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BEFORE THE

CALIFORNIA ENERGY COMMISSION

In the matter of,	)	
	)	Docket No. 18-MISC-04
	)	
Vehicle-Grid Integration	)	
Roadmap Update	)	

STAFF WORKSHOP ON THE

CALIFORNIA VEHICLE-GRID INTEGRATION

ROADMAP UPDATE

CALIFORNIA ENERGY COMMISSION

FIRST FLOOR, ART ROSENFELD HEARING ROOM

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

MONDAY, OCTOBER 29, 2018

1:04 P.M.

Reported By:
Peter Petty

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Siva Gunda, Deputy Director, Energy Assessments Division

Noel Crisostomo, Air Pollution Specialist, Fuels and Transportation Division

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California Public Utilities Commission

Carolyn Sisto, Analyst, Energy Division

Panelists

Jamie Fine, Environmental Defense Fund

Hannah Goldsmith, California Electric Transportation Coalition

Jeremy Whaling, American Honda Motors

David Schlosberg, eMotorWerks

Cynthia Fang, San Diego Gas & Electric

Dean Taylor, Southern California Edison

Eric Cutter, Energy and Environmental Economics

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Thomas Ashley, Greenlots

Matthew Tisdale, Gridworks

Steve Davis, Oxygen Initiative

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Ryan Harty, Honda

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Bill Boyce, Sacramento Municipal Utilities District

Kelsey Johnson, Nuvve

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P R O C E E D I N G S

OCTOBER 29, 2018 1:04 A.M.

MR. HARLAND: Good afternoon, everybody. We're going to get started. If everybody can find their seats, it looks like everybody's got one. We weren't sure what the turnout was and if we'd have enough chairs, but it looks like we do.

My name is Eli Harland. I work here at the California Energy Commission. I'm working with a team of folks across some of the Energy Commission Divisions to update the 2014 VGI Roadmap. And so, some of you have participated in this process for the last -- since September, and some may be new to it.

Thank you, everybody, for showing up today and for staying engaged in our roadmap process. And also, thank you to our showcase providers. I saw many faces here, who got to walk around and check out the Technology Showcase. But I do want to say thank you to those providers. That was all volunteer and all raised their hands and willing to come participate.

So, if we can do this again next year, maybe we'll have a larger space and more providers to come on out.

So, before we jump into the workshop, I do want to go through a couple housekeeping items. And then,

after that, I'll be turning it over for opening comments.

So, in case of an emergency there is a park, Roosevelt Park, that is across and diagonal from the Energy Commission. It's across 9th Street there, on the map. Please follow Energy Commission staff out of the building, if there's an emergency.

We are also broadcasting the workshop today through WebEx. Those on WebEx know that we're doing that because they're receiving this broadcast. But for the rest of you, we're broadcasting that message and it's being -- this workshop is being recorded through WebEx and we're also transcribing this workshop today.

So, we hope to have the recording available real soon, after we're finished up today and after we're finished up tomorrow. And then, we should have the transcript shortly thereafter. We'll notify the Listservs when both of those are available.

So, the folks on WebEx, your phone lines have been muted and we're going to keep them that way. We will offer opportunities to participate in the workshop through WebEx. And when we do that, we'll indicate when it's time to do so.

If you do have a question and it's something you can solve by chatting the WebEx administrator, please

chat the WebEx host with that question. If not, there's a raise hand function in WebEx and you can use that raise hand function to alert our WebEx host, if you have a question. We will be using that raise hand function when we're doing public participation and audience participation.

So, thank you, again, everybody for coming out. And I want to turn over the workshop, real quickly, for opening comments to Kevin Barker. Kevin is our Deputy Director of our Fuels and Transportation Division here.

Kevin, I'll let you take it over.

MR. BARKER: Thanks Eli. I've got some notes here, so pardon me if I'm reading off some of these. I'm fairly new to the job and I want to make sure I say everything that Noel wants me to say.

So, welcome back from lunch, everyone. First, Eli acknowledged the showcase. I'd like to acknowledge it as well. Thank you for everyone that helped put it on, on our staff. Noel, Matt, Eli, Rey.

Thanks to the vendors. I'd like to actually mention you all by name. BMW of North America. BTC Power. Center for Sustainable Energy. ChargePoint. Greenlots. EV Box. IoTecha. Kitu Systems. Nuvve. Proterra. Rhombus Energy Solutions. And UC San Diego.

So, thanks for your participation. And if we

could, could we just get a round of applause for everyone?

(Applause)

MR. CRISOSTOMO: And FreeWire Technologies was a late add.

MR. BARKER: And FreeWire Technologies was a late add. Thanks.

So, thanks again for everyone in the room and everyone participating here, on WebEx, for this very technical two-day workshop.

You know, when we initially were thinking of pulling these sorts of webinars and workshops together, we had thought about somewhat spacing them out. And I think, ultimately, we went with this format where we could have something fun that everyone could look at, and see the new technologies. And then, be able to space it out over the amount of days and not have everything have to travel up here multiple times, and really dive into the nitty-gritty.

So, this is our planned first and only workshop. We had a webinar earlier. As we move forward, you'll probably hear next steps. But, really, use this as your opportunity to get your input in and really drive where we're going.

So, with the VGI Roadmap, you'll hear that we

are building off of the one that we did four years ago. And as we sort of think about updating roadmaps, you know, you would hope that a roadmap would still be relevant and useful four years later. However, in this space, we know that's not the case.

Things are moving so fast that when we talked earlier, and this is actually when I was in the Chair's Office, about thinking about updating some other roadmaps, too, everything else we put on hold because we thought this was the most important update that we needed to do. And so, he directed multiple divisions to put this together.

And, thankfully, we even reached out to have the Siting Division, where Eli's part of, to help lead the effort.

So, I would note earlier this year ARB's 2016 GHG Inventory was released. And it came with really great news, right. So, we met the AB 32 goal, the 1990 level GHG emissions four years early. Folks never thought we were ever going to be able to do that, so really great news.

However, it also came with bad news. So, for the third year in a row the GHG emissions from the transportation sector increased.

