you. Vincent Weyl, Kitu Systems. Thank you to all the panelists this morning.

I have a few candid comments. I spent 23 years in Icaria working the telecommunication industry. And I've seen and unfortunately been part of a lot of bouts, disputes about protocols and standards including IP, ATN,

TMA, DMA, et cetera. And when I moved to the KIN-TEK industry a year ago, I thought these days would be past. But here we are this morning looking at protocol and how best to implement technology around vehicle to grid integration.

What the KIN-TEK world has brought us is IP. Thanks to IP, a lot of us this morning, we can look at e-mails on a variety of devises, smart phones, laptops. And we connect through these devices all the way into one to a service provider. IP support limited device, it supports you at the home area network level so you can have a home base use supporting network, it supported in network, it's supported by applications and service providers.

I guess my question this morning, we talked a lot about ISO 15118 as a protocol between the vehicle and the charger. And it seems to be, I -- you know, I don't have an opinion on that, I'm not a technical person. Seems to be a good one. But will that solve a program that's as big, an end to end as vehicle-grid integration?

MR. LOGVINOV: A short answer. Yes. Very much the same way as HTML, not IP but HTML running on top of IP enabled us to see webpages today and enjoy all the web's wealth that it has to bring to us.

ISO 15118 was developed as a language, if you

will, running on top of IP that allows the charger and the car to exchange a lot of information and not only control charging process but also to auxiliary functions that could bring us, you know, as example tariffs, they can bring us integration with renewable energy, and many other aspects of it. That was the intention. If you look at what was ten years ago kind of a starting point for 15118 development. It was essentially stemming from the idea.

First of all, why would you use high speed power on communication as a medium, right? Why not to use something similar to (indiscernible) it's good enough for control. But the idea even back then was it's not just for controlling of the charging process, it's for the ability to transfer data between the two and what kind of data in the future? Nobody knows.

And the protocol was created in a way that allows you this flexibility, allows you to define additional objects, blogs that you can put into it and communicate between the two actors which is a primary two actors, car and the charger, but also create data streams that can be originated from the car and from the charger and can be communicated up into the clouds to services that probably ten years ago we haven't thought about. But today we're already starting to envision. Tomorrow maybe we'll

deploy.

So that basic is a notion of 15118 and kind of a genesis of its creation.

MR. VINCENT: So I don't disagree with that. But in your answers was a lot between vehicle and charger. So how does the grid support 15118? What does a grid operator need to do to enable the use cases and --

MR. LOGVINOV: Well, if you go back and look at the pictures that I presented in my slide, 15118 is a constant point between the car and the charger. What will be between the charger and other actors and infrastructure components will differ and vary based on a variety of applications.

As an example, if you're using Alexa at home, right, you probably would want Alexa to talk to a charger. Alexa comes with its own protocol.

If you have, as an example, something that is being deployed in Germany, you would probably want EEBus between energy management system and the charger as a communication protocol because that's what standardized.

If you are in U.S., in some cases you probably would want 2030.5 as a means to communicate between the meter and energy management system and the charger. And the list of those examples is actually endless.

MR. VINCENT: So you don't see a world where you

reached out to the car without the charger?

MR. LOGVINOV: Well there are some implementations today and some examples today where as an example certain companies are using telematics to talk directly to the charger and it works. Do I see grid talking to the charger -- to the car directly? Yes. But does it have to be the same end-to-end protocol without stopping at the charger? I don't think so.

In fact, I can tell you that there are benefits associated with knowing the task, knowing which charger you're connected to. Because if you start talking about, as an example, deploying chargers within the confines of the existing power distribution, you have to be cognizant of what breakers you're on, what kind of conductors you have, what kind of cables you have running. Right?

If you imagine the world where the charger basically mindless device that enables you to communicate with the car, you're connected to something. You have no idea what you're connected to. It could be okay from the point that you have conceptual logical communication, but through the point of you power planning and constraints planning, it's useless.

MR. CHHAYA: I should add that (indiscernible) that five and all the work we have done over the last 10 or 11 years has focused on data communications between

the utility and the vehicle with the EVSE acting as a bridge. So it can have a five-layer bridge between Wi-Fi and (indiscernible) but the data goes directly to the vehicles.

That was further emphasized with the V2G with the grid, we are continuing to do and the (indiscernible) what we are continuing to do with deciding on the vehicles where (indiscernible) off the vehicles where the two end points (indiscernible) as if that five are the utility and the vehicle. The EVSE could have use cases allowing metering and billing, could have use cases around charging session management and diagnostics and so forth that could facilitate varying number of protocols but it is -- there are other means of communications that do allow this and they've been verified. Not only that but the -- we have under (indiscernible) that certain manufacturers are looking at implementing them as well on the vehicle.

MR. LOGVINOV: The bottom line is you have to look at where is the vector of trust. Right? Where is the majority moving? And if you look at where the majority is moving as it's very clear from the table I shared earlier which was a poll done actually in a similar setting, we see very significant evidence of 15118 becoming a common denominator as a mostly

widespread technology.

(Speaker without a microphone)

MR. LOGVINOV: Yes, exactly. And as I said before, you know, when we start -- think about as an example, a large home, right, or a building. You have circuits, you have chargers connected to different parts of the building. How do you do capacity planning if you don't know what the topology is?

It's great to say that you can communicate directly to the charger, to the car, but then how did capacity planning?

MR. VINCENT: I'm not making a debate about 15118.

MR. LOGVINOV: Yeah.

MR. VINCENT: I'm saying we're addressing a piece of VGI --

MR. LOGVINOV: Yes, absolutely.

MR. VINCENT: I think the goal here of this workshop to VGI.

MR. LOGVINOV: Exactly.

MR. VINCENT: I suppose with the technology you know the affects as well. So it's interesting, you know, and I've done, you know, it's very obvious and clear you say the momentum is around 15118, so how do we fix the rest?

MR. LOGVINOV: Well, and that is a very important question. And from my point of view, that is what can be fueled by us working together doing more demonstration projects, figuring out viable and useful use cases that we can leverage to accomplish VGI.

And that's what's important, right? That's what we can accomplish together. We have a basic technology in our hands. We have the language between the car and the charger, we have certain information. Now what information needs to be transferred from the charger and to where to enable VGI? Right? Are we doing behind the meter optimization? Then probably the set of tools that we will use in this case may be very different from us, as an example, controlling a single standalone charger somewhere out in the street. Right?

Or as an example, are we trying to optimizing operation of a fleet where we have probably need for vehicle to vehicle transfer, not just communication between the grid and the car. Right?

Or, as an example, if we embrace the concept demonstrated by Porsche where they have essentially storage embedded into the charging plaza and the ability to leverage the renewable through the same setting. Also somewhat different way to operate the system.

So I think we need to embrace that these are

going to be a very diverse set of deployments with probably protocols that will be selected specifically for the type of deployments. And they will be various.

MS. PIERO: You know, also -- so I -- I should back up and say that I actually do think that 15118 could address all of these areas that you're talking about. You know, Barton did say there are routes to actually work with all of these different technologies, including the one that I'm pushing, and I absolutely think he can get there.

But I think it was interesting the point that you raised about, can utilities, will they ultimately be able to just speak directly to any device, any car? And I don't know if they'll want to, actually. Because you're talking about utilities then increasing their controlled nodes by five, six orders of magnitude. They're not ready to do this and I don't know if that's actually -- that's not their business, frankly. Or it's not their business model.

So it could, if that type of scenario were to happen, it could end up being the new way that utilities are actually remain relevant in an involved system that has so many distributed nodes or it may turn out that there is a much more robust middle platform of DERMs, of aggregators, of third parties that are actually

translating these things. So does it have to be 15118 end to ends? Maybe not. But there is the capability there, it's absolutely true.

MR. FUNG: Sorry, I'm going to have to cut this conversation short, we're just about out of time. But I wanted to go to WebEx and see if there were any questions.

MR. LOGVINOV: If you don't mind, Matt, I would like to add one very quick point just building what Jackie said because I think it's important to embrace your point.

We're moving from central control to orchestration. And it happened in IT world and we have to recognize it will happen with EV charging as well. So you're absolutely correct with that.

MR. HARLAND: And, Matt, I believe we have one hand raised on the WebEx. Steve Davis.

So, Steve, we're going to unmute you phone. And after the WebEx comments, we are going to break for lunch.

MR. DAVIS: Yeah, thank you very much.

MR. HARLAND: All right, Steve, your line should be open.

MR. DAVIS: Okay. Can you hear me? Can you hear me now? Okay.

MR. HARLAND: We can, yeah.

MR. DAVIS: Okay. Okay. Thank you for all the comments from the panelists, this was really good. I think I would like to address the comment about communicating directly with the vehicle.

One of the things about 15118 is that it's designed with the automakers' brand protection mandate in mind. In other words, things are always very sufficient of the idea that the utilities would be in a position to directly control the charging of the car. The way that 15118 works is that the two actors, the station and the vehicle, engage in negotiation and the car has a chance to weigh in on what preferences are based on the end user's departure time and the needed kilowatt hours. Once a load plan is created, the customer gets and the vehicle gets that energy unless it voluntarily agrees to give it up.

There again, it's a matter of a long-running multiyear process that was engaged in over a period of several years before it was finalized. And then we've had years' worth of interoperability testing which of course will continue. So I think that's one thing to address the idea of direct utility control.

The other one to remember is that the utility regulatory model is going to evolve on a state by state

and country by country basis over the next several years. So having an object model which is creating a distributed energy resource that's dispatchable because of the object model's inclusion of a revenue grade meter, you -- you are flexible for going forward and I think that's an essential part of this.

And just to emphasize, I think it was Obrie, I'm not sure who was commenting because I had to step away for a minute. But I want to lend my support to, you know, we do need to define a standard, we do need to create a standard and put money where our mouth is about VGI by investing in a common unique standard so that as we move forward, the automakers can understand the market signal that's being created by the state of California that their preference is being validated by, you know, a matching investment on the infrastructure side so that they can deliver their customer promise.

It can't do it unless we do it. And we certainly can't have -- I mean, the enemy of simplicity would be more fragmentation. And I think we've already had enough of that on the DC fast charging side with multiple different connectors.

So if we really want to accelerate adoption, we have to simplify. And by simplifying what we're investing in and getting it to be a common unique

standard, then all the automakers, they're not -- they're not mandated to put it in their cars, but if they do, they'll be able to have a customer signed up for seamless roaming wherever the vehicle goes before they even roll off the lot. And the customer doesn't need -- need RF ID cards or apps anymore, they just have that plug and play experience which let's all remember, Tesla has I think in excess of 60 percent market share, and although they don't do VGI, one thing they did do right is to have just a plug and play experience wherever that customer goes. Thank you.

MR. HARLAND: Thanks, Steve.

I think that was the extent of the WebEx comments so at this point I think we're ready to break for lunch. But I wanted to thank the panelists. We probably could have kept going on that, that was a good conversation.

And let's come back at five after 1 so everybody has an hour to go find food.

MR. FUNG: I just wanted to add that there is a public comment session after this afternoon's panel. So if there's still topics that we want to discuss, there's still an opportunity. Thanks.

(Off the record at 12:06 p.m.)

(On the record at 1:10 p.m.)

MR. FUNG: -- for the VGI Roadmap Update Workshop. We'll be starting with the Customer Experience Panel. And it will be followed by an open comment period, as well as a discussion of next steps. And then we'll do a wrap-up from the agencies.

And as a note to the WebEx participants, please mute yourself. Thank you.

And I'll turn it over to Eli, who's moderating the Customer Experience Panel.

MR. HARLAND: Okay. Fantastic. Thank you, Matt.

And as Matt said, welcome back, everybody, from lunch. It looks like we're getting a close to on-time start. We said 1:05, it's ten after. Not bad.

So this is our -- the final panel of the workshops. And for those that are familiar with the matrix, as well as the 2014 Roadmap, this is a track in this Roadmap that we decided to add. And the objective or, I guess, the hope is that this track begins to bring together the kind of interrelated topics that we explore when we're looking at economics and we're looking at policy and planning and technology and considering how

the customer fits into that, whether it's those technologies working for the customer or it's planners that -- or it's planners assuming and making the right forecast for how customers may interact with the grid with their vehicles.

So we brought together a diverse group of folks with different points of view. And not necessarily that they're competing, but we definitely wanted to have folks who are working with customers in different capacities represented, and also include -- making sure that we're including strategies that address any of the needs for disadvantaged and low-income communities, as well.

So we're going to follow a very similar format to the previous tracks. We're going to start from my left and work our way around with panel presentations.

The first presentation will be from Byron Washom. And I just want to make a note that Byron is going first. He's going to have take off a little bit early. So if he does get up, it's not a signal for everybody else to leave.

MR. WASHOM: Thank you, Eli. And it's a pleasure to be here and thank you for the

invitation.

So what I'd like to do today is to show how vehicle grid integration blends into our microgrid at UCSD.

And so our microgrid at UCSD is compiled of a wide variety of distributed energy resources. Of particular note are 2.5 megawatt/5 megawatt-hour battery system, as well as our 2.8 megawatt fuel cell that is combining power with a 350 ton absorption chiller that also operates off of directed biogas. So we self-generate about 85 percent of our electricity on an annual basis and we import the balance of 15 percent. And that 15 percent is contracted to be 100 percent renewable.

So our goal is to be an embodiment of why we're here with the vehicle grid integration, and that is working with open standards, return the value of grid integration to the stakeholders to commercialize prior investments by the private sector and public agencies, and to make electrification of transportation accessible to all members of California.

If you take the old adage of when was the best time to plant a fruit tree, the answer is

five years ago. And so it was five years ago, approximately, that we had our first true engagement, deep engagement with the CEC Grant, both on ISO 15118, which we heard about this morning, as well as we had three DC fast chargers on the grant. And that led us to then purchase for our fleet 50 EVs that were ISO 15118 compatible. So that was our kernel of getting involved.

Simultaneously, we entered into a program, a no-regrets CAP X (phonetic) program to install 170 Level 2 stub-outs throughout campus. We were the single largest recipient of those settlement funds from NRG, and site funds. And that became an incredible, incredible fortuitous investment. Because as a consequence today, we now have EV charging stations at hospitals, retail, multi-unit dwellings, the fourth largest visitor center in San Diego, parking structures, our police station, fleet services yard, a zero-net energy warehouse, and an ocean marine terminal. That's all from that investment with EVgo back in 2014.

So with that, this is what just the ChargePoint profile portfolio looks like today of

134 Level 2 chargers on campus, and so it's widely distributed throughout.

And so as a consequence of this platform, again, with all these stub-outs, that enabled us to create a plug-and-play approach to a wide variety of different developers, both commercial and innovators. On the left-hand column here you see what we regard as commercial units that are either deployed or they're pending to be deployed. And by pending, I mean they're funding and are in their process. And that will include, as I mentioned, the 134 ChargePoints, 15 Innogies that are 15118 compatible, 20 from eMotorWerks. We're a recipient of 18 Power Your Drives from SDG&E, 10 Level 1s that will allow people to stay all day.

And of greatest significance, that I'll talk about later, and that's why I highlighted it here, we just concluded an agreement with EVgo to put 6 by 125 kW DC fast chargers at a single site at a plaza. So a distance from here to that wall will have on campus three-quarters of a megawatt of capacity of DC fast charging. I never thought I'd be saying those words.

Our single largest load on campus is two-

and-a-half megawatts and that's the San Diego Super Computer, which is our crown jewel.

On our right, we see a wide variety of demonstrations and prototypes to newbies, to Hitachi, Honda, Princeton Power. Shell has ten units. We have three DC fast chargers that are integrated with the -- with PV and second-life EV batteries and a DC fast charger.

So as a consequence, this makes UC San Diego the largest and most diversified portfolio of EV charging stations any place in the world.

So let me -- so our growth rate has been 150 percent in EV commuters and in megawatt hours dispensed per year. That equates to about nine percent a month is our growth rate. We originally started this program with calling it a Field of Dreams, build it and they will come. We've renamed it the Tiger by the Tail. We're not able to keep up with an overwhelming demand and response by the student, faculty, staff, our retirees, and the general public to this.

And so here's the growth profile and it's color-coded accordingly to the various vendors who are participating in this program. To put it in perspective, it took us seven years to reach

one gigawatt hour, which we'll reach in November. And it will take us only one year to reach the two gigawatt hour mark.

So basically, our 2018 goals, all of them will have been met by October. And they were basically a doubling of whatever we achieved in 2017. Our 2019 goals will, in fact, be a doubling of the 2018 goals. But of significant note, just in terms of volume, that I struggle and lose sleep over the volume because it's such a hard demand to satisfy, is we have 500 unique individual commuters coming to campus per week. I never thought that. So -- and ten megawatt hours of charging just on the ChargePoints. So the build it and they will come is, in fact, a workable strategy.

We have been able to maintain. The bottom dashed line on there is our growth rate in ChargePoint Level 2s. The blue solid line is our growth in -- now up to over 40 megawatt hours per month. And -- but then the top line is actually the individual unique drivers, we call them, that are continuing to come to campus. So we are now outgrowing ourselves. They keep coming as long as we keep providing charging stations.

Let's look for a moment of where are these cars coming from? We entered into a relationship with five OEMs that gave, basically, fleet prices to our student, faculty and staff. And so those fleet process then were -in the incentives and the affordability. So, in fact, providing affordability to an EV and accessibility to charging created that one-two punch to bring these cars to campus. And these are not Teslas. These are not being driven by Teslanaires.

You can see in the pie chart here you, in fact, have a fairly modest price range of cars, except for the BMW i3. And the BMW i3 is actually the largest unique commuter that we have on campus. And the reason why is BMW gave the sweetest deal, $12,000 off of the MSRP. And they also won last year's Governor's Award for Outstanding Leadership, that Dealership won the Governor's Award Leadership.

So I love going back to this chart, this statement here. It was actually written back in 2014 by J.C. Martin of SDG&E. And so I think he articulated what we are discussing today, four-and-a-half years later, and he really lays it

out, of what the customer choice requires that you have to satisfy.

"My biggest fear right now is losing customers and ending up with stranded assets. So I have to remain extremely competitive with alternatives of home-market charging, public charging, high-powered DC fast charging, et cetera. So everyone who installs, even though you're a workplace, you have to continue to maintain that competitiveness and look at it holistically in order to continue to serve."

So to J.C. Martin from 2014, I say, bravo. And today I say, when I look at this statement, what a delicious challenge this represents.

So here are some of the data. Here is a 3D chart. Along the bottom is the 15-minute intervals. On the right Y-2 axis is the, basically, the quarter. The earlier date is in front, later date is in the back. But what you see in this graph is the growth in the peak demand on the far left and how it's getting higher and higher, more and more megawatt hours. It also shows a second hump or the afternoon

charging, we have a second wave of chargers. And now the development of a third hump in the post-work hours. So eventually we want this chart to be higher and look like a plateau, and that means higher asset utilization, more turnover, more relocation of the cars after a completion of charging.

We then get to DC fast charging and versus Level 2s, and so we're fairly plateau. We have a fairly shallow performance of Level 2s of only about 10 kilowatt hours. But with time, more and more drivers are showing a preference for DC fast charging and, also, they're taking a deeper charge.

Another very significant observation is we have four parking stalls assigned to DC fast chargers and they produce about 25 percent of our total output. Conversely, Level 2s have about 80 stalls assigned to them and they provide 75 percent. So one, 4 stalls, 25 percent, the other one, 80 stalls, 75 percent, the ratio is terrible for Level 2s. And so on a college campus where parking remains scarce, even from your days when you were there, that type of ratio is compelling us to move faster and quicker to DC fast

chargers.

So let's look at some of the critical issues from a social consideration in order to make sustainable business models I EVSE.

The first one is -- this is from EDF de France, that it's an exaggerated chart of looking at how do you feed the duck curve or fill the duck curve, either with home charging 100 percent of filling the gap with workplace charging.

This is a major point I'd like to share with this audience. I contend that the workplace is the best accelerant of reaching the MUD market, multi-unit dwelling market, and the disadvantaged community market and all economic stratospheres, stratified segments of our market because workplace charging is common to all those people. You don't need home charging, you don't need public charging if you have adequate workplace charging.

So what this also shows is the value of if you price it right and if you make it available, then part of the duck curve will be solved, primarily through workplace charging rather than any other means. And so I forever want to be known as the individual who invented

the EV happy hour, because that's exactly what we're going to be doing with our EV commuters. We will be alerting them in advance, tomorrow there's going to be renewable surplus day and we are going to have an EV happy hour, literally.

And so since we're self-regulated, we can change our tariffs at will on a daily basis. Since we're self-regulated, we can pretend in order to see the value that they -- that we're in Fresno for a day. If Fresno is having a grid event and we want to see how our drivers and cars can respond, we're going to notify them that we're doing an experiment today and this is how we want to see how you react. If you participate, you get a free day of charging next week. And if the grid event the following day is in San Francisco, we can pretend we're in San Francisco for the day. So we can accumulate all these things on almost a daily basis, rather than wait for that grid event to happen in San Diego.

This is another metric that we have coming up, and that is called the enterer (phonetic) week cadence of trying to understand the EV commuters. And we start with day one is Monday, and so everyone is a first time driver on

Monday. And then on Tuesday, half of those people come back and the other half are new drivers. And then on Wednesday, you have three segments, four segments, five segments. What this chart tells me on the fifth day, on Friday, where 80 percent of our drivers are repeat drivers, is that these people probably do not have access to home charging. Why else would you put up with the hassle of having to relocate your car at the end of a charging session and try to find another parking space in the middle of the day on campus if you had home charging?

So these are more than opportunistic chargers and commuters. These are people who are treating the workplace as their primary source of charging. And if you look at the weekend, we even have people who visit us six and seven times a week.

Another thing on the disadvantaged communities, we have over 2,000 employees that live in disadvantaged communities. And we have special promotions for them to actually be engaged in this program so they have not only access to better parking, better opportunities, HOV lanes, they travel further and so they have a

greater depth of charge during the course of the day.

And this is where in proximity. The bottom right in the dashed areas is the disadvantaged communities of San Diego. And UCSD is in the upper right. Programs, like the new instant -- or prequalified voucher for the California rebate is now commonly known as Cash on the Hood. So these individuals can go down and take that voucher with them and use it as their down payment on an EV.

Another important part that I would like to emphasize to this group as you look forward into the Roadmap, and that is we are finding a significant difference between the earlier-adopter market and the data that they generated in the usage pattern and the data from the early mainstream adopters. And I think the gap is widening. So any data more than three years old on consumer behavior and charging behavior, I would suggest, is now stale. Because these people are behaving -- the people who own the 2018, the newbies, are behaving I a wildly different fashion when it comes to their charging behavior.

We have the ability to look at this. We have a data sharing agreement with ChargePoint, and so we have all the data for public charging in the San Diego Region, noted by this map here. We also have a relationship with EVgo where they have provided us with two DC fast charging stations, the data there, and PG&E, SDG&E, SCE and LADWP service territory to look and analyze the data, as well.

But again, I emphasize, the early mainstream adopter market is wildly different from the early-adopter market.

On ISO 15118, we installed 26 units back in 2014 under a CEC Grant. That was the largest demonstration in North America. And we're about to install about 17 units with Innogy, which will be the final protocol for 15118.

And then the ultimate electrification of transportation is that we're bringing the light rail to campus and it will be operational in 2021.

So what I wanted to share with you today is the success of a workplace environment. If a destitute public university can do this, so can any other workplace employer. We find it as an

attraction to our employees that greatly value it. We find it, also, companies who are competing right now in the marketplace, their new employees, attracting that quality employees, are looking for this amenity of having workplace charging. So it really covers the bandwidth of high-end, all the way down to the lowest paid employee at a workplace.

So it is happening. It is successful. And I hope more workplace employers have -- go from Field of Dreams to a Tiger by the Tail.

Thank you.

(Applause.)

MR. HARLAND: Thank you for that, Byron. I hope we get through the presentations so we have some time for some follow-up questions. I know there certainly are some.

So, Doug?

MR. BLACK: Okay. Thanks Eli. And thanks for inviting me here.

It's working? Great. Thank you.

So I'm going to be talking about our CEC-funded project that just completed this spring. We partnered with Alameda County. And we were looking at kind of solving a problem that Alameda

County had in increased costs that resulted from their efforts in increasing their electric vehicle proportion of their fleet and their providing public and workplace charging.

So similar, this is the same goals that Byron was talking about. This, I want to point out the Energy Manager of Alameda County, Phillip Kobernick, has been a big champion in trying to -- in the same ways that Byron described what they're doing in San Diego, Phillip is trying to do in Alameda in converting his fleet of county vehicles to electric vehicles. At the time, during our study in this, these numbers have grown, but he had 40 plug-in electric vehicles and plug-in hybrids, with the majority being pure electric vehicles.

Wrong button.

So the primary area that Alameda County has is their fleet vehicles is in a parking structure in Oakland. In the basement, they have about 20 Level 2 ports in the basement serving those 40 vehicles, so that's a challenge for their fleet staff. On two levels of the parking structure, they provide Level 2 and Level 1 charging ports. And during our study, they added

a DC fast charging station. And Phillip may challenge your trademark on the happy hour, Byron, because he was calling it a fast charging happy hour, as well, too, where he lowered the rate from 7:00 to midnight. So you guys might have a little ego battle there.

We also -- so our focus, what I'm going to talk about today is focused on the public charging, seeing as this was kind of a customer experience. It could also come from -- and I will touch on somewhat, too, the customer experience as the charging station provider, as the fleet owner. But primarily, I'm going to focus on the controls and smart charging that we implemented for the public, which could also be considered workplace charging because those stations served a lot of the Alameda County workers.

Just to illustrate the cost problem that charging created for Alameda County, the figure on the left shows the whole facility, so that entire parking structure, it's electric demand in kilowatts, which was pretty flat, peaked at about 60. And then after installing and converting to electric vehicles, installing charging stations,

their peak got to about near 120 and doubled. And you can see the two peaks here are indicative of the usage here. The morning peak is the public and workplace chargers and the evening is when the fleet vehicles are returning and plugging in to charge. And those were all -- on the right, that's all uncontrolled, before any charging controls were put in.

So to drill down into the challenge of the public or workplace charger, we looked at the individual charging sessions for each user of the charging station, so here are some examples. Each bar is a charging session. The beginning of the bar is when the vehicle plugged in. The end of the bar is when the vehicle disconnected. The dark portion of the bar is when the vehicle is actively charging.

So the important things to look at here and what's important to being able to implement any kind of smart charge, any kind of control, you know, the VGI controls to minimize demand or to shift the charging, it's critical to either have very repetitive or predictable or known values for the disconnect time and for how much energy is needed.

And in the upper left you can see, for the most part, the amount of energy needed, pretty consistent. This person uses -- you know, drives the same amount, probably chargers overnight at home, comes, charges, takes the same amount of energy to just fill back up what they used on their drive in. But when they depart varies greatly. The example in the upper right, the amount of energy that is consumed varies as much as the departure time.

In the lower right is just an example of just a little metric to look at for what the flexibility is, so how much can we shift that charging energy over the total plug-in period? And so to have more flexibility, to provide more grid services, to have more ability to lower demand, you have to be farther to the right of that histogram of the blue bars there of having greater flexibility. That indicates a longer plug-in time compared to the charge time. And those things that, of course, would vary if you had parking limits or you rotate vehicles. Any of those things kind of limit how much flexibility you have in shifting that demand.

So what we did here was create an

optimization algorithm that would take data from all the charging stations to look at how many vehicles were connected, which users were connected, what their charging needs were, look at and make a forecast of what the baseload would be in the facility. And then given the amount of time that a vehicle would be plugged in, and this is all with -- the example shown here is all with perfect information, so knowing exactly when the person would depart, who much energy they need.

The blue line is without control. That's the actual load without control. Each of the rows is a charging session. The fleet charging sessions are included here, too. Those are the ones up in the upper right that go in overnight. Public and workplace are in the middle hours from 7:00 to 7:00, 7:00 a.m. to 7:00 p.m. And you can see how the dark portions of each row are broken apart and spread out over the plug-in time. And then -- and that's how we shift the charging around, by sending new schedules to those charging stations that match those patterns and change the blue line to the green line and lower the peak demand and lower the cost for the facility.

So to be able to do that, though, we need to know when drivers are leaving and how much energy they will need because we don't get any information from the vehicle. So we devised a simple little text program that, when we would detect, these are ChargePoint Stations, when we would detect their user I.D. that as participating in our study, we would send them a text saying to go to the link that -- in which they just could enter the two simple pieces of information of when they're departing and how much energy they would use with a little pushbutton, too, of same as yesterday, to try to make it as simple as possible because it is key.

And I totally agree with the number one thing here is to not drive EV drivers away, that we need to make any VGI, any interaction, any interface that we have with the driver, that it is simple and, hopefully, rewarding. So we came up with what was a fairly simple way to do this. And this is how we would collect our -- the critical information.

Another piece that would be great to have in this that we had no way of getting was to get the state of charge from the vehicle.

Here's some examples then of the blue lines. So in the upper left the blue line is the actual charging that -- charging profile of one vehicle that was following set points that were determined by the optimization algorithm. We went back into the -- and looked at the ChargePoint session data and looked at what -- and recreated the -- what the charge profile would have been had we not controlled it, and that's shown in the red dashed line. So that's not a real line, that's just what we gleaned from the data and assumed would have been the charge pattern and what would have been the charge pattern in an uncontrolled setting.

So you can see, in that one vehicle, which would have had a peak demand of six kilowatts, its peak was two kilowatts spread over a longer period. That one vehicle had an impact on the demand of all of the charging -- all of the public charging stations' demand, shown in the upper right, and the -- what would have been the red dashed line peak turned into the blue dash -- the solid blue load profile.

In the lower left we see multiple vehicles that were participating, multiple public

charging station users that participated, and the change, the significant difference between the red dashed, what would have been, charging pattern and the blue pattern shifting from peak period to mid-peak period to minimize cost. And then on the right, showing that overall impact on all charging stations that were active at that time in the garage.

So our -- overall, what our objective here was to do -- to prove this kind of technology out, find a simple way to do this with customers that was unobtrusive, not strand any drivers, that was our real key which we achieved. We also did want to demonstrate the cost savings. We had a small sample here, a small set. We did those over three months and we had a range of only two percent cost savings in September, but up to 16 percent just for public charging sessions. That doesn't include the cost for a fleet or DC or anything like that.

We did come up with a creative way to look at -- to reduce the DC fast charging. In addition to the happy hour, we would detect when a DC fast charging session started. We would reduce the rate of any fleet charging sessions.

Since they have the luxury of charging overnight, we would reduce those and that would offset up to, I forget, about 25 kW offset from the 40kW DC fast charging peak.

One other thing we like to look at from what we -- of how the smart charging that we implemented across the board with fleet, DC fast charging, and with the public and workplace charging sessions is to look at both the normalized amount of energy that was delivered for electric vehicle charging at the facility and the cost of electricity at that facility. The cost is shown in blue and the total energy delivered is in orange. So the total energy has grown greatly and the costs have stayed relatively flat.

I do want to point out one thing that will make this maybe a plug for further research that could be funded by CEC is that the change in the peak periods will be -- will create different challenges for even fleet chargers and charging, chargers that can charge overnight that are relatively simple now to schedule. It will require some more sophisticated customer engagement to do those shifts in the ToU peak and

mid-peak periods.

And I can answer your questions.

MR. HARLAND: Thanks Doug. All right.

So we're going to move on to Sam.

Sam, the mike that you're looking for is near the WebEx station there.

MR. SAXENA: Cool. I'm going to make an on-the-fly change, as well. On-the-fly change made.

Doing a sound check. Presumably, you heard that. All right.

I see several new faces in the room here, so I'm going to spend a little more time on the intro content that, for those who have seen me give similar presentations, definitely Jamie, it will be a recap for you. What I'm really going to talk about is how can we create customer experiences that delight and, through creating those customer experiences, drive EV uptake and grid integration?

So we are very fortunate to be at a time where the EV ecosystem is vibrant. I mean, we have entities, like Veloz, doing statewide outreach in a whimsical manner, actually. I really enjoy the Veloz advertisements. And we

have, on the opposite end of the spectrum, stakeholders, EVSE providers, automakers creating products that really kick ass. I mean, there are some fantastic EV cars on the market. There are some fantastic EV charging experiences on the market.

And I think one of the tragedies is that despite all of these efforts, I mean, across the entire car-buying market, it's only about one percent, two percent of sales that is EVs. And I think Veloz is making a valiant effort to improve that, and I think we need more of the same.

But I think one of the things that's also a little bit under-addressed is the in between, between what Veloz is doing in terms of raising public awareness and what the automakers and the EV charging providers are doing in terms of great products. The process of deciding to provide a car to actually, you know, getting that product to be an EV is an area that I will especially be focusing on here.