So, with that said, with all the good work that

we've been doing, our emissions have still increased. And so, we can throw our hands up in the air and say I give up. It looks like no one in this room is saying that. Or, we could look at it as a great opportunity to make a change.

And so, I looked at it as the latter. Hence, I want to say maybe less than a month ago I took on this job as Deputy Director to run the Fuels and Transportation Division.

We've got a great group of folks. We also have a great group of other division staff that I've had the opportunity to work with many times, like Rey in R&D, Alisha. But then, also someone that you'll hear from, I believe later today, and then I'm glad he's not in the room because he's going to try and tell this same joke, but I'm going to get to it first.

We wore the same shirt today. So, you'll notice that for some reason we both shop at Target to get our dress shirts.

But anyway, so working with Siva over the course, breaking down the silos within the Energy Commission I think is really important. And so, I'm glad we've been able to have this group.

So, today and tomorrow we seek to collaborate to break down additional silos. But this silo is between

the transportation and the power sector. The electricity sector must keep pace with renewable energy prices and needs to modernize and make the grid resilient among the impacts of climate change.

Similarly, transforming the automotive industry must respond to evolving customer preferences. Automakers, who previously only sold cars, are now offering mobility subscriptions. Their transition from combustion engines to zero emissions is critical to address air pollution.

Fortunately, policy ambition for cleaner air is being met with innovation in batteries and networking technology.

Importantly, as we head into this very, very important election on November 6th, we're seeing consumers vote with their wallets on a daily basis. But still, the Intergovernmental Panel on Climate Change provides us a stark challenge. Limiting global warming to one and a half degrees centigrade requires rapid and far-reaching transitions in energy, land, transportation and building infrastructure, and industrial systems.

These systems are transitioning to unprecedented -- in terms of scale, but not necessarily in terms of speed, and imply deep emission reductions in all sectors, a wide portfolio of mitigation approaches and a

significant upscaling of investments.

Responding to this call, staff from across the four divisions of the Energy Commission have been collaborating with colleagues across multiple agencies to assemble your expertise so that we can accelerate from evolutionary progress in electric vehicles and the grid, to revolutionary adoption of renewable-powered transportation.

This is only possible by working together. Integrating across divisions, across agencies, across industries and across countries. The roadmap helps focus our joint efforts. For example, CEC's annual research reviews of EPIC and ARFVTP investments, the CPUC's Communications Protocols Working Group.

But the roadmap must overcome persistent barriers. It's critical to align policy incentives and stakeholder economic motivations and address consumer awareness so that we can leverage electric transportation technologies to their full potential.

As we update the VGI Roadmap, we encourage you to identify solutions that overcome barriers to VGI. More importantly, we need to identify paths for implementation, with the urgency that protecting California's health and welfare demands.

We look forward to seeing what courses of

actions that you map out with staff and continue progress so that we can make driving electric for all Californians a reality.

So, with that, I'll hand it back over to you, Eli. Thank you.

(Applause)

MR. HARLAND: All right, thanks, Kevin. I know I'll be consulting the transcript for some of those talking points in the introduction of the roadmap, when we prepare that draft. That was great.

So, before I provide -- you can see there's a schedule that's up on the screen. And before I go into the third bullet there, under today, the roadmap overview, I wanted to quickly describe the panel format we've laid out today, and the panel format for tomorrow.

So, the way that we've designed each of these panels is, for those that are familiar with the roadmap matrix of issues and barriers that we -- that we released back in September, and a lot of folks reviewed and comment on. We had these four tracks that we attempted to kind of silo those topics into so that we could begin to digest them.

And so, we had a policy and planning track, an economic potential track, a technology needs track, and a customer experience track. So, we've taken those

tracks and those themes and have created four panels for today.

Those that are familiar with the workshop agenda, you'll see each of those four panels described, as well as the panelists that will be participating, and a moderator.

So, the way that each panel will work, we're going to hear brief discussion and presentation from each of those panelists, addressing the discussion questions that are on the agenda. They may address some, one, a portion of one, all, or additional items, potentially. But we're going to hear each of the panelists that we've invited to participate, we're going to hear their reactions to those questions.

Following that, the moderator is going to, hopefully, spark a conversation between each of the panel members in reaction to what they heard. And as we begin to exhaust that conversation, we're going to open it up to the audience members to participate in that discussion, as well.

So, if there's something that an audience member wants to react to, or a question, or want to provide a response to one of the agenda items, we're going to open it up for audience participation.

During that time, we'll ask you to just raise

hands, and we'll walk around with a mic and queue people up as best as we can. We're also going to allow folks on the WebEx to do the same thing.

So, we have a pretty full room here and a pretty full WebEx, so we're going to see how well we can do that.

I don't intend to limit people's time that they're speaking, but if it seems like it's going too long and people aren't going to have a chance to participate, we'll have to manage that as it comes up. So, that is how the format's going to work.

So, this afternoon, we're going to explore the Policy and the Planning, and the Economic Potential Panels.

And then, tomorrow, we're going to have the morning session is going to focus on Technology Needs. Afternoon session, we'll focus on the Customer Experience.

So, objectives for the workshop. We're really after the information that we would need, as staff, and our partner agencies. So, the California ISO, the Public Utilities Commission, and the Air Resources Board, who are partnering with the Energy Commission on this update.

We're really looking for the information that we

would need to be able to begin identifying and describing solutions to those issues and those barriers that are currently articulated in the matrix that was -- the revised matrix that was released on Friday.

We're really keen on finding the responsible, I guess you could say, entities or organizations that would put that action into play, as well as the priority of those actions. And anywhere, where it makes sense to identify if that action has a relationship or an interrelationship to a different action, or it may be something that needs to be sequenced, or it may be something that's dependent on something else.

For those that are familiar with California's Energy Storage Roadmap, there was a similar format that's followed for identifying those particular actions and the folks to undertake them.

I will, for a disclaimer, when we're talking about actions and assigning responsibilities, through this roadmap process we have zero power to tell people to do things. So, this is a stakeholder opportunity to help us articulate to other entities, whether it's an agency, or a market, or a combination of that, on things that can be done to overcome any of those issues and barriers for VGI.

And, obviously, the steps to prioritize those

will be important, as well, because we don't want to hand a menu to an agency without much context, like prioritization.

So, through the workshop today, through the public comment period that is available for folks to comment on, that's where we're going to be gathering this information. Our goal is to have that information and be able to go back, following the public comment period, and prepare a draft roadmap.

That draft roadmap is going to include supporting text and preamble, along with an updated spreadsheet that has more than just goals and issues in it. It's going to have goals, and issues, and actions, and those responsible organizations and prioritization.

So, real quickly, before we get started on kicking off our first -- getting started on kicking off our first panel, I wanted to revisit real fast with everybody, this is originally the schedule and approach that we presented back in September that we were hoping to be able to follow for the roadmap effort. So, we did hold a kickoff webinar on September 6th, and initiated the public process for the roadmap.

We did release, at that time, a framework, as well as a matrix of goals and issues. We received comments from 13 organizations -- or, 13 public comment

letters, representing about 30 organizations. So, to those in the room or those listening, that did submit those comments, we really appreciate it. There was really attention to detail, a very thorough uncovering of issues and thorough comments. So, we do recognize that people spent a lot of time on that and that we're asking folks to spend a lot of time on this. And here we are, again, and we're going to be asking for more time.

So, the kickoff webinar and the comments on that, what we hope to have developed, what we called a discussion document, where we were going to describe, essentially, VGI policy and VGI programs in the State, in a bit of a consolidated, organized fashion.

And we also wanted to release a refined goals and issues within the matrix, as well as pose some discussion questions for the workshop today.

So, we were able to put together the workshop discussion questions. Those are in your agendas. That agenda came out last Friday. So, folks that have the agenda, it's available in the back room, folks on the web you know where to find that agenda. But those are the discussion questions.

These discussion questions are the result of staff here looking at the comments that we received from

the organizations on the original matrix. And those discussion questions are meant --

(Operator interruption)

MR. HARLAND: Those discussion questions are meant to force -- they're meant for staff to answer the questions we would need, essentially, to begin filling out that matrix.

And then, we also, on Friday, released what we're calling an updated goals and issues/barriers. So, that spreadsheet was posted on Friday. And you'll see that there's a column in there that indicates the original problem and issue, the way that staff articulated that back in September.

And then, the column to the right of that is a new -- or, a new issue or a problem statement. In some cases, you'll see that we decided to either collapse or consolidate some of our old ones and create a new issue statement. In some cases, we didn't make any changes at all. And then others, we completed deleted some of the ones that we were working on.

So, when you read through that, you'll be able to clearly, hopefully clearly see what's new and what changed. And so, I just want to alert everybody to that fact that there's that new problem and issue.

And so, all of that was leading up so that we

could get to today and tomorrow. Which is our, you know, as Kevin discussed, this is meant to be our -- the heart of our public process at this point, as far as a workshop process goes for the roadmap.

We're going to go through the panels that I presented there, in just a bit. We're going to start with the policy and planning.

And comments are going to be due on the 21st of November, in response to today.

And the goal for us, still, is to, after that comment period closes, that comment opportunity's done, we'll have enough information to go back and put together a draft roadmap. And at that time, we'll release that draft roadmap and hold a webinar, very similar to the first webinar we did to kick off the roadmap process.

And again, that's going to open up an additional public comment opportunity. So, today isn't the last time. Up to the 21st isn't the last time to comment. There's going to be a comment period on the draft roadmap. And that draft roadmap will have those, our first cut at actions, as well as prioritization, and some of the assignments that we're doing.

So, I'm going to turn this over to Noel. Noel is going to kick us off, our Policy and Planning Panel,

with the bullet that's next to the workshop discussion document, where it says policy and program review. Noel's going to kick us off with a framework that he's started to develop to begin framing the interaction of policies, and programs, and the market. And he's going to walk us through there.

And I hope that that's a good setup, before we get into our Policy and Planning Panel.

So, I'll turn it over to Noel and let him present.

MR. CRISOSTOMO: Thanks, Eli. My name is Noel Crisostomo and I'm an Air Pollution Specialist in the Fuels and Transportation Division.

And we'll try to provide a little bit more context of why we're here and why we need to continue to improve our coordination, again, across state agencies, across industries, so that we can really electrify our transportation sooner, in order to rise to the challenge of climate change.

Our main goal here is to power zero emission vehicles with clean energy to help the economy of California achieve carbon neutrality by 2045. This combines some recent policy efforts by the Governor, in his executive orders, in addition to increasing the ambition of our regulatory agencies' programs to support

electrification.

As Kevin mentioned, we've seen increases in the total share of emissions in California coming from transportation. They're roughly have of the State's greenhouse gas footprint. And from an absolute perspective, they are the largest in the State.

We want to accelerate the deployment of 5 million zero emission vehicles by 2030. And by that time, we'll be transitioning to a power system with 60 percent renewable portfolio standard. And, eventually, want to have a fully clean electric system by 2045.

And just as examples of all the policy efforts that have recently passed through the Legislature this year, the agencies will be responsible for assessing infrastructure needs and moving toward enabling more expeditious charging station installations.

As Eli mentioned, the matrix of goals, issues and barriers from September identified a goal to "frame the interactions between policy initiatives, market pushes, and demand-pull factors that are required for achieving widespread deployment of charging and grid reliability goals, and to propose changes to EV deployment plans and VIG policy to address gaps."

Stakeholders generally commented in agreement that coordinating between the many transportation

electrification efforts that will ultimately impact California's grid was necessary to improve planning and investment deficiency, and to ensure that our efforts are moving quickly.

So, to initiate a solution to overcoming those barriers, back in 2014 stakeholders considered the 2014 VIG Roadmap's three interrelated tracks. I'm sure most of you are familiar with the old VIG Roadmap. But to remind you, the three tracks were first, determine VIG value and potential. Two, to develop enabling policies, regulations and business processes. And, three, to support enabling technology development.

So, back then, stakeholders expected that these would be implemented roughly sequentially, largely with the valuation of use cases defining policy and program requirements, which inform technology deployment and implementation.