And you know, I imagine you've gotten this on your phone before. And if you're anything like me, it creates a great deal of anxiety because all of a sudden I face the risk

of not being able to respond to an email from Peter. And, gosh, I mean, what if I couldn't do that, I'd be worried. Or, heck, even worse, if I wasn't able to use my phone's navigation to get home, you know, a form of stranding. But if you get this in your car, big problems.

And now imagine if you're a fleet manager and you got this on 50 of your cars today. All of a sudden, you're having a really shitty day; right?

Now the really tricky thing about the customer experience is that through technology solutions that are built into the products, into the cars, into the charging stations, we can help to mitigate this being avoided -- this being encountered in real life. But the problem is that simply having a perception that you're going to have this problem scares a lot of people away from even choosing those vehicles in the first place.

And what's interesting is that when someone is looking to buy a vehicle, whether they're a car buyer or fleet, there's a deep set of questions that they have to overcome, a deep set of issues they have to overcome. I mean,

they have to overcome issues around, hey, is it worth it for me to choose a greener vehicle? Is range going to be a problem for me? How and where will I charge this vehicle? Do I get the Level 2 charger from my house or not? What if I live in an apartment building and I can't charge at home? Is it okay if I'm only charging at Byron's charging stations while at work? What happens if Byron parks in my parking spot and I can't get that charging station today, am I okay? You know is it okay if I'm charging only every second day? On and on and on, right, because these questions define sometimes the corner cases that scare people away from choosing an EV.

And if you are a fleet manager, you've got all of these questions and more because the and more is also, hey, I might have 15 different building locations that my fleet is traveling between. How many of these locations should I install a charging station at? How many charging stations should I install there? What type of charging station? What's this going to do to my electricity rates? And more; right?

Complicated questions. It turns out to be a lot simpler for someone to just say, you

know what, forget all this, I'm going to get a conventional vehicle. And that happens a lot, unfortunately.

Now our approach to overcoming these problems is what we call the MyGreenCar platform, which is a mobility-decision platform that combines widespread data collection, physics, and data-science-based analytics, and visualization and attribution that gets tailored to different types of audiences that are leveraging the data and the analytics. The key enabling technologies are that we've got vehicle physics models for pretty much every car on the market, so we're able to predict, using mobility data, using phone data, using fleet telematics data, what would be the sources and syncs of power and energy if someone was driving around, not in the current vehicle they're driving but in any car they're thinking of buying, and where would that power be coming from?

We've got almost 14,000 unique vehicle physics models and have developed a pretty streamlined process for being able to mathematically formulate, calibrate and validate vehicle physics' models. And, in fact, working

with the U.S. Environmental Protection Agency and others, we've proven the validation of our technical approach on over 2 million miles of on-road data. So the technology foundation is there.

But what's really interesting is when the technical foundation gets packaged into a format that can be used by people who are looking to buy a vehicle. So for individual car buyers, we've created the MyGreenCar app that allows someone to install the app, choose whatever car is on the market they're considering, drive around in their current vehicle just as they normally would, the app is automatically detecting when they're driving and recording their trips and calculating, hey, if I made the trip that I just made but in any car I'm thinking of buying, what would my costs be? Or if I'm considering an electric vehicle, what would my battery charge profile be? So to take a breather, I'm going to take a break and let the video tell you what MyGreenCar is.

(Whereupon, a video is played and not transcribed.)

MR. SAXENA: Now for those who have heard

me talk about MyGreenCar before, the point that we're at with it now is actually a really fun point to be at because we've spent years developing the underlying technology foundation and the project has now shifted into the frame of mind of what I'm talking about here in terms of creating a delightful customer experience. You know, we've brought product developers and marketing professionals onto our team to help take MyGreenCar to the next generation of, let's call it, usability.

And on top of that, we've even shown the substantial impact that virtual test drives like MyGreenCar can have on shifting the uptake of EV car buyers. We've shown, through behavioral science studies, that there is a 45 percent increase in people choosing an EV as their favorite car after using this sort of virtual test drive approach.

And, heck, given that it's got vehicle physics' models for pretty much every car on the market, we're able to attract people who aren't even thinking of an EV in the first place. Perhaps someone is, say, comparing a Honda Civic and a Toyota Corolla and a Ford Focus as their

cars, Ford Focus conventional, as their cars but, you know, there's no reason why we couldn't simulate the comparable EV and show them, hey, you know, if you considered an electric vehicle, you could save 2,000 bucks a year. Oh, by the way, there's $12,000 of incentives available in your area. So the power of being able to attract a wide audience and then nudging them towards EVs is a dimension that we're going into.

Now we've been very fortunate to get the support of the California Energy Commission in a recent EPIC award to take MyGreenCar into the directions of helping fleet electrification. And so in that direction, we have begun creating what we call MyFleetBuy, to use M names again. MyFleetBuy is allowing a fleet or fleet manager to gather data on how their vehicles are driving around, either using their existing vehicle telematic systems or -- pardon me, fleet telematic systems or using phone apps similar to MyGreenCar. We allow them to choose whatever vehicle they're considering for their next round of fleet purchases and then allowing them to, you know, see what that vehicle in their current fleet operations would look like.

And so to give you a preview of what MyFleetBuy is, here it is.

(Whereupon, a video is played and not transcribed.)

MR. SAXENA: So given that we are at October 30th and tomorrow is Halloween, I figured I'd tell you about something that in our efforts to do market discovery, we're very fortunate with MyFleetBuy to have the support of CEC's Market Facilitation Office, and so market discovery is a big portion of what we're doing.

In speaking with fleet managers, we've come to determine that infrastructure is a giant pain in the butt because they're not really willing to rely on public charging infrastructure that might be available sometimes, might not be available sometimes. They'd like to have ownership of their infrastructure. Sometimes they'll be leasing the buildings that they operate out of, sometimes they won't be. Sometimes they'll have electrical upgrades required, sometimes they won't. And so the costs of infrastructure a real obstacle to fleet electrification.

And so that has been guiding where we're

taking MyFleetBuy forward from what you just saw in the video. That's what's coming up for MyFleetBuy. We're really focusing on helping the fleet managers understand how many of what type of charging stations do we need at which of our locations for however many EVs we want to purchase; right? And how will that ultimately affect our electricity costs while taking into account the various rate structures that they may be exposed to and the demand charges that they may ultimately be exposed to.

And what's really interesting is that you can't predict all of this just through software because there is a strong human element to the decisions that need to be made. Questions around should we upgrade our building infrastructure and electric panels and so on allow you to say, for example, get competitive bids from electricians to, you know, help you see what the costs are going to be? Well, that turns out to be a real pain in the butt for fleet managers. It's a distraction of their real job of having to run a fleet. And so the headaches involved are an obstacle.

So one of the real directions that we're

taking with MyFleetBuy is at least making it as streamlined as possible for them to get the information they need. Give them a walk-through process of when I do get an electrician into my buildings to give me price estimates, here are the exact pieces of data that you need to get from these electricians in order to make decisions on how many EVs are we going to purchase, how many charging stations do we need at which of our locations and understand the sensitivities around what your costs are going to be. So that's where we're headed.

Now MyGreenCar and MyFleetBuy have been around for a while. Over the past little while we've measured some really exciting stuff, over ten percent week-over-week growth rates in MyGreenCar. Our fleet pilots are ramping up. We've got the California Department of Transportation, Alameda County and City of Oakland as our three early pilot partners in MyFleetBuy. And then lots of entities that have supported us and, heck, even funded us towards the different efforts that we're taking on.

And so with that, you know, to wrap up, I think that driving the uptake of EVs and then

driving the uptake of grid integration, it really requires a delightful customer experience to be created in that entire process. In the entire process of learning, hey, I want to buy a car, say from the lows, being exposed to, hey, an EV might be an option for me through to navigating all of those issues we talked about.

And so one of the fun areas that we've experiencing with is even creating messaging around how can we attract people through these processes. And so, the final video.

(Whereupon, a video is played and not transcribed.)

MR. SAXENA: So with that, where I'll leave off at is we are actively in a portion of our efforts where we're seeking input. We're seeking partnerships to drive the next phase. Specifically related to our fleet efforts, we're actively looking for partners in the corporate or government sectors that are interested in electrifying their fleets and navigating the sets of issues that we're talking about here. And also looking for partnership with EV and EVSE solutions providers, OEMs and developers, so that we can make sure that the tools that we are

building can help reduce any friction in your own sales processes.

So with that, thank you.

(Applause.)

MR. HARLAND: All right. Thanks. Thanks Sam. It's good to see our video system is working well, too. In the building, it's all interoperable; right? So --

MR. SAXENA: And it's better to be in a place where I can just press the video and control presentations.

MR. HARLAND: It just goes. Yeah. Hopefully it works well for WebEx.

So next up, we have Carlos de la Cruz.

And, Carlo, we're just going to pull up the questions we have here, so thanks.

MR. DE LA CRUZ: Good afternoon everyone. My name is Carlo de la Cruz. And I want to thank Eli, Matt and Noel for inviting, and the rest of the CEC staff for having the Sierra Club at the table. I guess we are the big green representative to talk about what's happening on the ground to communities. I want to thank not only the other panelists but the other experts in the room.

And just to get a sense of who is in the room, I'm curious, by show of hands, who represents or works for, is with an OEM, related to, obviously, EVs? It could be the charging infrastructure. And then who works with electric side, power sector generation, utilities? I see you. And then government agencies, regulatory agencies? Hopefully not just CEC Staff. And then out of genuine curiosity, who owns or operates their own electric vehicle? So a fair share. That's probably higher than the California average. And then who does not own an electric vehicle but has access to and still utilizes the benefits of electric vehicles? Oh, so I see a few hands. Are those electric buses of electric trains you've been riding? I see a nod of heads.

So the reason I wanted to do that small exercise is that I think when we talk about customer experience and customer relations, we often fall back upon the historical notion of what we think is the car user and the car buyer as the individual user that has to either utilize their car for their private use and transportation usage and then, also, is

responsible for the refueling and the maintenance of that vehicle. But I think when we talk about electric vehicles, we really need to redefine how we think of not only the vehicle as an end product, but also how the user participates. Because we often will try to equate the electric vehicle as the new better product than what the internal combustion engine vehicle has given us. But I think when we talk about that type of mobility and that type of customer-to-product relationship, we really miss an entire market.

And I'll just say that today, I do not have slides but I really wanted to go back to basics and just make three points today, one about equity and affordability, the second about what kind of air quality benefits we can really cogenerate, not just from the electric vehicle users but communities that are situated next to local air hazards, and then finally the potential for medium- and heavy-duty.

And the reason I list these three is because I think by limiting our conversation to a typical electric vehicle owner or driver, we then forget about the entire market, whether it's 97 percent of the market or, you know, the section

of the market that doesn't typically own or purchase vehicles that is transit reliant, we exclude these markets out. And although SB 350 has provisions around including and penetrating disadvantaged community markets, there's still a critical conversation that needs to be had around what will it actually take to get there?

We have these goals under SB 350, under SB 100, under other state legislation that requires infrastructure and charging in state parks and state schools, but what will it actually take to get the low-income renter, low-income homeowner to actually then participate in not only the VGI, but also potentially vehicle-to-home, vehicle-to-building exchanges.

And I think that is a really critical piece because we shouldn't just think of equity as the state requirement that we have to layer in on top. It really should be the spice that we bake into the cupcake, not just the frosting that we put on top to make it look pretty. Because equity as a pathway towards resiliency and affordability really then allows us to think about what are the barriers that prevent any individual household or communities or fleet

operators as a whole to be able to enter this market, to be able to participate in the benefits that you can potentially accrue from VGI, V to building, V to home. Because, frankly put, and we all know this, that the electric vehicle market of today and of tomorrow is not going to be the same electric vehicle market in two years, five years, or by the time the Olympics and Paralympics come to Southern California and California.

So 2028 is less than ten years away, less, we're about to have the new year. And so how can we think about where we need to get to in ten years in terms of expanding the market for those households and those communities who are least able to afford some of these investments.

And the reason I mention that again is because when we look at the utilization rates for not only electric vehicle charging, home charging and things like rooftop solar, it's not always said but when you look at the analysis the segment of the population that's able to benefit and take advantage of those new technologies and the rebates and the incentive programs around those new technologies are also the same

populations that are homeowners, vehicle owners, live in suburbs, do not live, typically, in multi-unit development, in other words, are already beneficiaries and recipients of other state or public incentives and are already a market that has lots of resources. So instead of thinking, well, how do we get this segment of the market that has so many resources, whether it's the home that they own, the car that they own and the rooftop that they're then able to lease, how do we think about the other part of the market, whether it's multi-unit developments that can be aggregated into a microgrid that's also being a participant?

So that's my point on equity and affordability.

And I want to then pivot to air quality benefits because we think -- when we think V-to-G air quality benefits, I think most of us, myself included, think of power generation, and what are the emissions and what are the local air pollutants that are emitted by power generation? Well, fortunately and unfortunately, in California, we are ahead of the curve. We have disconnected most of our contracts from coal-

fired power plants. We are sunsetting many of the fossil fuel power generation on our grid. And thanks to SB 100, we will eventually get to clean energy generation for all of California. That may not mean that we don't use either carbon credits or offsets, but it means that our grid will be much, much cleaner.

And so when we think about the co-benefits for air quality and local health, public health especially, we can't just think about the power generation sector. We also have to then think about the fuel refinement sector which especially affects communities in Richmond, Long Beach, San Pedro, which are adjacent to many of the industrial uses and the industrial centers that then not only, you know, not only produce the fuels that are currently being used in many vehicles, but then often have local effects to the communities that surround them.

So by thinking of how we can electrify and also bring industrial users as part of the participants as for V-to-G, we can then think about how can we electrify those sectors faster? How can we electrify the heavy- and medium-duty sector faster by adding a greater value use

proposition for those assets?

And the reason I'm bringing this up is because I think, especially for the medium- and heavy-duty, and then we think through what does the medium- and heavy-duty market, buses and trucks, what is it really comprised of? Is it municipal fleets with garbage trucks, maintenance vehicles, bucket trucks? Is it transit fleets with large buses? Is it public school districts with school buses?

And school buses are my particular favorite example because if you drive around on the weekend and you happen to find a school bus depot, you could just see a parking lot full of buses that just sit there non-utilized during the weekends and also during the summer holidays.

And so if we can think about fast forward to when school bus price point is as favorable as the price point is for renewable energy right now, we could see a world in which a lot of these school buses will become electrified. Therefore, how could the school buses themselves also act as a benefit, not only to the school district but also to local community that sits around that bus depot? How can they benefit from either a

greater distribution, great load management or backup power for when there is a brown outage?

And for -- I'm based in Los Angeles and I work within the Southern California Region and we have a lot of different actors in terms of our power generation side. And it's an interesting landscape because, although you can drive seamlessly from one city to the other, the utility that's behind that power and behind their own plants for electrification, I won't -- I wouldn't say that they're all up to the same level, that we have some leaders and we have some laggards. And so how can we think of V-to-G as also a way to think about overall grid resiliency and grid upgrades that we'll need for, you know, the coming change, hotter days, more extreme climate and more extreme weather anomalies that potentially could result in disruptions to our grid; right? So V-to-G technology allows us to think about those issues while also thinking about equity and affordability.

So I want to end on just one example on why not only VGI but also vehicle-to-building, vehicle-to-home could also be a pathway for affordability and equity.

Many of us know that building electrification and other types of electrification for decarbonizing our economy, that in some ways those are more far-off targets because of the cost of being able to electrify those sectors or those technologies. I really believe that VGI or vehicle-to-building or vehicle-to-home could be one way we could actually make building electrification much more affordable and accessible to a large segment.

There are already test programs and pilot programs being tested now, everywhere from Japan to Oahu to Maui. And one of my favorite examples, actually, is from Maui, not just because I have family on the island but, you know, I think Maui is a great example because it's an island. So unlike California and the western grid, it doesn't have the ability to just offload its power to a different grid network or different user. So instead, Maui is really constrained in where it has to figure out, how do they use that energy? And obviously, as an island with lots of natural resources and environmental concerns, they don't necessarily want to shift back towards fossil fuel

generators.

So they have a pilot program for V-to-H called EV Ohana. It's a Maui demo project that launched in 2011 and launched in two phases. And it aggregated over 200 Nissan Leaf owners and it gave access to 13 Level 2 chargers. And the phase two of it, it also installed 80 bidirectional chargers and enabled vehicle-to-grid and home power so vehicle-to-home, as well.