But in reality, due to several factors that I won't list exhaustively here, we weren't accounting for things like SB 350, and its transportation electrification responsibilities for the utilities, and the new integrated resource planning process.

We weren't accounting for pretty rapid advancements in controls research, battery technologies, and the expansion of electrification to many different

sectors beyond light vehicles.

And new imperatives to serve customers more broadly, particularly low-income and disadvantaged communities have put a fire under us.

And so, staff is at this point recommending that the roadmap update reflect this fact that electricity markets, policies and programs, and VIG technologies are not only evolving sequentially, but in parallel, at the same time.

The challenge, however, comes from the fact that despite best efforts to coordinate, because our efforts share scopes that ultimately affect program designs, vehicle demand, and charging sessions, and at the very end grid loading, policy silos might pose challenges for our efforts to cost effectively integrate vehicles with the grid, impact customer usability, and forego benefits to society.

So, to account for policy interactions more holistically, instead of just treating VGI as a technology or a rate design issue, we want to close policy gaps, identify key areas of leverage, and improve efficiency of our planning processes, which will accelerate the benefits to everyone in California.

And so, the next slides propose how we could work together to frame how policy, planning, and market

efforts that influence VGI and are influenced by this effort, this integration, could work more closely in the future.

And Eli said that this was just my idea, but we've been working together with the agencies to try to make the inputs and outputs of each of our independent processes more aligned.

So, these range from the R&D and innovation process, manufacturing, transportation emissions reductions policies, characterizing how VGI resources behave and act, integrated resource planning, program design, deployment to customers, evaluating the differences in impact to the customer and to the system with and without VGI. And, of course, the public and private investments that are underpinning our efforts.

And so, to help organize our thinking, I'll be highlighting in a build to this slide that naturally arise when we consider our common efforts across these areas.

So, first, how does an agency's effort or an automaker's effort create and foster the use of ZEV technology to achieve an environmental objective?

What's the right time to introduce a new product? And when are policies appropriate to accelerate deployments?

Second, to support new technology deployment how do markets support rapid competitive scaling of necessary vehicle and charging technologies from a supply chain stand point?

What types of public and private investments are necessary to crystalize market success and buy down any incremental costs or overcome barriers?

How can we expect drivers to charge? So, resource characterization happens in load profiling at the CAISO, in defining resources, in doing submetering. And so, how do we track behaviors and how do we anticipate enabling technologies to make these loads more dynamic?

How VGI resources fit in the broader integrated resource planning process and our decarbonization efforts overall? How do we leverage this resource to avoid conventional ramping generation from being built or required for operational conditions?

Sixth, how are procurements and incentive designs created to put VGI in the hands of customers, and fleet providers, and the public at large? And how are they then enrolled into dynamic rates, or ancillary services to help the grid?

Seventh, what steps must be taken in order for users to more easily adopt, construct, use these

technologies, both on the vehicle side and the EVSE side?

And how can all the things that have happened in the upper part of this process be recognized so that when we're making investments today, because we will be working in parallel, how do we understand how those decisions affect the extent to which we can reduce grid impacts, to improve the customer experience and, ultimately, greenhouse gas emissions?

And then, finally, acknowledging, again, that these policies have to be moving in parallel. How do we ensure that we iterate quickly and expand the potential for investment that minimizes the impacts on ratepayers and maximize emission savings?

And so, the goal of this framing, again, is to identify potential synergies between actions, because policies and products are continuously being developed, but could synchronize better. Better alignment would improve cost effectiveness of vehicle and infrastructure deployment, reducing utility costs, minimizing emissions from both sectors.

And so, this framework, which will be published in the discussion document following the workshop, provides a visual means to support stakeholders' understanding of the opportunities for VGI throughout

all of our transportation electrification efforts.

And, specifically, when you tie this back to our matrix process, and the commenting process, we think that these categories and the connection between them could serve as identifiers in how we can sequence these efforts to the greatest amount of leverage.

And so, these are kind of a table-setting effort to delve into our policy and planning panelists, in which they'll be responding to these themes and the questions that you have in your agenda.

What are the key policy actions and interfaces that we could create to make sure that VGI is better integrated into our processes and programs?

And how can we all be working more effectively, from a policy development stand point, to maximize benefits that we all want to realize today?

So, I'll turn it over in order of panelists listed on the agenda. So, Jeremy, I think you are up first.

Oh, sorry, now, that was the old version. Unfortunately, Matt Stanberry, from AEE, is unable to attend due to some inclement weather. But I'll just be highlighting a few points that come from his and AEE's recent paper. Right.

EVs 101, a Regulatory Plan for America's

Electric Transportation Future. Just for your reference, this is a nice document for you to read.

And so that our record reflects some of the -- adjusting utility planning and operations to fully integrate PEVs, he had some recommendations for how to improve policy.

So, we have to geographically and granularly do load forecasting for peaking analysis of the grid at the distribution and wholesale market levels.

Second, there's a need to develop shared planning scenarios and assumptions based on broad stakeholder inputs.

Third, there's a need to invest in advanced utility monitoring and control systems, like SCAA, AMI and DERMS.

Fourth, there's a need to manage load with smart chargers, capable of remote communications and embedded metrology.

Fifth, there is a need to create processes for the expeditious review of interconnection requests and customer participation in services, including vehicle-to-grid.

And sixth, regulators should recognize standard is critical for making investment in infrastructure.

And so, to transition to people who are able to

be sitting here with us, today, I'd like to introduce Jamie Fine from Environmental Defense Fund.

And, Jamie, do you have a clicker with you?

MR. FINE: No, I do not.

MR. CRISOSTOMO: Okay.

MR. FINE: Do you want me to stand over there?

MR. CRISOSTOMO: Whatever you would -- whatever you'd prefer.

(Pause to set up)

MR. FINE: Okay, thank you very much. Thank you very much for the opportunity to offer some comments from Environmental Defense Fund.

Before I jump into those, I do want to also send a shout out to the demonstrators this morning, the folks who were showing off their technology. I just can't tell you how important it is to have your innovative ideas in this house. And I know it's hard to take time out of your very busy schedules to provide that experience for us. But for us advocates, who are oftentimes trying to understand what you're up to, it's really very valuable. So, thank you for that.

So, Environmental Defense Fund is a national environmental nonprofit. We're about 500 strong nationwide, now. Actually, around the world. We have offices around our country, and in Beijing, and in

London, and in Mexico. We have programs in oceans and water health, climate and, of course, energy.

And in the energy space we have major efforts in electricity and natural gas. And I'm going to be speaking mostly from my experience, advocating around electricity policy reform, a lot of the time at the CPUC, here in California.

So, I want to just start by telling you what EDF's key points were in directly answering -- that's right, I'm forwarding my presentation, but not yours. Directly answering the questions.

On the first question, what's the policy framework we should be thinking about?

Well, you heard it already from AEE. I'll say it somewhat differently that we should be endeavoring to provide an understanding of value in increasing time, place, and product or service type.

This is something that we've spoken about in the context of retail pricing, and reforming electricity prices that residential, commercial, and industrial customers see. But it also plays out in exactly this same space, too. So, if you want charging behavior to behave, that aligns with the grid, that charging behavior needs information and the starting point of that information is pricing information. That infor

one time to the next.

And, as well, we need to have a long-term planning horizon as we think about value. Put simply, if we don't know where we're going, we're likely to end up somewhere else. And that planning horizon oftentimes can be confounding if we're looking at long-term siting and investment strategies around, for example, large generation or transmission. If we don't have a 7- or 10-year planning horizon, we're going to miss opportunities to help the system evolve towards the goals that we want to see because, frankly, we'll run out of time.

On the question of how do we leverage VGI as a distributed energy resource? First is to recognize what's possible. Recognize what VGI resources can bring. For example, an ability to take solar energy that we're currently curtailing in California.

And then, I already made by point about and then have planning time horizons and information that allows us to design towards that goal.

Well, I'll make a further point about that, as I get into my few other slides.

On the question of procurement programs, I've already mentioned we need precise pricing. And the reason we need that is because we want to trust that our

innovators can bring solutions to the table. And if they have that pricing information, they can innovate.

We can think about other innovations we've seen in the system. And that innovation, in many cases, happens in the absence of good pricing.

I had three conversations this morning and every one of them revolved around an ability to harvest value that cannot be, yet, harvested. And that's a problem, right. So, let's trust that our innovators and our markets can harvest that value when it's presented and when it's available.

And then, finally, yes, we do need to change our business model practices. We need to transition away or at least deemphasize the rate of return construct. We know that there's strong utility enthusiasm for investing in infrastructure when it can be a rate of return asset. And EDF has supported those investments.

We want to be sure that they're used and useful and there's the right balance between risk and reward between shareholders and ratepayers. We haven't seen that balance in early VGI proposals, but it's certainly something that I think we can achieve.

And then, one way to deemphasize rate of return revenues is to emphasize or open the door to new revenue ideas. Notably, fees for services. And I'll be

speaking a bit more about that, as the day goes on.

And so, that's kind of my take home point, and to motivate those points a little bit, and to move quickly with the right slides.

So, this is just curtailment data. I have an analyst back at my shop, who's been tracking CAISO data on how much we are turning off our solar and wind generation. And again, you're not -- I don't know how well you can read that slide, but what you're seeing is each line is a newer year. The top line is 2017. And what we see is massive quantities of solar generation being curtailed. And this is both the bulk and private, rooftop solar generation capability.

And at the same time, we're seeing this curtailment, we're seeing -- we have other challenges in California that we need to be aware of. For example, one-in-three customers are on rate discounts because of household income constraints. And many of those customers are not yet able to get access to the energy services that they need.

So, we need to be aware of the initial condition in California and it's not a panacea for everyone, yet. And we actually have some real symbols of waste in the system that a smart VGI and V2G program can begin to address.

So, I think we're all familiar with the duck chart challenge in California. Thank you. And the essence of it is it's a challenge, but it's also a massive opportunity.

I've worked for several years in the California Public Utilities Commissions, advocating for changing residential customers for time-of-use rates. And that is, indeed, progress. But those time-of-use rates only hint at the significant negative locational margin of prices we're seeing in the grid.

They do inspire folks to use more energy at the low-price times of the day, in the middle of the day, the price signal is not nearly as strong as LMP prices suggest it could be. And it doesn't reveal that locational value that I spoke to earlier around, you know, distribution system values.

This is an opportunity for EVs to help solve the duck problem. And when we think about solving that, we have a tendency to think about the individual, the individual EV. But the work I've done, looking around California, there is an enormous need to also think about community and regional-scale solutions.

We know that a lot of our capacity investments are driven by local reliability needs. And we also know that many of our communities do not have access to the

capital necessary to invest in their own EV, in your own driveway today. But community-scale opportunities are out there and they're already being developed.

EDF highlighted one example and that's a community mobility services center that's being built. Or, actually, their ribbon-cutting ceremony was two Friday's ago in Huron, California, one of California's poorest cities.

And the notion behind that is to provide a mobility solution that is one where -- the mayor calls it the anti-Uber, and it's one that provides economic opportunity and income opportunities for people living in a community, now, who have few attractive opportunities in that realm.

Thank you. These are EDF's comments on the VGI Roadmap that we want to develop V2G market opportunities. And this is a broader way of saying what I've already said. We have seen examples, already, of aggregated demand response services from EV charging networks. We'll hear more about that today.

That's just a tip of an iceberg. There is an enormous value stack that could be harvested. And it is often thought of as an aggregated service of multiple vehicles and that can, in fact, be the case. But if you have pricing at the distribution edge that is very

accurate, you don't necessarily have to aggregate resources for sale into wholesale markets. You can harvest value against that very precise tariff. And some of the aggregation and sales pitch work you have to do, and satisfying CAISO, for example, standards is a step you maybe don't have to take.

And then, notably, these resources should be planned for capacity. That's where the big money is in California. And if we don't plan for our parking garages to become power plants for an hour each day, we're going to build other power plants to do that work.