There are also other examples here more locally. The BMW i-Charge 4 Project with PG&E, which launched in San Francisco. And the reason I mention this is because we often talk about vehicle-to-grid integration as only the vehicle providing the power generation side, where we can also think of second-life batteries as providing a bulk of that local generation. And that not only has benefits in terms of waste stream and avoiding more toxins ending up in our landfill, but I think that can offset the load and the discharge that we have on the vehicles themselves.

Because I think is it aptly put, as Sam said, none of us want to see a low battery notification either on our car or on our vehicle.

Having driven electric vehicles many times but not owning one, I definitely have that range anxiety because I have access to electric vehicles but I don't have access to charging at home.

So think thinking about second-life batteries as also part of the V-to-G and V-to-home ecosystem can allow us to think of these creative solutions, not just how the vehicle relates to the grid but how do these assets overall relate to the grid and the energy system.

So with that, I'll hand it over. And I await your engaged and your questions.

MR. HARLAND: Those will be coming up next, after Eric and Rick. So --

MR. BORDEN: (Off mike.) (Indiscernible.)

MR. HARLAND: Yeah, you can initiate a stretch break. I think that's a great idea.

(Off mike colloquy.)

MR. HARLAND: And, Eric, I think to move the slides -- yeah, you got it there.

MR. BORDEN: So the joy of being on the last panel of the second day, second to last, is that most of my topics have been covered, which

is actually good in a way because I think it will be more about emphasis and framing than introducing new topics.

But one thing I'll remark on is that it does seem like, you know, everybody is speaking the same language. We kind of know what the issues are. And that's a lot easier to deal with than if we were all just completely talking about different things and didn't -- you know, there was no coherence, so that's positive.

So in case you don't know TURN, because we don't participate as much as the Energy Commission, we're a consumer advocacy group for Californians. We primarily practice at the Public Utilities Commission, so primarily on utility regulation, applications, policy. We work at the legislature. And, of course, we're happy to be here at the CEC today.

So stepping back broadly, I think there are two values that we're trying to capture here when we talk about VGI. The first is system values; right? And you know, again, this has been talked about, shifting EV load to particularly low-cost hours where you might have solar over gen can save a lot of money. And to

build off what Carlo was talking about with equity, I do view VGI as a way for all consumers to benefit from electric vehicles.

It's not the only way but I think that's the right framing in that, you know, I'll put it a little bit differently, most of the subsidies that have gone out for electric vehicles to date have gone to wealthy homeowners and to wealthy businesses; right? And that's -- that happens in a lot of nascent markets. That happened with solar. It happens a lot. But I think, really, California can be a leader on how can all consumers benefit from EVs, both financially and from an environmental perspective? And that's really the tact that we take; we want to see all consumers benefit.

So there's the generation system values, we've talked about those.

Less talked about, though mentioned yesterday, are on the distribution system. And the main one we think about is basically just the local capacity values. I actually think this is an area where people say, well, they're really large, like utilities spend a lot of money. I haven't seen -- you know, SMUD did a really good

study on their service territory, but those values are going to change depending on the IOU, depending on the scenario, depending on the use case. And so I do think there's some work in defining those values that we can gain from the distribution system a little bit better.

That said, those values cannot be realized today with how utilities do distribution planning. And again this was mentioned, but the way it works today, and it's the same with all load, EVs aren't particularly discriminated against of something, is that the utility sees new EV load coming on and they're going to say, well, if all of that charge is on peak, what is my distribution system capacity need to be, and they're going to build to that capacity. So even if you're saying, well, EVs are really flexible, we can shift away, we can use algorithms to shift away from distribution peak, it doesn't matter today because even if you do, the utility is building new capacity and all ratepayers are paying for that.

So I put as -- by the way, I use the term technology loosely here -- I put as the key enabling technology here is just people knowing

about this, which I'm glad it was mentioned earlier, as well as data collection on, well, how flexible can EV load be and do we really need to building new capacity for it? You know, there is the question, do we need some sort of regulatory change? I think we need more utility understanding. And I think we should all be advocates for being able to capture this value. So today, it can't be captured, but I think in the future, we can hopefully change that.

Just stepping back again, there, you know, there's been a lot of sort of complicated talk, but I remember really see two primary tools that already exist today as being able to capture a lot of the VGI values that we talk about.

The first is demand response. I particularly like demand response as a product to capture these values because a lot of the value is within a few hours of the year, whether you're talking about the top 250 peak or the bottom 250, you know, curtailment or over-gen hours. Relatively, that a very small number of hours for which you can send a concentrated price signal.

The other way to look at it is with rates. I'm going to talk a little bit more about

time of use. But you know, it was mentioned, Cindy Fang talked about yesterday, their VGI rate. You know, that's a rate that builds in a kind of demand response component where they're looking at system peak and distribution peak and sending out the price signal. One of the interesting thought experiences with that rate is, so let's say that that rate perfectly incentivizes everyone who's on it to shift away from their distribution peak; right? And so I haven't seen any data, I don't know if that's happened, but it's theoretically possible, particularly because the prices are very high during those hours.

So even if that happens, actually, there's no cost savings to ratepayers, again, because -- and what's actually happening, which is sort of ironic, is that instead, if there was a capacity upgrade, those costs are actually charged to customers other than those -- than the ones who caused it; right? So that just kind of highlights the issue. But I do think getting data from a rate like that will be really helpful in crystalizing the distribution issue.

So I'll talk a little bit more about

rates. I'm mainly focusing on residential, just due to time constraints. Commercial, obviously, also really important, but we're making a lot of progress, particularly with the IOUs. Here, the major utilities are proposing EV-friendly commercial rates or have already implemented them, so we've made a lot of progress, so we can move on to other problems.

So again, with time-of-use rates, we have whole-house and EV-specific time-of-use rates; right? So we don't need to reinvent the wheel. However, we have very low uptake of the rates; right? So looking at somewhat recent data, maybe around 15 percent of Edison's territory drivers, I don't mean to just pick on this and I think, you know, it's probably around 20, 25 percent, and presumably a lot of these customers could be saving money on -- if they get themselves on the right -- on the right rate. So like what's happening there?

But I want to -- and the -- but one issue with the rates is that a whole-house EV rate might not be right for every customer. It depends on their load profile. If you don't drive a lot and you use a lot of usage during

time-of-use peak hours, we'd hate for folks to get on an EV rate that actually made their bills go higher; right? And the answer to that -- so that's one issue.

The second issue is you hit some rate design issues that I'm not going to totally explain. But basically because when you comingle the loads of a house and EV, it gets harder to design the right rate. And so it all gets like solved with sub-metering; right? The ability to just isolate EV load and charge that rate.

And you know, I asked the question earlier about sub-metering to a different panel and I was a little bit surprised. I asked, "Well, what should the state do?" And I thought someone might say, well, they should just mandate that this gets done. So I didn't hear that. That's a little surprising.

But I can tell you what I'm hearing as an advocate on this issue is you ask the charging station companies, does sub-metering work? Are your meters accurate? And they say, yeah, this is like not that hard. We have the hardware. You go to the utilities and they say it's impossible. And they also sort of say that the billing,

the -- you know, anytime you touch a utility's billing system, like red flags go up and like, there's like sirens and it's like really scary. And you know, there's sort of this thing, well, if we do do sub-metering the costs are going to be huge and it's going to erase a lot of the benefits, and I think that's actually right. Like if they said, well, it's actually going to cost $1 billion or whatever it is to do sub-metering at a large scale, then it doesn't make sense; right? Then we do have to do other options.

And so from an advocates standpoint, you know, I think sub-metering makes a lot of sense because you want to charge -- first of all, for the EV driver, they're going to be able to get the lowest off-peak rate possible with an EV-only rate. It doesn't make any sense to deploy new utility-grade meters to every house that has an EV, particularly when we think about in the millions category. And so this seems to be an issue that people sort of agree on but -- you know, and I haven't been involved with the sub-metering pilots. I know maybe Noel can tell us all about that. But it does seem like one of

those things that should be on our radar that we can like hopefully solve.

The other thing that -- you know, going back to the low uptake, it's just about education and outreach. It's not happening, I guess, at this point. So I'm looking at a couple of things coming up that -- where this could change.

The first is an updated low-carbon fuel standard program which will provide a point-of-sale rebate. This is going through a car process right now and I think will come to the PUC. But that seems like a place for me where the automakers -- and I'm really hoping the automakers take a role in helping to explain rates.

The other issue is nobody knows what cents-per-kilowatt means. They don't. I mean, is it lower? Is it better than? You know, this needs to be explained easily. And I'm hoping the automakers can take a role, particularly if they and the utilities, as well, are providing a point-of-sale rebate where they can say, hey, here's where you live, here's your utility rate, and here's how much it could save you.

The other thing that's happening around

maybe late 2020 is all residential consumers, except for low-income customers in hot climate zones, will be defaulted onto house time-of-use rates. That may be an opportunity where an EV driver -- you know, where people are knowing what rates are -- all the studies now say a lot of people think they're on time-of-use rates now and they're not, they're on tiered rates. And so that could be an opportunity again to hopefully get people onto the right rate.

So just taking a step back, this kind of just summarizes, but, you know, I go back to what I said in the beginning, I think all consumers can benefit from EV adoption, both financially and from an environmental perspective. And VGI is one of these areas where it can flow to all consumers.

So thank you very much.

(Applause.)

MR. HARLAND: Great. Thanks Eric.

Rick, you're up next.

MR. KUBIN: All right. Can everybody hear me? That works.

(Off mike colloquy.)

MR. KUBIN: All right. So I am the last

speaker. I'll also tell you up front that I'm actually not an expert in customer analysis and other areas, but I've done a lot of work in supporting customer systems and providing analytics around customer activities, so I think it's been an interesting exercise for me to go through this.

I'll just explain a little bit about Grid Democracy. So we were founded in 2017 and we're providing consulting and advisory services into, primarily, the energy space, but also the broader IoT space. We focus right now, primarily, in California and working with a number of startups and trying to help them figure out how to navigate into the energy space in California. The utilities are typically very difficult to get into.

So along the bottom there are some of the entities we're working with. Power Ledger is a blockchain energy company out of Australia and is one of the -- considered one of the leaders in the field. Clean Energy BlockChain Network is their arm for supporting North America. Silicon Valley Power is from the City of Santa Clara Municipal Utility. I'll talk a little bit more

about them. Lecida is a startup that's focused on advance machine learning for the IoT space and been helping them see how they can help the energy industry.

So when I went through this, you know, we were kind of given these four questions. So I took a crack at going through them, so I may end up giving more questions to the questions than I may provide answers. But it was a useful exercise, at least for me, to work through them.

So around, you know, how do we account for consumer behavior within utility grid planning forecast? So I'm previously with PG&E, so I have a pretty good understanding of how all their systems work and how their processes work.

Consumer behavior is really influenced by three primary factors: personal, psychological and social. There's different mechanisms. Again, I'm not a marketing, customer-focused person but, you know, there's some fairly typical ways to get information out of target markets. The key thing that I picked up here is that, you know, the market and the objectives around, you know, EV proliferation and VGI are still very nascent. And it's been pointed out a few times

here, you know, most of the sales to date have been to higher-income, single-family-owned homes, which is missing, you know, a huge portion of the California market, and just many unknowns.

So I think my takeaway on this was that, you know, need to look at trialling different approaches and measure results and try to do that collaboratively across agencies.

How effective are outreach and education efforts? So you know, to date, from what I've been able to see, outreach and education has been pretty fragmented. You know, there's been education and programs from some of the EV makers, from some of the other entities, from some of the utilities who have, you know, promoted, to some extent, programs like LCFS rebates, stuff like that. But overall I think, you know, there's a lot of work that needs to be done. And again, I think coordination across agencies, utilities, cities, EV makers, EVSEs really need to try to come together to make this happen for California.

So around improving air quality and pollutant emissions, specifically around disadvantaged communities, I was talking with a

friend of mine who's working on some projects in the Santa Barbara area. And one of the things that was happening down there is the utility is proposing to put in an additional peaker plant to help support the additional load that's being projected from EV growth. So that's, you know, obviously not the best solution.

Again, don't necessarily have answers but, you know, a coordinated approach that includes distributed renewable generation community-based-plus storage, in addition to providing a charging infrastructure at the community level, can go a long way to mitigate and address those problems.

So the fourth question is where, you know, I think I have more direct expertise around technology. So the last 10 or 12 years, I've been primarily working as an enterprise architect putting together systems to address the needs of the energy players. And I know the words are a little bit harder to read here, but my perspective is this isn't a lack of technology. There's a lot of technologies that are available or are in development that can achieve the results that we're generally looking for, and

I'll talk a little bit more about that.

Part of the challenge, really, is having a coordinated approach with clear policies and economic incentives that promote collaboration across the stakeholders, while also supporting healthy competition. I know that sounds like maybe a contradiction but, you know, a lot of the discussion we've had as been around standards, like 151180 -- or 8. And you know, I think things like that are key in moving some of this forward but still allow for competition within a framework of standardization.

So kind at the center and hardware levels, the EV makers, we've seen -- heard from Honda. You know, they have equipment that they can put into the vehicles, inverters, sub-metering, et cetera. So you know, that technology is not necessarily an issue. How to pay for it and are consumers ready to pay the increase for that, I think, depends on how the customers can take advantage of that and how that can be turned into potential cash flow back to them.

You know, I touched on the integration and data standards, so I'm also a proponent of

ISO 15118. I think, you know, a future where you pull up to any charger, you don't have to pull out a key card, you don't have to do anything with your phone, you just plug your car in and there's a handshake that happens and the charging is based on smart contracts, which I'll go into a little bit more detail.

Which brings me to the next one, around blockchain technology. So there's been a lot of hype around blockchain over the last few years. I just came from another conference last week. But you know, you hear about it solving world hunger and all kinds of crazy claims. But from a system engineering perspective, you know, I early on kind of latched on to the potential of what it brings to the table.

And I'm not going to go into detail on explaining blockchain but just in kind of one sentence. It has the potential to reduce friction and costs for managing exchange of value. And if you look at what we're doing within the energy space, it's really all about exchanges of value. So you have generation of electricity that gets transferred to somewhere, that's an exchange. You have an exchange of that

electricity into an EV, that's another exchange. You have an EV that's potentially providing some grid services back to the DSO. It could be DR. It could be, you know, time-of-use and changing charging characteristics, but it could be more advanced, like frequency regulation.

So these are all what I view as micro transactions. And current systems aren't really able to support that level of complexity around the administration and accounting and financial tallying of that.

Blockchain offers a very unique solution to be able to support those types of activities in a way that has built-in security and other things that make a lot of sense.

And then lastly on here, machine learning. It's come a long way in the last few years. You know, everybody, I think, is pretty familiar with AI and its application with Alexa and Siri and things like that. But there's a whole element of applying advanced machine learning to the IoT space. So sensor data and being able to optimize around that data and also provide predictions about, in this case potentially, customer behaviors.

I just wanted to switch gears a little bit and just kind of give an example of how, you know, some new technology can come into play. You've heard a little bit about the low-carbon fuel standard. So we're working on a project with Silicon Valley Power and Power Ledger to bring a blockchain platform to bear on, basically, tracking low-carbon fuel flows from, in this case, Silicon Valley Power has got solar deployed on the roof of a parking garage. They have some storage battery capacity inside, then they have 49 charging stations that are connected.

So some of the new changes that are coming within LCFS is the potential for having an enhanced credit where if you can show that the fuel pathway came from a low-carbon source, in this case from PV generation, then you can apply for this credit enhancement. So the question is: How do you actually provide proof of that?

So this is a great application of blockchain technology. So we're tracking generation from tapping into the meters coming off of the PV, and then accessing the API from a ChargePoint chargers, then we can basically close

the loop on that. So you can see from the numbers there that it's not an insignificant market, so there's definitely some motivation there.

This is one area where, you know, coming from PG&E, I know how they applied the LCFS Credit Program there. It was a one-time $500 rebate to EV purchasers which really -- and I think it was the same at So Cal Ed. I think SDG&E was maybe slightly different. But I think it's a disservice to their customers the way they've done that because the credits are actually accumulating on an ongoing basis, it's not a one-time deal.

So being able to provide -- and the other thing is smaller entities, like Silicon Valley Power, just due to the overheard of working into the system, and it's all manual, they basically submit spreadsheets that get reconciled once a quarter, is difficult for them to justify the expense. So what we're giving them is an opportunity to actually track this whole flow of, basically, kilowatt hours, provide them with an automated way to generate the report to claim for LCFS credits. And then we're also in discussion

with the folks at CARB on actually tokenizing the LCFS credits.