This is an RMI construct that I think is valuable because it shows the 13 different services batteries could provide. And it shows those services from the perspective of three different stakeholders, the ISO, the utility, and the customer.

And I think it's very important for us to keep in mind that the question of cost versus benefit, and the question of value needs to be thought of in the context of whose value, and who ends up owning this stuff.

And then, I'll also note that this construct reveals that you could think about centralized versus distributed solutions, and they should all be contemplated.

I mentioned harvesting the full value stack. I've been in the distribution resources planning proceeding at the CPUC, where we are planning out the values of distributed energy resources on the distribution grid. And I've got news for you, we're not planning to harvest all the value, yet.

This is a long list of the values that we could be bringing to the grid with DERs, and this doesn't include elements like enhancing the ability to utilize our renewables, our bulk renewables, because you have DERs providing services.

One data point on that is Lawrence Berkeley Labs estimate of demand response potential in California.

Well, we're all familiar with DR, as we're demonstrating it now, a shed of resources, where we ask our cars to stop charging if the grid is challenged. Or, we ask them to charge when the grid is perhaps curtailing renewables. And that's a very important start.

V2G means something much more sophisticated and much more complex, and an opportunity to harvest a greater variety of values, including tapping into capacity, this long-term reliability component.

If we can't get into the capacity value, again, those are costs that we'll be incurring elsewhere, and

it becomes a missed opportunity for the vehicle fleet.

I want to wrap up quickly here. I do want to mention that when EDF talks about providing dynamic prices or other precise pricing and information at the distribution edge, this is not necessarily something that everyone will want to embrace.

I love this graphic from SoCal Edison. It's now a few years old. But what it reveals is if you look at the average performance of customers participating in a demand response event, and this is a shed-DR event, what you'll see is that you'll get some good performance there by the average group. But you get some very impressive performance by what we call a sub-group of responders.

And what we need to be thinking about is creating that opportunity to harvest value, if you want to be a responder. Not requiring everyone to do it, but giving that opportunity for those who want to play.

If you can't have responders like this, getting back to the Lawrence Berkeley Lab Study, shift resource and shape DR resource, which is kind of routinely changing our load shapes in response to prices, be it TOU rates, or other types of information and signaling could, in 2025, if we could shift just 20 percent of load off of the peak in the evening, and the peak ramp,

and shift it to line up with solar, we can increase the utilization factor of our renewables from 88 percent to 98 percent. Saving the system approximately $700 million a year. This is a 2025 year estimate by LBNL, in their demand response potential study.

That's massive value. And that's a lot more value than could be planned for just providing a shed-DR resource. So, we need to think about that routine shape and shift type of DR, which you can achieve with pricing.

And then, finally, I'll just close by mentioning that we often think about California's most vulnerable customers and we, indeed, worry about how these customers can be price responsive when moved to a time-of-use regime.

On the other hand, we tend to forget that -- if we think about customers in America, this is kind of old data, now. We developed this when we were actually working on cap and trade at the national level. But what this shows is America split up into quintile, the 20 percent poorest Americans are in Q-1. The 20 percent richest Americans are in Q-5.

And you see household purchasing of high-intensive goods and services, gasoline, utilities, high-energy goods and services, think hamburgers. And what

you see is the richest 20 percent of Americans buy three times as much of this stuff as the poorest 20 percent of Americans. Yet, it's only about four percent of the household income.

But for our poorest 20 percent of Americans, though these households are buying one-third as much of these goods and services, it's 25 percent of household income.

So, if we ask, who's going to be motivated to participate in price-responsive demand response, we shouldn't be leaving our most vulnerable households out of the picture. In fact, we should be asking how do we put these households front and center in the picture and position them to be winners.

This doesn't mean a new Tesla in everyone's driveway, obviously. But it does mean that this is the consumer group I want to make sure we're thinking about and we're trying to empower to be winners in a zero-carbon, electrified world.

And with that, I thank you for your attention.

MR. CRISOSTOMO: Thank you, Jamie.

(Applause)

MR. CRISOSTOMO: We'll transition to Hannah Goldsmith, from CalETC. We're bringing up your presentation. You are going to be okay.

And just a reminder, we'll have ten minutes per presenter.

All right, Hannah, take it away.

MS. GOLDSMITH: Oh, hi, I'm Hannah Goldsmith. I'm the Deputy Executive Director for the California Electric Transportation Coalition. So, briefly, I'll just say a little bit about CalETC.

We're a nonprofit industry association, seeking to advance and accelerate transportation electrification. That's our mission statement up there, as well as a list of all of our members, which you can find on our website.

And I will note that in the context of vehicle-grid integration, we have been working with more entities than are listed here. And I'll also note that not everything I say is necessarily an exact representation of every one of our members' views. But it's our CalETC positioning on these topics.

So, that's me and my dog, in my electric vehicle.

And Noel already mentioned many of these topics here for a policy landscape. But I'll just briefly say this is the primary lens which with, through CalETC views all of these topics is to accelerate transportation electrification and meet these goals

here. And that includes getting 5 million zero emission vehicles on California roads by 2030, as well as the necessary infrastructure to reach that goal. And then, also access to zero emission vehicles for disadvantaged, and low- and moderate-income communities. And we also are very active on the medium- and heavy-duty side. And, of course, vehicle-grid integration crosses all of these issues.

So, and most recently, the 2018 ZEV Action Plan came out, and that includes many relevant action items for vehicle-grid integration. One of those is updating the VGI Roadmap. So, that's why we're here today.

It also includes direction for the IOUs to implement projects to advance transportation electrification in their service territories. And that includes addressing how these investments can enable vehicle-grid integration.

It also includes an action to support state- and federally-funded vehicle-grid integration pilots. And I'll note how important this is, as we've many times, I think in this arena, have offered the large-scale pilots and demonstrations are a really key way to prove out these technologies, standards, the value and cost for consumers, as well as the market, and all of the kind of pieces of vehicle-grid integration.

And the last bullet there is to explore strategies and rate designs that protect against negative grid impacts and minimize costs. And this is something that CalETC has been active with engaging our members on to look at rate design, and demand charge design, and all of those topics in the context of advancing transportation electrification. And ensuring that electricity, as a fuel, is really cost-competitive or cheaper than gasoline. Because, if it's not, then the picture for consumers to adopt these technologies doesn't look good.