So rather than, you know, going through this fairly onerous current practice of collecting all the data and then using brokers and having to go back and audit, and they regularly go back and change their numbers based on information they get, using a blockchain platform to actually take care of all of that would be self-auditing and it would take a lot of the cost and expense out of the system and actually provide a liquid market for the credits.

So kind of coming back to some maybe summary perspective on some of the points, so I think from a customer experience view, education is really key. And I think what we want to do is to, you know, convey to the citizens of California that they can participate in the vision of getting us to where we want to go with EVs and greenhouse gases. Incentives and pricing, you know, go a long way in promoting that but, you know, policies do, as well. And I'll talk, you know, a little bit more about how we can maybe adjust some of that to address some of the more disadvantaged aspects of the

population.

It's a simple term but, you know, maximize customer value and minimize friction. So you know, when a lot of smart home stuff came out a lot of people kind of jumped onboard and bought stuff and installed it and, you know, looked at it once and twice, showed their coworker, oh, look what I got here. And you know, a week later they forget about it. And you know, if they save a dollar or two, you know, on their monthly electric bill, you know, they're okay. If they don't, they don't care.

I think being able to maximize the customer value so it actually becomes meaningful, but in a way that minimizes the friction, so again, blockchain technology has the potential to allow you to establish smart contracts that basically determine terms that you're willing to trade under. So you could say that, you know, if the rate goes down to this, you know, I'll charge then for this period of time.

Similarly, if you want to offer services back to the DSO or utility around DR or whatever, that could also be accomplished through a smart contract where you basically just set sliders to

determine what thresholds you're willing to trigger under, and then the technology will go ahead and calculate that and basically create immediate reconciliation of the charges.

So this was just kind of my take on trying to wrap my head around that, you know, this isn't one set of customers. It's not one set of customers. It's really a multi-threaded set of entities. So you've got, you know, private owners. You've got shared ownership. You've got ridesharing, public transit, commercial. And, you know, we haven't really talked too much in the last two days about autonomous vehicles. But you know, with the advent of those coming on, you know, how is that going to change, you know, what we're looking at? I think there are still going to be some people that will, you know, demand to own their own vehicle. But I think we'll see more and more shift towards shared vehicles.

And then from, you know, the population demographic side, you know, talked a little bit about, you know, the more affluent people in single-family homes. I live in San Francisco and I do own my home, but 70 percent of the

population there doesn't, so they're renters. And their access to the charging is severely limited. So you know, there's some new models that are coming out that can address some of that.

One of those that I'm familiar with basically loads solar on the roof. They do battery walls in the garage. And they have something called an allocator that will allow behind-the-meter flow of kilowatt hours from those systems into the apartments, but also feeding EV chargers which are not just open to the folks in the building but can be accessed by people that subscribe to their system.

So some, I would say, interesting ways to kind of deal with the current situation with the utilities that make some of this stuff difficult.

Similarly, with low-income and disadvantaged communities, by moving towards looking at putting in more community solar and storage that are local, schools are a good place to install chargers that could be used after school or during school. And then, you know, public and workplace charging, we've talked quite about.

So just some recommendations. And this is, you know, not just on -- this is kind of the broader view and, obviously, my opinion primarily. But I think the regulatory framework here in California needs to support broader changes in the roles that we have right now between IOUs, public utilities, CCAs. You know, some of what I'm seeing right now is there's conflicts between CCAs and IOUs. The CCAs are getting the customer touch, but the IOUs are still responsible for the infrastructure and billing systems. And trying to implement innovative programs within that structure is actually really hard.

And just, you know, when I -- it took me about a year at PG&E to finally figure out how they got funded. So through, you know, a three-year general rate case process and trying to understand how that all loads through, how they actually did work, was -- it's a bit insane, I think. So that's what I view as a cost-of-service model where they basically tally up what they think it's going to cost them to provide electricity for the next three years and go to the CPUC and get rates approved.

There's different ways to do it, so moving towards more of a services- and value-based-model where, you know, the ratepayers pay for what they get, not for infrastructure that they're saddled with. But you know, that takes major changes from the regulatory perspective. And you know, do -- you know, does California have the appetite to do that? I think it will happen in small steps.

Economic incentives are really needed to address the major gaps to support rental markets and low-income residents. And I think, you know, a large part of that should be looking at encouraging distributed solar and storage, along with community charging.

It's also going to take a major social and popular culture shifts. I think in San Francisco, people are already embracing kind of the fact that you don't need to own a car with car share programs, with a great public transit system, with electric bikes on the corners. But, you know, I think the rest of the state has got a long way to go.

So I think that that should be another coordinated effort. So I think it's an

opportunity for the EV makers to work with, you know, work with the state agencies, but also other stakeholders, in putting together a fairly common message that can be shared to help drive people in the right direction.

The last point. So in my time at PG&E and I supported a lot of EPIC projects through the first two phases. And you know, my personal perspective is that, you know, it's really not the best model. It's better than nothing. You know, going back to their funding model, you know, they have no R&D budget. I came originally from the high-tech space where, you know, you have a 10, 12 percent R&D budget that you skim off the top and that goes, you know, back into a continual improvement. The utilities didn't have that.

So the EPIC program was a way to help them address that. But I think it could have been -- there could be better coordination of the objectives of that program, aligning them across not just the IOUs but also the EPIC projects that happened outside and really try and bring it back into more of, I would, you know, maybe use the term of, you know, kind of almost a sandbox

environment where some of these ideas could be shared.

So there's some interesting work going down -- going on down in L.A. that's quite related. So the City of L.A. has partnered with LACI, which is the L.A. Cleantech Incubator. And they just launched a Roadmap activity which I would recommend you folks take a look at, as well. It's called Zero Emissions 2028 Roadmap. And it's focused on actually accelerating some of the objectives under the California state targets to occur by 2028, which is when they're hosting the Olympics.

So there's some new models where, I think, we can borrow from the way things work in Silicon Valley, the way technology has evolved and iterated. And I think we need to embrace that in a more holistic way and, really, to support rapid, rapid development cycles. So within kind of the agile model of software development, they talk about fail fast. So you have an idea, a concept. You put it to test, and this typically happens with a one- to two-week cycle. If it doesn't work, you make adjustments or you throw it out and you continue. You know,

that's just not the mentality within the utility space.

But I think to address the problems we have in front of us, we have to take a different view on maybe how we do some research and development and how we fund it and, more importantly, how we coordinate it across parties.

And that's it.

(Applause.)

MR. HARLAND: All right. Great. Thanks Rick.

So I think before we open it up to the audience questions, I bet everybody would probably love a five-minute break. And so we'll make that a quick five-minute break. We'll come back. We'll do the questions with this panel. And then we'll go through a couple more small steps before we have a close. So thanks, everybody.

(Off the record at 2:59 p.m.)

(On the record at 3:10 p.m.)

MR. HARLAND: All right, everybody, we're going to get started. Doug's back, and Eric is making his way back, as well, to the panel.

So I wanted to make sure we provide

enough time for the audience to be able to ask questions of our panelists. And, unfortunately, we did lose -- we did lose Byron. So if there were any questions there, we're not going to be able to follow up.

UNIDENTIFIED MALE 1: (Off mike.) (Indiscernible.)

MR. HARLAND: Yeah, he may appreciate that. I did have a couple questions for Byron.

But I did want to ask you, Sam, the apps that you're developing, what is the, I guess, like the uptake -- well, we saw the uptake numbers, but how do folks find out about this app? Is this something that dealerships are using or places where vehicles are being sold or purchased? Or, I guess, kind of how are you getting it out there?

MR. SAXENA: You're asking a question that is subject to a few NDAs. So if I told you, I'd have to kill you and I don't want to do that. So I'll speak in vaguer terms than that.

So it's, I would call it, a multi-pronged approach. So our partners that are driving the commercial uptake of MyGreenCar have just very recently started their online marketing

campaigns, Facebook ads and otherwise, quantifying their costs of user acquisition. And they've actually recruited some really cool brains to bring to that operation. I think they were able to recruit the former marketing director of Senator Harry Reid's first election campaign to guide some of their efforts. So online marketing is one broadly-applicable strategy.

Partnerships is another strategy that is being pursued. And there's been, I mean, for example, the NRDC had a really cool blog post surveying many solutions in this space. And so partnerships and cross-promotions is another.

And finally, to the, you know, speaking of dealerships, automakers and others, I think that white labeling is a very open strategy that's being pursued. And so working with, let's say, the big guns in this space, the OEM automakers, the EV charging manufacturers and so on, is a path forward.

MR. BORDEN: (Off mike.) (Indiscernible)

MR. SAXENA: As in taking the MyGreenCar branding off of the app and putting the turn branding on it.

MR. BORDEN: (Off mike.) (Indiscernible)

MR. HARLAND: Okay. And, Rick, I was going to -- I wanted to ask you a question about the blockchain. The example you provided was for what sounded like behind-the-meter resources that are used to charge the vehicle. And I just wanted to just quickly understand if that sort of accounting and ledger can be used for, I guess, the system as a whole or system larger so that you can account for and track the color of the electrons, I guess?

MR. KUBIN: Yeah. So the proof of concept or the pilot that we're doing with Silicon Valley Power, we're actually tapping into their existing meters. So it's not behind the meter, it is the meter. And then -- so we're measuring the kilowatt hours that are being generated by the PV into the local grid. And then we're pulling from the ChargePoint chargers the charging session data for the amount of energy that's put into the vehicles.

MR. HARLAND: Okay. And I guess it relates a bit, I guess, Eric, to this follow-up question I had, but your point about the VGI, its

ability to bring benefits to all consumers from the adoption of EVs, I was hoping you could like unpack that a bit and kind of talk about what those -- that spectrum is of benefits, I guess?

MR. BORDEN: Well, I don't think it's as complicated as that may sound. It's just, I mean, there are two main financial benefits from EV adoption that effect ratepayers. One is getting more load on the system and spreading costs across that load. Some people refer to that as downward pressure on rates, so I didn't talk about that, but that's one good potential way for all ratepayers to benefit.

VGI is a little bit separate where your capturing values from the electric vehicles out there based on when they charge. So for example, I think the study that's been cited today and yesterday, you know, well, I'll say in the IRP at the CPUC, they've quantified some of this and they've said, well, if we shift EV load into times when solar would be -- would have to curtail, we don't have to buy as much solar and we don't have to buy as much storage; right? And so we get those, so that's another value that all consumers would benefit from. So those are the

financial benefits.

And then environmentally, everybody can benefit with cleaner air.

So I think those are the main -- the primary consumer benefits that I think about.

MR. HARLAND: Okay. That's helpful. Thanks for unpacking that.

And I wanted to turn it to the audience. So we do have roving microphones. And we're at about like 15 minutes or so before we wanted to start the -- before we wanted to end the panel and go to the next one, so hopefully we can keep it contained, but we'll see how it goes.

MR. TAYLOR: Hi. Dean Taylor, Southern California Edison. My question is primarily for Eric.

First off, thanks for noting that, you know, current grid planning is -- there's really on savings there because we design for worst case, you know, scenarios. So, in fact, SMUD did -- I think I mentioned this yesterday when I was on a panel -- SMUD did this study where that's the huge potential, is just buying lower-level charging equipment is where you can huge savings and, you know, literally five, ten times

more savings than you can get by soaking up this extra solar or shifting to, you know, nighttime charging.

That said, so everybody's talking about, well, how do you get more value out of the distribution, you know, system? And I guess the question is: How far do you want to go? Because there's -- just take residential rates; what people don't realize, it's for the entire system and there's very different costs to serve, let's say desert customers versus coastal customers. Transformers are big out in the desert yet, you know, the coast tends to have old 4-kV circuits that need a lot of upgrading. And there's varied difference in serving a small, little apartment complex for a senior citizen or a low-income person and a big, giant, you know, house. But that isn't reflected in our rates today.

I mean, so there's -- and even when you get over on the commercial side, there may be huge differences but we have 4,600 circuits, you know, so there may be, you know, you're going to punish those circuits that are right near the edge where they need an upgrade and charge them higher rates.

So how -- there's huge equity issues. I'm trying to extract, you know, this value out of, you know, this potential distribution system. So how far do we want to go in that, is my rhetoric question?

MR. BORDEN: Well, I think that's a little bit of a different framing. I think, first of all, we need to reflect that EV load is and can be flexible. Let's say that you, as a utility, have years of experience of customers on a ToU rate that are shifting their customers off peak and you're showing that you don't need to do distribution upgrades or them. At what point do you trust that they, if they're on a ToU rate that they're going to shift off peak; right?

So that's just valuing the flexibility that the EVs are showing, not necessarily sending some -- a perfect granular price signal, like I talked about with the VGI rate. And I think that's what you were kind of eluding to, which is sending a specific demand response-type price signal to every customer based on their circuit. That's one way to do it. I agree, I think I see that more in the commercial space as viable. I think maybe it could work for some residential

customers. But I think I was more thinking about the inherent flexibility that we already see from EVs, just incorporating that into distribution planning could get us a lot of the way there.

MR. WHALING: Yeah. Jeremy Whaling from Honda. A question for Eric, as well.

Along those same lines as what Dean said, but -- so you have -- you said, you know, you really like demand response because you get a lot of value out of a few hours out of the year. But I wonder with some of that is, you know, maybe the peak times are changing and everything like that, but in general, you know, with ToU rates and things, customers are already going to be not charging their car during that time, so how much value can be really be assessed if the cars are already not charging and you're -- essentially, then what are you -- are you going to pay them to continue to not do that? Or it seems like they already will do that, so --

MR. BORDEN: Well, that's great. I don't know that that's a fait accompli, that that will necessarily happen.

EV customers, I think this is a really interesting question because default ToU is

coming, so residential customers will be on a default ToU rate. You're assuming that because they're on that rate and have an EV that they'll follow that load signal. But all the data we have to date is about customers who opt in to a ToU rate. So that's a different mindset and it's, hopefully, a more mass group of customers that we're reaching with EVs and not just the energy nerds and the people that are really into time-of-use pricing and just people who, you know, want to drive a cool car. And so I think that's an open question.

Now to the extent that you're right, that everybody's just shifting off peak and there's, you know, nobody -- and there's no problems there, that's great. But I don't see that as a like 100 percent guarantee at this point.

MR. WHALING: But, I mean, if you can't get them to ToU, how are you going to get them on DR? Isn't DR like an even further step? Unless it's somehow mandatory or something.

MR. BORDEN: Well, so this is a place where I had on that slide where I showed the two tools. The main players, I think, for DR are the utilities and demand response aggregators. I

would actually love to see demand response aggregators. You see it a little bit in the residential space with companies like OhmConnect. eMotorWerks is doing -- they're not really a demand response aggregator but they make chargers -- they sell charging stations.

And so I think the main obstacle to that market at this point is that there's not enough EVs on the road. But to the extent we get a competitive market with a lot of demand response aggregators who are going around and saying, like OhmConnect, you know, hey, if you participate during these times, we'll pay you this money, yeah, I think those values are there.

MR. WHALING: I mean, I just further want to highlight, though, it's like, you know, I had OhmConnect and you get a lot of hours and stuff in p.m. But, you know, half the time, I wasn't actually home. So you end up having a case of, you know, does the -- if the EV isn't home and you had a DR event, did it respond? So you kind of have some of these cases where it's like --

MR. BORDEN: No.

MR. WHALING: -- you know, it's like if the tree falls in the woods, you know, and

there's nobody around --

MR. BORDEN: Right.

MR. WHALING: -- does it make a sound?

MR. BORDEN: Well, so -- but, you know, and I'm not saying that one business model over the other. My only point was that demand response is a really good tool to get to the values that we're talking about. I think that's what I was saying.

MR. WHALING: Okay.

MR. BORDEN: I wasn't necessarily saying that all EV customers are going to be super interested in demand response. I think that's something that we need to work on.

MR. WHALING: Okay. Thank you.

MS. MCDOUGALL: Hi. Pam McDougall from NRDC. I'd first like to thank all of you for being here and for representing the customer, who is often lost in the VGI discussion. So I'm really happy that you're here to represent them.

I just want to think a little bit farther in the future and like kind of dream big, because we are here at like a Roadmap discussion. Let's imagine that we have the millions of EVs on the road and our buses are electrified and our public

transport is all electrified. How -- what policies do we need to put in place or do you suggest that we put in place so that we see that the value of VGI actually makes it down to the customer? I'm not talking about just the EV driver, but also somebody like myself who isn't a car owner but a public transit user? Like how can we make sure that these buses that are doing VGI, the value makes it down to that person that is using that service?

MR. SAXENA: So you're in the dream-big space, which is also a space that one can be dangerous in. And I'd actually like to respond with I think that the low-carbon fuel standard is a really good starting point in that direction. Getting the value all the way down to the end customer, I think, is still a tricky thing.