So, I'll go ahead and jump right in to policy recommendations. So, at a high level, and Noel already mentioned this, so that's great, but better coordination on the state agency side, as well as market participant coordination. And these aren't siloed, even though they're represented as two different bullets here. But we really believe having all of the state agencies that are in charge of pieces of this VGI picture, as well as any of those that seek to or are in the process of looking at regulating charging stations, or other parts of this puzzle need to be working together, with each other, as well as with the market participants. And that's also from kind of a data sharing and collaboration perspective, as well.

And one of the pieces of this, too, is that -- at least from CalETC's perspective, we're involved in pretty much every transportation electrification proceeding going on the state. And we're seeing that there are regulations kind of coming at charging stations from different places, so that might mean labeling. That might mean metering accuracy. That might mean inoperability protocols and things like that. And we really need to see the agencies working together to look at this holistically, to ensure that potential costs that could be borne by anyone in the market, especially on charging stations, aren't going to be negatively impacting transportation electrification.

The next topic on there is determining VGI value and cost. And so, I won't get into this too much because I know there's an economic panel after this. But we think it's really important to understand this better in order for the market to move forward. And that will help inform all of the policy actions.

We also think it's important to prioritize customer experience and value. And without customer engagement and understanding, we're not going to have any VGI opportunities or successes. It's important to include that and we're glad to see that in the update.

And the last one on here is to analyze and

leverage prior progress and ongoing work relating to vehicle-grid integration, and distributed energy resources. And the reason that's on here is that there has been a lot of work done on distributed -- DERs. And to the extent possible, and appropriate, we don't want to be reinventing the wheel here. We should be building upon those frameworks and lessons learned.

Okay, so this was in our comment letter on the matrix. And this just lists out many of the areas within which VIG touch. And we'd like to ensure that the VIG Roadmap update scope includes all of these. That's not to say that any of these are better than others, or that every single area will be ripe for vehicle-grid integration actions. But we think it's important to be looking at the picture broadly, and holistically. I've been using that word a lot.

But in order to see EV adoption drastically increase, we increasingly need to manage the electricity usage of EVs as the market grows. And understanding and being able to prioritize the scope of grid impact issues across these sectors listed here, for the different types of vehicles, is an important first step to fame the potential acceptance and ability to move everything forward in these spaces.

And we'll note that, you know, user preferences

need to be analyzed so that these programs are not designed in a way that could hurt the EV driver's experience or dampen EV uptake.

Oh, that's pretty small, sorry. So, we're including some approaches here for consideration. And Jaime mentioned some of these. But time of use and time of day rate design has been a proven, low-cost, effective means of encouraging charging during beneficial times, and getting consumers to charge when we most want them to. It doesn't require any communication system, or expensive hardware requirements, and it's applicable in many applications.

And in different service territories, the utilities have received customer feedback on this and have really seen it prove out very well.

Demand charge design is also listed here and there are different opportunities for including demand charge design to get consumers to charge the way that we want them to. And that includes time-variant rates, with lower demand charges, demand charge neutralization, which is when the charges do not get separate peak demands, but as long as they stay under the building load, they don't ramp that up higher.

Demand charge phase-in, and that's kind of what Southern California Edison will be doing soon, in their

approved rates. And that has a period of term where the demand charge is not charged to the consumer, but it's included in a time-variant rate. And then, it's phased back in as the consumer gets more comfortable with how to charge and how to use their fleet in a way that complements grid conditions.

And then, there's also an option on here for residential demand charges for some applications. I fully recognize that that is probably not valid in many applications and we wouldn't want to harm any low-income, or moderate, or disadvantaged community folks. But there are some consumers that that might work well for.

So, in addition to kind of rate design topics, demand response programs, Jaime mentioned this, too. There have been many successful demand response programs to date and we should encourage continued programs and opportunities for EV drivers to charge in ways that soak up excess renewable capacity, or renewable generation, and not charge during peak times.

Another policy suggestion is Low-Carbon Fuel Standard Program design. And so, that was just updated. And effective 2019, there will be incremental credits for smart charging. And this is both a penalty and a reward because it reflects grid conditions and

emissions' rates that are happening at different times of the day. So, it encourages charging in a smart way.

And then, on here, storage mandate design. So, flexible load shifting and V2G quality, but V1G should also be able to qualify under storage mandate design.

And this is my last one. I'm probably running out of time. So, and then, finally, kind of off of the utility side and charging side, you can also design rebates to encourage certain outcomes. And we are seeing this happen now, but it's a good way to kind of get this rolling.

We especially think it's important to encourage low cost VGI solutions. And an example of this includes power sharing and sequencing. So, power sharing is when multiple vehicles hook up to the same charging station. And depending on how many vehicles there are, the full capacity of that charging station is divided among those vehicles.

And so that, or sequencing, which is -- let's take the same example, multiple vehicles hooked up to the same charging station. The first one fills up and then the power moves to the next vehicle, and on and on.

And these are ways that we're seeing that a building can install charging for multiple vehicles, without needing to have any expensive upgrades for

capacity, and keeping their overall building load constant. And so, we more charging out there.

And then, finally, as I mentioned previously, large-scale pilots and demonstrations are very important to prove out vehicle-grid integration opportunities, communications, effectiveness, value and cost.

And that's it, thank you.

(Applause)

MR. CRISOSTOMO: Thank you, Hannah.

And then, next, Jeremy Whaling from American Honda Motors. I'll give you a signal around nine minutes, Jeremy.

MR. WHALING: Sure. Okay. So, this is going to be a little bit of an eye chart here, since I don't have a big enough poster. But, originally, we made this sort of roadmap that kind of highlights where I think we need to get to in order to really meet California's goals.

And what I'll be doing is actually just kind of going through it. So, you won't have to necessarily read every little sign right here. But what you can see from here is there's a lot of different pathways, a couple of scenic routes, and a nice, little Honda dealership with stuff on it, and then some other stuff around there.