To give an anecdote that I heard about at the fleet expo, the ACT Expo. I think this was actually from an L.A. County speaker. There is like, apparently, opportunities for fleets to like just directly put in for getting rebates through the low-carbon fuel standard, but like the vast majority don't even know about it. It's like this untapped opportunity.

And so I think that things like the LCFS are a great starting point. But the accessibility of the LCSF -- LCFS is, I think, still at the high level that needs to be addressed. So that's my first-cut answer.

MR. BORDEN: I mean, one of the biggest values that is going to accrue to individual EV drivers is savings on gasoline. So how do we get that? Well, first of all, it depends on what the gasoline price is in your future. But we're going to get to the lowest electricity prices if, one, we keep utility costs in check and, two, we get sub-metering to let people charge at low price off peak. So that value with come to the EV driver. How big it is depends on gasoline price and electricity price.

Let me think about the second part of your question.

MR. DE LA CRUZ: Yeah. I'll just add that I'm typically involved in a lot of discussions around how do we electrify certain industries or certain sectors that are pretty resistant to it, not necessarily because of environmental or ideological concerns but because of price points and economics. And in

California, we pay higher energy costs than some other Pacific states, notably the Washington/Pacific Northwest.

And you know, I'll also share an anecdote from a recent conference. L.A. Metro was the host of the U.S. Zero-Emission Bus Conference. It included many transit operators from across the country either looking to electrify or doing projects. And they were sharing anecdotes about challenges they were seeing on the ground. It was a really interesting portrait of where we are in America in terms of electricity prices. There was an audible gasp in the room when the fleet manager from Washington talked about how little they pay for electricity. And of course, that is part of the advent of hydroelectric, cheap electricity in the Pacific Northwest.

But I bring that up because I think at the end of the day, our electricity market is also driven by policy in that we can choose as a state and as the fifth largest economy to subsidize certain electricity prices. And we already do that, either for residential or industrial users. And so how can we think of whether it's a VGI application or really getting

the benefits of electrification down to the end user. I think we need to think holistically about energy costs and electricity prices. Because if many of these industries are saying that, well, we would love to electrify if it's just wasn't for the cost of electricity. And, you know, right now the fuel is at parity with our electricity, so why should I electrify and spend all these millions of dollars infrastructure? If we can start sending the price signal from that very basic point, I think we can see a pretty staggered effect.

I'd also add that I think in that future where everything is electrified and we have 30 million EV passenger vehicles on the road, we still need to see really robust coordination from all players, from the local utilities to the regional -- the regional actors, the aggregators, as well as to the consumer, software interfaces. It really should be a seamless end-to-end. And the same way that we've come to expect that no matter what city in California you go to you could open up your app and if it's serviced in that territory, you can either require -- request a Lyft, an Uber, maybe even an electric scooter.

And that type of interoperability across the region and across the state, we need to begin seeing that on electric vehicle, and the VGI side, as well.

MR. KUBIN: Just another aspect of that is from an economic perspective, if we're looking that far in the future, we're not actually buying exported fuel or imported fuel. So we're not sending dollars out of the state to the same extent that we would have been if we're importing fuel from the, you know, Middle East or wherever. So there's dollars that potentially stay within the state. There may be some reduction in tax dollars from sale of fuel. But I think that's more than made up for by the fact that there's going to be jobs created around the whole industry of electrification and, I think, support around that that everybody will benefit from.

MR. BLACK: Yeah. I think that -- I don't know if you're ever going to -- well, I shouldn't say ever going to see, but it's hard to see that there's going to be an individual benefit, like you, as an electric transit user, to see an economic benefit, like a reduction in your -- you know, how much it costs you to ride

the bus. But it's going to enable VGI. It's going to enable, you know, maybe bring down costs for those buses, enable greater storage that enables greater clean power, you know, the larger societal benefits. You'll breathe cleaner air when you're out on your trail runs.

MR. SAXENA: I remember seeing this presentation a while ago from Lyft's director of sustainability on how one of the directions they're pursuing in the long run is integrated billing across many things. So, for instance, I take a shared bicycle from my home to the Metro, jump on a train, you know, get to the other side, and then take a shared ride to my -- you know, wherever I'm going. And that whole process not involve bus tickets and multiple apps and multiple platforms and the change in my pocket just like all be integrated into one app, and Lyft happened to be talking about integrating that as a long-term direction into their platform.

And I think, ironically, the like -- pardon my French, but all the shit we have to deal with to make VGI actually happen, like all of the billing integrations, all of the counting

of electrons going this way and that way, you know, happens to be the similar type of stuff that has to be dealt with for like these integrated billing problems that you, on a daily basis, will be like, oh, thank God I don't have to carry change in my pocket anymore. You know, I think that those types of like delightful customer experiences could fall out really effectively.

MR. CRISOSTOMO: So I have a question, maybe connecting Doug's demand response solution with what Rick and Eric were talking about in terms of leveraging sub-metering to maximize flexibility and use it in a more seamless fashion for accounting. So maybe, if you could, bear with me and kind of brainstorm.

To that point from Pam, how solutions could look in the future to allow for like maximization of savings versus gasoline, because it seems like we're kind of touching upon the need for better solutions than what was available at ALCO (phonetic), better solutions for utilities when it comes to their billing systems. And it's hindering some of the benefits to society at large, ratepayers, and greenhouse gas

emissions.

Do you guys have an idea of how what you heard today could work better together to the point of coordination?

And maybe a final point directed at Eric. Would you be, as a ratepayer advocate, willing to consider what I was describing as 21st-century billing systems for the utilities so that they could do that better integration of sub-metered loads, connecting APIs across back ends of EVSPs and aggregators much more simply? Would you be willing to be okay with that as an advocate?

MR. BORDEN: As with all my work, it comes down to what are the costs and what are the benefits? If a utility, again, if a utility comes and says it's going to cost a billion, two billion, whatever, and I mean, when you add up all the costs, as we all know, with a utility, like it's not always what it looks like, if those erase all the benefits, why would I support that as a ratepayer advocate; right?

So it depends. Like, I mean, it's crazy, like literally for a lot of companies $1 million would be a lot of money; right? So if a utility came and said we could do this for $1 million, it

probably wouldn't be a big deal.

So you know, I hope that maybe the CEC should take on some kind of bridge role here. But I do think that we need to investigate, well, what are those costs and are they manageable enough that it actually makes sense? Is that fair?

MR. CRISOSTOMO: (Off mike.) (Indiscernible?)

MR. KUBIN: Yeah. So blockchain technology could support the measuring and transacting of, again, what I would call micro transactions that support that value. And it could be, you know, micro transactions to, you know, if you were doing peer-to-peer energy trading, you know, micro transaction back to the DSO or the utility for use of their infrastructure. So there's different ways of defining and rewarding that value. And you know, blockchain has the capability of doing that in a way that is pretty low cost compared to a traditional billing system.

But the question comes back to how do you integrate that into what's already there? And you know, a comment was made earlier about, you

know, PG&E's billing system, and I'm pretty familiar with that. And, yeah, if you want to bring up a new program that impacts the billing, it's generally shut down, you know, without a question because it's just a non-starter.

I think there's other utilities that are maybe in a better place. But, you know, it's a massive undertaking to replace that. And you know, in the current funding model, you know, they would have to apply for that as part of the general rate case and it would be, you know, definitely not $1 million. It would far, far north of that.

So I don't know. Under the current model, I think it's difficult. I think there's possibilities of how you might return that value to the customer without having to do it through their bill. And again, that could be done through some kind of a tokenization that would be returned to them that they could exchange for something else.

But, yeah, the incumbent utilities, the IOUs, are all pretty tied into their current infrastructure which was, you know, not designed to support all these new programs.

MR. BLACK: So the technologies are definitely there. The blockchain can track and tokenize.

I think one of the key things that we really all need to address, though, or figure out is what values are you going to assign to it all? That's still a whole huge open question, what really the value is, and what is the value to the distribution system? There isn't a clear. You know, in the wholesale, there are market and market prices we can look at and things that give us some indication. There's still some open things there, too. But especially at the distribution level, we don't really know what the values are and that's, I think, something we've really got to start addressing.

MR. KUBIN: Good point

UNIDENTIFIED MALE 1: Hi. This is Karim Farhat from PG&E.

So just to address one comment that was made specifically about the PG&E billing system, quoting it, it was I, from my experience, I did not see a single program that got automatically shut down. I think that's a little bit severe and harsh language. All the programs at PG&E get

evaluated very objectively based on their benefits and their costs to our customers. So I just wanted to clarify that.

The second point, sorry, the second point is also related to the billing. And I'm just going to make this a very broad comment, which is that while I fully appreciate the fact that we need to enhance the customer experience, I think we might be convoluting two points, which is the fact that we need to make the billing easier and the fact that the billing or the assumption or the assertion that the billing has to happen through the utility. These might be two different points. Like I think everyone would agree that you would want to have a smoother billing experience. Then there's the question about who is going to be handling that billing experience? I think that's still an open question.

MR. KUBIN: I'd just like to apologize if my statement was a little too, too broad on PG&E. And I know they've done some great work on some of the DR programs and some of the other things that they have now. So I apologize (indiscernible).

MR. BORDEN: I just had one comment before I -- I think, also, so it's -- I'm not a billing system expert so I can't speak to everything that they're dealing with on the back end. But I do think that there's probably an opportunity to move incrementally; right? So let's get 100 EVs. Let's go to 200. And then maybe those solutions become more scalable, versus right now we're just stopping at essentially zero and saying, well, it's too hard. And so maybe this is an area where we can scale up over time. But, you know, again, I'm not sure.

MR. TAYLOR: Hi. This is Dean Taylor, Southern California Edison.

So there are some utilities that are doing these alternative approaches. So Los Angeles Department of Water and Power and ComEd give you like using like ChargePoint or other people's billing or metering, they're giving you a rebate for, at the end of the year, for how much you're using off peak. So that's an example where you could use things, somebody else's metering.

The other one is the low-carbon fuel standard starting in January will have these

incremental credits. They're, frankly, kind of geared towards automakers, using telematics because they have to go over VIN numbers. But that's another way of using, you know, time-of-use, getting incremental things based on carbon reductions going cleaner than. You know, the grid gives you 80 percent last, but you can get even more reductions in carbon by charging at different times. So that's another way. And that does not require utility-grade, you know, metering. And in the future, depending on what CAISO does as far as things, there may be opportunities there for aggregators also to not have utility-grade metering.

The original purpose why we have, you know, high costs for separately metered was because we used to, in the '90s, have these dual-meter adapters which were rather cheap. But the problem was that none of them were never UL certified, so we ripped out like 1,000 of them at one point and required putting in two separate panels. That's why that's so very, you know, expensive. And, yes, we do some, you know, sub-metering as part of the pilot but it's all manual, so the issue is how much does it cost to

go to an automated system? I mean, at some point, yes, that may be, you know, feasible. But maybe some of these other options are also, you know, worth, you know, looking at.

So this whole issue of what do the different agencies require as far as meter accuracy is maybe a key, you know, a key part of the question here, too. We talked about that briefly yesterday.

MR. KUBIN: Yeah. I think just on that, I think the LCSF [sic] program could be leveraged as a new way to bring some of that value back to the various customers and without necessarily impacting the billing system of utilities.

MR. HARLAND: Okay. Do we have WebEx? Anybody on WebEx who wants to ask a question or participate?

Anybody else in the room ask a question of the panel or pose a suggestion?

Panel members? Great. One question. Last question.

MR. COLDWELL: Sorry, Eli, I know you're -- we're over, but --

MR. HARLAND: We're good.

MR. COLDWELL: We're good? Okay. So

Matt Coldwell with the Energy Commission. I just -- I don't really have a question, it's more of a comment.

And you know, since the panel is on customer experience, unfortunately, the first sort of touchpoint when somebody goes to purchase -- when a customer goes to purchase a car is with a car dealer; right? And so I don't want them to get lost in this discussion; right?

And so just as a quick anecdote, I went to test drive a Bolt recently. And I had made an appointment. It was first thing in the morning so they knew I was coming. I was the only customer there. They had about five Bolts on the lot. There of them weren't charged. One of them had like a 12-mile charge. And fortunately, one of them had enough to where I could actually test drive.

And so after test driving, I get in -- went inside and start talking numbers, and not once did incentives come up at all. They were -- they had no clue about the state or the federal incentives.

And so my point is that with VGI, and I know that dealers aren't really necessarily part

of the VGI discussion, but at some point somebody has to communicate the value to VGI to customers. And so I don't know where that happens and how you sort of package that up to deliver to the dealers.

And, Sam, I don't know if you touched on this earlier before I got here, but at some point they do need to be wrapped into the discussion, once we sort of have -- maybe a little further down the road. And so I just didn't want them -- because I haven't seen a lot of the discussion on that.

I know, Eli, you asked a question about it earlier. But I just wanted to make sure that that was brought up and it's sort of part of the discussion.

MR. SAXENA: So I think you're spot on that the sales process around EVs can be a painful one. There's good news and bad news here. I mean, the, for better or for worse, the good news is that a lot of people are very skeptical and scared to set foot in a dealership. And so consumers at large spend like a ridiculous amount of time, like the average is over 20 hours in online research prior to even setting foot in

a dealership because they want to go in informed because there's this sort of like, whether or not it's a founded perception, this perception that, oh, if I go to a dealership, they're going to try to rip me off, you know, whether or not that's true.

So I think that dealers have been very skilled at selling cars. And the tricky thing is that with the EV market of today, there's a whole education process that's required about EVs prior to them even being able to sell a car. And, unfortunately, what that creates is for dealers a bit of a pain in the butt. I mean, if someone wants to buy an EV that sets foot in their dealership, they have to play almost like a game of 20 Questions to sort of get past all of these questions on incentives, on viability, on costs, on rate structures, on, you know, so on. Whereas, their specialty is, hey, you know, these are nice leather seats. Hey, look at how smooth this is to drive. Hey -- you know?

So I think that educating the car buyer on the broader benefits and issues around VGI and EVs in general prior to them getting -- setting foot in the dealership will be the pathway to

having dealers be a real force for selling EVs, getting them past that game of 20 Questions so that they can focus on what they're good on.

MR. HARLAND: All right. Well, that wraps up this panel. So if everybody can give everybody here a hand, that would be great.

(Applause.)

MR. HARLAND: So we built in time on the agenda for public comments, as well as what we called topics that required additional discussion time. So we had the panels leading up to this. I know yesterday, we definitely ran out of a little bit of time on those. And then we had an active conversation towards the end of the Technology Panel this morning. So we did build in extra time for expanding those conversations or continuing those conversations.

So the first thing I want to do is just open it up for public comment. Obviously, we've had a lot of interaction and a lot of audience engagement. So there might not be as much public comment as you're used to when you go to a workshop.

But at this point, we are going to open it up for public comment. So we still have the

microphones that are roaming in the room. So if there's general comments that you'd still like to make or questions to ask, please do that. We're also going to go to the WebEx. And then following that, we're going to have each of the agency partners on the Roadmap Update come up and provide some closing thoughts. And then we'll finish the workshop with some next steps within the Roadmap process. And we'll also, you know, entertain questions to those, too.

So first up is, I guess, the official public comment period. So please raise your hand if you'd like to make a general public comment.

MR. TAYLOR: Hi. Dean Taylor, Southern California Edison.

I think I'd like to refer people to look at the VGI Working Group results, which are posted, that the five agencies looked at. I mean, there's an incredible wealth of information there and they dealt with extremely difficult issues. I think there was at least 10, you know, meetings, it felt like 100 phone calls or more, 100 stakeholders. And we really didn't even really get just to task one. There is a draft report that's published. I understand the final

report will be out. But they looked at more from a technology perspective, what are some of the options here for communicating from the EV all the way to the grid.

And, you know, on a fundamental level there's kind of two options.

One is to -- is a one-step process, just going directly from the car all the way to the grid or the grid aggregator.

And the other is a two-step process, or potentially even a three step where you have to go through the charging station and have to de-encrypt, translate, re-encrypt into a different communication protocol to go the whole way. And in there you'll see the analysis, I think, of five, six, seven, eight different options, you know, against a very rigorous set of criteria.

And so there's been a lot of talk about these. I know 15118 got talked a lot about, but it's worth looking at how that one scored compared to some of the others.

So it isn't the only option out there. There are some other very, very, you know, viable option which, frankly, scored in that, you know, multi-agency process. So I think it's important

to, you know, to look at the results, you know, of that since it was so painstaking and not try to reinvent the wheel and come up with new, you know, information. Because I think that is the -- you know, that's where we're at.

And that's why I think that this coalition that I mentioned yesterday of automakers and utilities have been asking to do more, to start validating in real world what is the experience there, cyber security, functionality, customer experience, you know, and to really start -- and also, of course, net value. What is the costs and benefits? Because at the end of the day all this has to have something on the car and the automakers have to make a business decision whether they put on their car. So I know that plenty of automakers are seriously looking at just bypassing the charging station and going straight and becoming grid aggregators themselves, at least in many, many use cases.

So be careful in jumping to saying that there is an answer at this point because there's -- I think that you are -- you'll see a lot of comment letters on this that there's a lot

more work to be done to get to that point, including also the VGI Working Group never got to task two and three, which is on value proposition or net value and, you know, policy alternatives which might be a less expensive way of going.

So the technology question is really, really challenging and don't oversimplify it.

MR. HUMMLE: Good afternoon. I'm Holmes Hummel with Clean Energy Works. And I did have the opportunity to pose a question to the Economics Panel yesterday. The response that we heard then made me feel, in retrospect, that I hadn't been clear. So I have prepared a little bit better for making a contribution this afternoon.

Clean Energy Works focuses on accelerating investment in grid-edge technologies with innovations in financing that can help accelerate the deployment of EVs that ultimately realize the value that we think is there when it's -- onboard storage is integrated with the grid. We're excited about the Roadmap because it will provide navigational aid to decision makers who even outside of California.

There are some things that are happening

here at an unprecedented scale and I mentioned one yesterday afternoon, and that is that between the CEC, with some supplemental funds from CARB, we can expect to see Californians spend $100 million to buy electric school buses in the next couple quarters. Almost all of the value of those buses will likely be paid by public dollars.

To put that in perspective, that's on par with the combination of all VTP program solicitations in one year combined for one vehicle type with one owner type. And the long dwell time of these large batteries creates a ready-made platform for showcasing the value of grid-connected onboard storage across many of the different avenues of exploration that we've heard about, the technology, communications' protocols, the value proposition, the business models.

So the first of two quick comments, I hope, is that the Roadmap should not miss this remarkable opportunity to explore the many questions in the priority areas for innovation surfaced in the workshop.

The second of the two comments is the pace of deployment of EV technology affects the

pace at which we can realize the value of that technology when it's integrated, and the pace of deployment of heavy-duty EV vehicles in California is currently critically constrained by the availability of grant funding which doesn't underscore the need for more grants, it underscores the need for more innovation in financing and business models as part of the Roadmap.

The EV school buses, which will ultimately be funded almost entirely by the state, are not money-losing value propositions. After all that money is gone we will have addressed about 1 percent of the market, and we have 99 percent to go. There's good reason to be curious about innovations in financing and business models borrowed from energy efficiency in buildings and appliances that we've seen in India and other parts of the United States, even some that have been endorsed by the Commissioners themselves in their landmark Barrier Study completed just 18 months ago.

Clean Energy Works has explored one option that includes site-specific investment and cost recovery by utilities for the onboard

battery and the charger that connects it to the grid and makes it smart using capabilities that the CPUC has already mandated that each of the IOUs develop in service of their on-bill financing platforms. While the IOUs were restive and resistant at first, PG&E filed a notice with the CPUC last month that called it's on-bill capability, quote, "foundational," end quote, to its business strategy for achieving the states goals for energy efficiency in existing buildings. Why not in the VGI Roadmap think about what the implications would be if we unleashed that on a marketplace that is currently completely dependent on the state for commercialization?

We see there is good reason to believe that consumers of every socioeconomic background benefit when our largest public investments and shared mobility are moved from diesel to electricity. And the pace of that transition does not need to be constrained by the pace of state pending, lest we actually take advantage of the VGI Roadmap to open up creativity across the sectors and across the topics of economics, technology and consumer value proposition.

I hope that those two comments will help inform and possibly expand the scope of certain portions of the Roadmap so that by the time it's updated again in five or so years, we will have been able to see some real distance traveled.

Thank you.

MR. HARDY: Hi. My name is Ryan Hardy from Honda.

We didn't talk enough in this meeting, I think, about markets and potential for rate and tariff design. From my perspective the single biggest barrier, and we showed off kind of a little Roadmap cartoon yesterday about, you know, how we get to a world of V1G controlled charging, and how we get to a world of V2G by directional control charging, and then how we get all the values that come out of that.

But the very first step on that Roadmap is really about the markets and, you know, how do you break apart the value streams and then allocate those value streams to the actors that provide them in a way that's sufficient for that actor to do that job of providing that service?

So, for example, we, the automaker, to do -- just to do VIG, some form of controlled

charging, if we're doing it through telematics, we have to recruit a customer. We have to engage them. We have to develop an app. We have to operate the server. We have to operate -- you know, integrate with an aggregator or with the utility in order to do that. All of those things have costs. But the value that we get from VIG as the automaker is actually remarkably small. If we, you know, push the customer from peak time charging into time-of-use the customer saves money, that's great. We've increased the value of our product. If we can educate enough people about that, maybe they're willing to pay more for electric cars in the future and that could be, you know, expressed as recovery of that value. Today it's not really, really true that way.

The same thing for each, you know, chain along there, that the -- you know, if we want to get to a world of V2G, we have to put hardware onboard the car. The, you know, the aggregator in the system, everybody in that chain needs to get paid. And we saw from the Lawrence Berkeley Labs like the single biggest, you know, pool of value is money society won't spend. Well, how do we -- how do you monetize money that nobody's

going to spend. If you do something good, how do you monetize that?

I think that some of those things could be done through, you know, very smart tariff design. You get the tariffs right now and, you know, even through pilots and tests and lots of papers with PUC and whatnot, but a combination of tariff design and market design with the ISO and the utilities, I think we've got a really good chance of getting this right. You know, and it's up to us as the automakers to get the costs of doing these services as low as we possibly can. And we need a competitive market for, you know, energy aggregators and whatnot so that they can compete and get their costs as low as they possibly can and, finally, everyone can benefit from these.

But if we don't have those markets in the first place with some means of recovering those values, then we kind of have no hope. And maybe the time-of-use rate is as good as we can do, and then we have to just educate the customer to, you know, charge after their peak time.

So that first thing is just we have you make sure that for every actor in the system,

that the value that their customer gets exceeds the price that their customer will pay, which exceeds the cost of providing that service, that good or service to them. Otherwise, that -- we're out of business.

And then the second thing, we've talked about VGI a lot, but we haven't really defined enough about what it needs to do. And when we talk about the technologies we need to apply, whether they're, you know, V2G hardware onboard the car, whether it's communication through telematics, whether it's a communication standard between and EVSE and the car, we have to be, I think, a little bit more clear about what we need that -- what we -- what we're trying to achieve. And then we can talk about the tools in the toolbox that we need to do that job.

And today, I think we heard an awful lot about ISO 15118. There's a lot of standards. Dean very eloquently said that, you know, the VGI Working Group looked at a lot of different standards. There's lots of different ways to achieve the goals that we want to achieve. And then I think together, through rate and tariff design, we need to look at how to do that in the

most cost effective and best way for our customer and for society.

And that's all.

MR. SCHORSKE: Hi. Richard Schorske, EV Alliance. This is a question and a comment. And the question has to do with next steps in the VGI Roadmap process, really from a project development perspective.

I know many people in this room were around for the last generation of this that, I believe, CAISO hosted. And you know, we don't have a lot of projects to show. We have some CEC-funded projects but not a lot of market-driven projects. And I think that's a concern for the project going forward.

And I just wanted to suggest some outcome goals that might be more outcome oriented than process oriented, more project oriented than standards oriented that would reflect, you know, Holmes has a great example with his school buses. I think everybody's in agreement that the VGI e-bus use case on schools is perhaps the paramount opportunity right in front of us. But you know, Honda is doing some great work. Nissan is doing great work in the U.K. on VGI with new V.

There's so many other examples out there. There's some heavy-duty deployments in the ports. That might not be a great use case but it hasn't been fully explored. There's a lot of battery capacity there. And there's e-bus VGI use cases. And we're leading one in AVTA territory. There's another one in VTA, and so on.

So what I would love to see is some actual metrics for VGI enablement in a variety of contexts, maybe one per major customer or vehicle segment, that has some real numbers to it and that has some commercial partners with skin in the game, not just grant funded, not-not grant funded, perhaps, but something where we have some thousands of vehicles two or three years from now that are involved in commercial-scale VGI deployments, including V2G, as well as VGI. And there's so many ways that can happen. Utilities, you know, have gone through their first round of pilots with some, you know, clarification of processes, and thinking the Excess Supply Pilot and all the great things in San Diego and other places.

So I just want to make sure that there's a process in place where we can propose those

projects and get them baked into the Roadmap process so we're not exclusively working in the policy and planning domain but actually in the project development domain.

And I just wanted to ask Noel or whoever else would like to field the question about sort of what's next in this, in the Roadmap process, and can we actually build in some project and deployment work?

MR. HARLAND: I will be -- before we leave I'll go through the next steps for the Roadmap process, so I'll kind of walk through what to expect next.

As far as building in those use cases, within our framework we have right now we haven't excluded any ideas or decided -- or finished exactly -- or finished scoping out exactly what each of the actions may look like. But the final format as, and I'll describe this again, is to have a matrix or a list of actions. And the descriptions in those actions, that's what we're working on between now and the draft Roadmap that we put out. And then those actions will include an assignment to an entity or entities, so it could be the market, it could be a utility, it

could be agencies, and a priority level, as well as any possible sequencing.

So if there's a particular way to draft that action so that it recognizes and includes the type of analysis or the due date for the information you might get out of analyzing a use case or use cases, as you're describing there, I don't think that there wouldn't be a place where that wouldn't belong in the Roadmap Update. But -- so the format that we're following at this point is to have that list of actions that are prioritized so.

UNIDENTIFIED MALE 2: So I have three comments and I'll try to be brief. The first one is I just want to reemphasize what several members have talked about, which is the inclusiveness of the Roadmap. So in our comments, we emphasize that we'd really like the Roadmap to be inclusive of all of the dimensions of VGI. So when you're talking about sectors, that's residential and commercial. When we're talking about type, that's V1G and V2G. And then the list goes on, without going into further details on it.

But with that said and to the extent

possible, and I appreciate the difficulty in that, is trying to balance that with keeping the Roadmap focused on VGI and not try to boil the ocean with all of the issues that have -- that are related with electrified transportation, because then you can easily get lost. So there's a balance between being inclusive of all of the VGI issues but not also inclusive of all of the electrified transportation issues because that's just a different animal.

The second point that I want to -- is really a question. And I was hoping that maybe in the next panel we can get a little bit more clarity around the involvement of the different agencies. So at least in mind, and this is a question, I'm wondering, are the different agencies participating in the development of the draft documents that are being sent by the CEC or are they just providing comments? Are they incorporating the comments that are being received from the public into the draft documents? How exactly is this process working.

And then lastly, this is also a hope and a light request, which is once you, Eli, talk about the next steps, I really hope there will be

like, you know, some time for public feedback about what people think about those next steps and if there's anything that we can improve in that.

MR. KARLEN: Good afternoon everyone. Erick Karlen with Greenlots. It's been a great discussion today. I just wanted to highlight two themes that I think are important for us to think about moving forward.

MR. HARLAND: Eric, put the mike up. Yeah. There you go.

MR. KARLEN: Yeah. A little additional emphasis.

First, we should be thinking broadly about VGI. And this is not just with respect to future V1G functionality down the road, also what is possible with current technology, smart charging in particular, managed charging functionality. You know, for example, it's not too inconceivable not too far down the road to imagine a place where smart charging and managed charging is not just supporting rate design and what rate design accomplishes and provides to the system, but it's also going beyond rate design, and perhaps even obviating the need for rate

design in certain contexts or for certain EV load.

Secondly, I just also want to focus that while we should be thinking broadly, we also need to think about keep ourselves grounded and think about near-term deliverables that this group should be providing, specifically with respect to standards. It was a big topic on the first panel today and I think we should not leave -- lose focus of that. The market is coalescing around a variety of standards for -- that concern EVSE, and specifically between the EV and the EVSE. But not just that, but also upstream communication standards, OCPV (phonetic) and open EDR (phonetic), in particular. And it would be a pretty big miss for this group if we let the perfect be the enemy of the good and let that be a reason for not taking action, realizing that standards are an iterative, evolving process.

So, yeah, I just want to leave it that. Thank you.

MR. TAYLOR: Hi. Dean Taylor, Southern California Edison again. I wanted to, you know, emphasize something.

When I was thinking about the school bus

it made me thinks there's, I think, a lot of policymakers may think there's kind of like a one-size-fits-all solution. And you know, unfortunately, we're not centralized to charge at, you know, stations, like gasoline. And the markets are -- the solutions are all very different for the different markets, you know, be it home solutions for homes could be radically different than solutions for fleets or public or workplaces, or even MUDs. So we have to look at the different, you know, markets, or even different solutions for plug-in hybrids at home versus battery EVs. So you know, even within fleets, you know, the school buses could be a prime example of a very -- you know, the best thing within the fleets.

So it's just important to have that be conveyed as we're going through so when we're, you know, talking about any of these things, be it the cost benefit analysis or which communication protocol, the answer may not be the same for the different markets. You know, and I think it's really important to have that, you know, come through at a top level because I think policy makers kind of like one-size-fits-all

solutions and that's not going to happen in this case.

MS. WALL: Hey, it's Francesca Wall with Tesla. I just wanted to make one quick point, since Tesla not only does electric vehicles, charging and solar and storage, I think we've heard a lot of about use cases and customer experience, which I think has been really good discussions.

And one thing that people alluded to but that wasn't touched on as much in a particular use case segment is really just to remember, too, the impact on customers who are making investments on solar and storage onsite, as well, and how that may change their kind of VGI value strategy. And so when looking at the Roadmap, kind of taking that into consideration, too. And then not over-complicating some of the concepts out there today. So there was a lot of discussion around DR programs which could be relatively technology agnostic and have participation across a broad spectrum.

MR. HARLAND: All right. That looks like all the public comment in the room.

I'm looking at Hilary to see if we have

anybody on WebEx that would like -- Steve Davis? Okay.

MR. DAVIS: Hello. Can you hear me?

MR. HARLAND: No. There's two un-mute buttons.

MR. DAVIS: Okay. Can you hear me now?

MR. HARLAND: We can.

MR. DAVIS: Okay. I just want to -- I've got a bad echo again but I'll make my way through this.

I just want to comment briefly on the -- some of the points being made about the various choices of standards. We're really at a moment. And I think if you closed your eyes and you imagined it was December of 2016, you'd have a hard time, you know, noticing any difference from what we were saying then to what we're saying now about standards, which is to say that we've had a stalemate on this topic since 2012, I think it is. And we have got to make a decision and begin to put our money where our mouth is with regard to VGI. As much as it may sound, you know, not in the spirit of the kinds of things people like to say at the CEC, at some point you've got to make a decision.

And if we're guilty of anything in this, you know, while we're seeing the frightening effects of climate change and new reports coming out from the IPCC emphasizing our need to act in unprecedented ways at unprecedented speed, the idea that we still have not picked a communication standard for vehicle grid integration flies in the face of everything we know.

And I think that the automakers that have shown up and put their comments, along with CHAR (phonetic) in and others, that Oleg and Obrie or Hubject put forward should tell us that, you know, we were -- in 2014, we were kind of asking California to tell the automakers, hey, there's a market signal, here's what you can build. We hear you and now we're going to do this.

Now we're in the opposite position and the automakers have moved on because of European clarity about this issue, and other places around the world that have clarity about this issue, and they're telling us now what they plan to do. And not just European automakers; Hyundai, Kia and others have also indicated their plans.

So if we talk about the number of

stations needed to be in the ground and ready to, as Byron Washom was talking about, you know, be the -- take the Field of Dreams approach and helping people make the decision by building the stations and giving them confidence in the product, we have to do that now.

I'll put -- let me dramatize that. If we were to get 250,000 Level 2 stations into the ground by 2025 and we were to subtract out the 10,000 we have right now, starting today, we'd have to install over, 3,300 stations every month from now until 2025.

So we're still installing stations every single day in this state and throughout the United States, but we have no clarity about what it is we're going to install, so we basically just install stations that do not support, basically, standard space communications for VGI. Now that means we're going to be living with telematics. And a lot of automakers may want to do that, you know, on into the future. But those that want to implement the standard can't because there's no matching investment from us.

And so, you know, once again, in December of 2016, we all got together. We had the typical

stalemate discussion and we said we're going to solve this with a vehicle -- a VGI Working Group. And at the end of 2017, we met in December and nothing was accomplished. We agreed to disagree. And so the VGI Working Group report basically failed to move us off this stalemate.

So now we're at a point where we're saying, okay, let's talk about VGI once again. We have got to decide on a communication's standard, full stop. And that may sound like, okay, there are people in the room, I'm sure, that hate hearing that, they hate me here, hate hearing me say it for the millionth time but that's the truth. And we're talking about, you know, trying to move forward on vehicle grid integration and address climate change and tease forward this revolution-scale adoption of electric vehicles. The only way you do that is to defragment something that's very fragmented. And so that's my point on that.

I'll make one other. Much of the discussion also has been on the low adoption rate of ToU tariffs. If you look at some of the utilities the super-off-peak rate is 23 cents during the winter months. The peak rate is 25

cents and the off-peak rate is 24 cents. So when you have rate structures like that, that basically never really -- it's kind of a heads-we-win-tails-you-lose tariff for the customer, it's very difficult for the customer to see how signing up for a ToU rate or doing anything necessary to set a timer or interact with delayed charging, that's never going to happen unless there's a real price signal. So the price signal for the super off peak or the times when you really want somebody to change, there has to be a bigger delta in the price.

And with that, I'll close.

MR. HARLAND: Looking over at WebEx, Hilary, do we have anybody else raising their hands?

UNIDENTIFIED FEMALE: (Off mike.) (Indiscernible.)

MR. HARLAND: I do. It's always a big challenge. You don't know what you're going to get.

UNIDENTIFIED FEMALE: I know.

MR. HARLAND: But, okay, so we are about to un-mute the call-in users who are on WebEx. For those who aren't going to make a comment, if

you just mute your phone after we un-mute the lines, that will be helpful. We're not going to leave them open for long. But if you do have a comment, your phone lines are un-muted. Okay. Great. That -- it never sounds like that when you un-mute the lines, so that was fantastic.

So thank you everybody for your public comments. I'm going to transition now to closing remarks from the folks that are partnered on working on the Roadmap with us, so I'll let them introduce themselves and provide those remarks. And as I mentioned, the last thing I'll do is I'll go through next steps after those closing remarks, and then we'll -- it looks like we'll probably wrap a little bit early today.

R. KLAUER: There we go. Good afternoon. I'm Peter Klauer. I work for the California ISO. I'm a Senior Adviser in this market technology space.

The California ISO operates and maintains reliability of the bulk electric system for about 80 percent of California. We have a vested interest, though, in understanding how distributed energy resources can help us manage the grid. We know the grid is evolving and we

know that's the future, so we're looking for opportunities to enhance our market opportunities for these resources.

The good news is that we've been working very hard to provide these opportunities in the wholesale market for our participation of distributed energy resources. For example, we have an ongoing stakeholder initiative called ESDER, which is Energy Storage and Distributed Energy Resources. And the most recent activity in that initiative is to provide the opportunity for demand response resources to actually perform some sort of load shift, so we're actually trying to introduce load consumption, not just load curtailment.

The other activity that relates directly to EVs is the ability to have a performance methodology measurement for EVs separate from the facility load. Because we understand that this granularity of loads within loads or within the facility is certainly a big topic, and we heard that over the last couple of days. So we're kind of chipping away at our ability to allow these resources to participate.

Now these are still loads and it's load

curtailment, so it's not perfect. I think a lot of what I heard today and what I would agree with is that we're looking for more sort of dynamic opportunities for these resources to participate, not just low curtailment but more load management, and not necessarily V-to-G only but V1G, as well. If we can manage to load and they can provide those services, that could create greater opportunity for these resources to participate in the ISO market. And we've got, you know, several thousand megawatts participating our DR program and in our DR product, so it's working, but it needs to continue to improve.

What many of you may not know is that we also have another framework we call DERP, which is Distributed Energy Resource Provider. And this is fairly new, although it's been out there for two years. The DERP framework was devised with the understanding that aggregations of DER could essentially be utilized in the ISO market and span both load and gen, to operate more like a battery or a virtual power plant.

And, unfortunately, though, even though we've had those DERP provisions in our tariff, we

have no DERP resources participating in our market today. And I would attribute most of that to many of the challenges that we've talked about over the last two days. These challenges are, you know, such as cost benefit and the value, you know, what kind of revenue could be obtained from these types of resources? Is there a business case today? Will there be a business case later in the future?

Distribution interconnection is a challenge; metering options, communication technologies, wholesale versus retail rates, and multi-use applications.

So I have to say first that when we introduced these rules into our tariff, we understood that this was going to be a challenge in the system overall. So I think if you look at the challenges that we faced in implementing DERP compared to what the utilities have to think about, allowing these resources to participate at the ISO where we are dispatching them in aggregate form, you know, from the distribution system to provide those services, we don't have the visibility that the DSO has and that the distribution system has.

So it's understandable that the interconnection application is going to be more complex. More has to be thought through in terms of the aggregation geographic area. But we've, you know, we've kind of started this process. And I think it's continued largely in the multi-use application proceeding, or it was actually the storage proceeding on the CPUC started a working group for multi-use application. And the concept there is how can you have distributed resources that provide services up through the distribution -- up through the distribution to the ISO so they can provide into the distribution system, as well as the transmission system?

And a report was filed this year in August. It's under review from the Commissioners right now. And I attended a workshop review last week where some of the findings of the outcomes were presented to the Commissioners. And it's likely that there's going to be additional rulemaking on multi-use applications. So I think that's going to be a good forum to kind of keep pushing the more dynamic ability for these resources to be aggregated and provide more sophisticated-type services to the grid.

So I think I would agree with, I think, a lot of the discussion that took place over the last two days. And I was really impressed with both the panelists and the presentation materials and the workshop overall. I think it was very valuable, at least for me, to hear and kind of reaffirm some of the challenges that we've been facing.

So you know, the only thing I can really wrap up with is that we look forward to working with the EV stakeholders, with the agencies. We do have a vested interest in allowing these new forms of participation in our market. And we look forward to overcoming these barriers to make it happen.

So I'll close there.

MS. SISTO: Hi. I'm Carrie Sisto with the California Public Utilities Commission.

Just to kind of carry off of what Peter closed with there, one thing internally at the Commission that we're moving towards is better integrating all of our resources planning teams, and that includes Integrated Resources Planning Team which looks at the system as a whole, the Distributed Resource Planning Team which looks at

the distribution system and how it fits into the system as a whole, and then the storage and the multi-use applications and figuring out ways that EVs fit into their planning processes and how their planning processes can inform our proceedings on EVs and better align the DER planning processes in general.

So this working -- this workshop and this VGI Roadmap Update is pretty critical to help guide that process because it helps -- one of the themes I've heard a lot over the past two days is what questions should we be asking? Are we asking the right questions? And that's what this Roadmap is supposed to do, it's supposed to identify and help us prioritize what questions to answer first and who should be either feeding that or doing it and how those answers can be reached. So I think that the past two days have been very informative in helping guide that prioritization effort and help us figure out which step to take next.

I know a lot of people have asked me separately in side conversations about the final staff report from the VGI Working Group that was carried out last year. We're hopeful that it

will be issued by the end of the year. I'm done writing it, so hopefully it will be issued by the end of the year.

And, yeah, the CPUC is going to continue working within itself and with our sister agencies to move this process forward.

MS. PALMER: Hi. My name is Stephanie Palmer. I work in the ZEV Implementation Section at the California Air Resources Board.

Many of you have heard today about the implementation of SB 454 Electric Vehicle Charging Station Open Access Act. I just want to let you know that CARB is paying very close attention to what you were saying about the consumer experience and the status of technology. We are listening. We are reading. We are trying to follow everything and use it to help implement SB 454 in the best manner possible, taking into consideration industry, as well as the consumers. They are definitely in the forefront.

I also want to say thank you very much for being here for the last two days. We've heard a lot of valuable information. And I look forward to taking it back to CARB and distributing it amongst the different branches at

CARB because they are working on projects with EV charging and they need to know the updated technology information.

So thank you very much and I look forward to seeing out the rest of this process with everybody.

MR. GONZALEZ: Hello. My name is Ray Gonzalez and I'm the Staff Lead for Transportation Research here at the Energy Commission. I work with Matt Fung and together we support the EPIC Program, focusing on electric drive among other alternative fuels or advanced technologies.

So the Roadmap, so why the Roadmap? So we use this process to bring in stakeholders, to bring in experts, to bring in the public to help shape a plan or a document that's going to inform our programs, provide the right priorities or lists of priorities so that we can move forward with investments that will address the barriers that are outlined in the Roadmap. So it's very critical that we get this participation.

So I do want to commend everyone for attending. This is two days. This is a lot of work. There's been a lot of information. We've

got a huge task ahead of us to go through the information, put it in an organized fashion, and to begin authoring the next Roadmap. So the plans are to draft that Roadmap and provide a draft and we'll move forward with either a webinar or a public workshop, in-person workshop if needed, but I think right now the plan is for a webinar. But the important thing is that we've collected all the feedback and that we can organize it in a way that will inform our programs. And likewise, we want to establish some actions that will be co-shared with our sister agencies and organizations, like California ISO.

So our programs, both the ARFVTP and EPIC Program, we do investments. So these investments are at various, what we call, TRL levels. Some, the EPIC Program, covers early research. Other projects will be more of the technology demonstration and deployment. ARFVTP has done quite a bit of demonstration efforts and is now moving forward with stations, electric vehicle infrastructure rollout. And there's a lot of technology in a lot of different TRL levels or maturity in technology, you know, where it's

relative to commercialization.

And likewise, there's a lot of different topics that we've covered today. And our programs can support some of that. Other agencies and other programs will, you know, do what they can that fits into their programs. But the important thing is that this Roadmap provides good context so that we all know what the goals are, what we're trying to achieve, identify, as I mentioned, the barriers that are preventing progress, and it provides us a good look at what needs to be accomplished in order to move forward.

There were some great topics that were mentioned that I didn't want to lose sight of, so I focus a lot on the research side, early research side. But things like education and outreach, those are critical. Those are critical because, as was mentioned today, an EV owner is not going to be a grid expert. And in order for them to have a seamless experience with their technology, that has to be well thought out. That has to be well designed. That has to be well rolled out. And as well, it needs to be -- there has to be some education or some

information that is going to come up.

I think the analogy of -- that was mentioned today, talking in terms of kilowatts versus gallons of fuel, is critical. And those of us in the room, of course, we understand it. But it doesn't go too far beyond where we are that it's difficult to understand. And then to turn around and say, you know, that investment you're going to make, we may want to use it as a resource.

So it's going to be a difficult sell, potentially, or we can make it an easy sell.

And so things like other topics that were mentioned, like cyber security, areas that we have not -- it's been years since our research program has supported projects within that topic, but it's important for the Roadmap to identify whether that's a barrier, whether we need to address it in one way or another or if it's going to prevent progress to enable VGI?

Value potential. I think the value proposition is still -- there's those of us who question it or those of us that are sold, that we know it's going to be valuable. But I think, you

know, identifying what is it we need and what -- you know, who needs to take that action is going to be critical. And it's something that we can, again, take that information and translate it into actions in order to allow VGI to progress.

There are some major challenges that were identified in our two-day workshop. Among those are grid upgrades or trying to alleviate grid upgrades, addressing things like demand charges.

So when I started in this space about ten years ago, when we talked about EVs, we were really focusing on passenger cars. In the last few years and through some of our EPIC investments, we have quite a few projects that are supporting heavy-duty vehicle demonstration. Some of the feedback that we're hearing is that there -- the experience of the cost of powering those vehicles is incurring demand charges and is looking like it's a little more expensive than conventional or natural gas technology. And so it's something that we weren't expecting. It's something that we need to address. And it's important that we capture items like that so we can continue to try to broaden the adoption.

There was some mention of demonstration

efforts that are ongoing or will be starting soon. The school bus is one. There's ports, trucks that are being demonstrated. And it's a good feedback that we need to try to take advantage because our programs can't -- you know, there's only so much that we can invest in, there's so much demoing that we can do. But other programs that embarking on these demonstrations, it's good feedback that we need to take advantage and learn as much as we can for the demonstration efforts that are going on, and that goes beyond California.

Let's see, so I did want to thank the team here at the CEC, mainly Eli Harland, Noel Crisostomo, Matt Fung, Mark, and Mark, I'm going to get your name wrong, oh, Palmere, I wrote it down. Okay. And also our Agency partners, Peter from CAISO. This was a very difficult thing to try to put together in a short period of time. And there's a lot of information, as I mentioned, that we're going to half to comb through, get it organized. And together, we're all going to review it and we're all going to present this.

One of the things I do want to do is thank all of you for participating. And one of

the things that I'd like to extend, I hope my team doesn't -- or agrees with this is that, and I've done this in past Roadmap, is that I'd like to include in the appendix all the participation throughout the process. Because I think it's important that the Roadmap reflect the participation of all, beyond the government agencies and CAISO.

Let's see, I think that's all I have to say, so I'll pass that on. I think the next section is next steps.

MR. CRISOSTOMO: Thanks everyone for some closing thoughts.

So next steps on the development of the Roadmap, as is described in the agenda and the notice for the workshop, we'll be accepting public comment from everyone here. So as Eli has identified in various parts of the day or the two days, our goal is to complete the second half of the Roadmap which is focusing on not the problems or where the solutions -- or, sorry, not the problems or issues but the actions to resolve them.

As you'll see, there are crossed-out parts, there are new parts, there are melded

parts. And so despite modifications that we know weren't necessarily unanimously supported by all parties, given the substance of the discussion here and the disagreements on issues around sayV2G, value, the usefulness of things, our planning horizon, utility incentives, we know that there are contended issues in this space. But we want people to be action oriented and solutions oriented for the second half of the work -- of the matrix.

So identifying those specific actions, highlight who you think would be appropriate to be involved, including yourself if you are interested in engaging in this respect, and the prioritization. We intended to really highlight three levels of prioritization, high, medium and low, depending on the timeframe in which the action needs to be solved in order for us to animate markets and in the perspective of available resources, and this could be state resources to enable a policy or create a market, or industry resources in terms of developing new technology or test centers or what have you.

And so please be specific in using that key because that will be critical to determining

how many, say, lanes we pave on Honda's VGI or v2G roadmap for a certain issue. And eventually, the sequences will help tie all those separate areas together. We know that policy, economics, technology and the customer experience are extremely interwoven. And so perhaps we don't have 45 action items, but instead we have 20 because we are just interdisciplinary, solutions-oriented people.

And so please use an Excel spreadsheet to directly input your comments so that we can more easily meld them together. That will help us a lot and avoid having to do mindless cutting and pasting. So if -- I believe .pdfs are only accepted, right, through the interface? So if -- in addition to any letters that you want to submit via that portal, if you could follow up to an email -- with an email to us, including your Excel spreadsheet, that would be a great help.

In addition to the matrix itself, we're going to accept feedback on questions that are listed in the prompts for the agenda. And we will also accept feedback on the policy market and planning interaction framework, and that will be served through our normal list interface.

And so public comments will be due in a little over three weeks, right before Thanksgiving. So I'd expect some Wi-Fi connections via the airport to send comments to us. But we want to give you some time. If you want to engage with us prior to submitting comments, we are available and can take calls to discuss any questions that you have, so please feel free to reach out.

And in terms of next publications, we haven't set exact deadlines for when the draft Roadmap will go out or the webinar to present the Roadmap. And so we will be providing further detail on that as soon as we're able to wrap our hands around the next round of comments.

And so I guess to reiterate and kind of close the day, our goal here is to move towards a carbon-neutral economy. And transportation is, obviously, a critical element of helping California be California, but we have to move as quickly as possible toward decarbonization because our climate is counting on us. Our citizens are breathing dirty air. And the fastest that we can coalesce around solutions the better, because I remember asking these exact

same questions in a room of similar stakeholders in 2012 when I began drafting the original VGI Roadmap with Peter and others in the room in the board room of the CAISO.

And so we have to be making better progress in order for us to decarbonize. We cannot be repeating the same questions. So let's set a road and drive down it, so that we're actually making progress.

Thanks.

(Applause.)

(The workshop concluded at 4:45 p.m.)

REPORTER'S CERTIFICATE

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.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 7th day of December, 2018.

_____

Eduwiges Lastra
CER-915

TRANSCRIBER'S CERTIFICATE

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 transcribed by me, a certified transcriber and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 7th day of December, 2018.

_____

Myra Severtson
Certified Transcriber
AAERT No. CET**D-852