And so, we'll go through it real quick. So, at the start here, we're looking at V1G markets. And so, currently, with the markets that we have today, for things like demand response, they're really built on the framework for traditional demand response, like air conditioning and stuff like that.

And Honda has Honda Smart Charge, which is a small program to, you know, have vehicles bid into the grid and be grid resources. And so, we're trying to fit them into this market and what we're finding is electric vehicle charging's actually -- it's more flexible than the market is giving it credit for.

So, we have sort of this flexibility where we can charge at any time throughout the night but, basically, the market really wants us to see consistent charging at a certain time, and then on the day of the event we move the charging to a different time.

And actually, the most lucrative right now is actually to charge on peak and then be paid to move off peak. So, that's not going to scale really well. That's not really encouraging. That's not good for the grid. So, we need to do a little bit more than that.

You know, the baseline metrics and stuff like that, it's a good start, but I think we need to improve it and, you know, pay for more of the flexibility of

what we can do here.

And the next thing on our roadmap here is submetering from vehicle. So, what we've found, too, is that with using, you know, the traditional markets and everything right now is you're still bundled with the house load, or the building load, or the site load and that means that the site -- if the site load, or the building load, or the house load does something, but the car did respond then, you know, you may end up wiping out what the car response is and basically you come back and say, ah, you didn't respond, even though we know the car did.

And so, we need submetering from the vehicle or using vehicle data to do that. It really makes it clear that, yes, the vehicle responded and it did do what we needed it to do and, you know, regardless of what the site load does.

So, then, from there we get to controlled one-way charging or smart charging. It's not currently recognized the same way that stationary battery storage is. There's no mandate for procuring it, much like storage is. V2G services can be lumped into storage, but not V1G. And we think there's a big potential to use a lot of V1G, primarily because it can be a very inexpensive resource. So, we have this opportunity to

use a very inexpensive resource to supplement what could be a very expensive resource.

So, you know, the major capital cost there is really more of soft costs in terms of getting the customer and, you know, setting up the backend system, and being able to send a control signal to either the station or to the vehicle. So, there's not a lot of like -- you know, you're not buying, you know, gigantic batteries and siting that, and interconnecting that, and stuff like that. So, this is a low-cost solution, but it needs to be recognized.

So, from there we get into multiple DR program participation. So right now, with doing smart charging we've had -- we've seen that the customers that we sort of acquire are early-adopter customers that kind of already -- you know, a lot of them are in demand response programs with either the utility, or OhmConnect, or various other programs. And because they know that system and they know like, oh, there's these rebates and things, they see smart charge and they go, oh, I can do this with my car now. Finally. Awesome. Let's do that. And then, we find they have a conflict and we can't have dual program enrollment at the same time. So, that's definitely a problem.

So, there's a couple different things. We

should be able to participate in both. It would be very nice. And I think at first you go, well, you don't want to double dip. But you do have systems where it's like your air conditioning demand response is typically, you know, 2:00 to 5:00, 6:00, 7:00 p.m. And EV charging, smart charging could be, you know, middle of the night and stuff like that. But in general, you know, we need to kind of work with this and be able to do multiple programs. Because we've got a lot of adopters that they already kind of are familiar with some of this stuff and they're some of our biggest advocates, and so we need to get them on board.

So, onward to V2G. So, first of all, we'll notice our little V1G rest area. So, you do all those things. We'll get a nice V1G system, it's great, but we need to do more. We need to get to V2G. And so, we'll continue onward to our V2G stuff.

So, one of the big things, too, here is regardless of technology there is going to be -- for V2G, you're going to need an interconnection permit. And so, you're going to need, you know, a generation type system, and you've got all the stuff associated. Essentially, similar to what, you know, a solar interconnection permit is needed.

Sometimes this can take a quite a while. And

we've noticed with our V1G programs is if you have anything where there's a delay, or you need to wait for a little while, early adopters hate waiting. You know, they want this stuff now. In general, you know, folks really want to be able to -- you know, if it's a feature of the vehicle, they want to be able to use that feature as soon as they can.

So, we need to consider things like a type certification, you know, based upon this sort of vehicle is certified and it's able to be interconnected anywhere in the system. Or, you know, barrier-free pathways. You know, I'll let you figure out the details, but there needs to be some stuff there.

Okay, so the next one, Rule 21 includes vehicle standards. So, currently, Rule 21 lists UL 1741 for inverters. However, UL doesn't apply to automobiles. That standard includes things like, you know, access, and clearances, and labeling, and everything that it just doesn't apply to vehicles. And so, UL 1741 isn't quite compatible with vehicle standards are set to.

So, we have the Society of Automotive Engineers has a standard for bidirectional charging, with onboard inverters, J3072. So, what we basically kind of need is a tweak that allows us to either list J3072 as an acceptable safety performance standard, or we could go

and Rule 21 could specify IEEE1547, which the onboard inverters in cars are also certified to. So, we could kind of do that.

There's a couple different ways to approach this but, basically, we need to allow some of the standards to allow onboard inverters.

We also -- we see a lot of cost reduction in AC onboard inverters, but we definitely need that in order for that to occur.

Also, the interconnection rules dictate the type of inverter and generation source. You know, the generation source for a car, depending upon where it's charged it's going to be all over the place. So, we kind of need to change to sort of a power-based system and not the specific model of the inverter.

As well, you know, if you have, say, a workplace that has bidirectional charging capability with that stuff, you may have vehicles, different models of vehicles that are plugging in and they have onboard inverters. You have all kinds of different cars at different times, so you really need to certify more of that site, that charging station. But either way, power-based, so that way it's kind of equipment agnostic.

I've got some final comments. Honda believes

the auto industry is technically prepared. We're definitely -- you know, we've got the technology to do this. But as you've seen, there's quite a bit of different little hoops to get through to get, I think, to a widescale adoption, what we really want to see in the future.

So, all the state agencies, CEC and others, can help, you know, with a couple of different things. We've got some vehicle incentives. Until sufficient market-based value can be generated, we can have some vehicle-level incentives to reduce the risk to OEMs installing the hardware onboard the vehicles.

Essentially, the OEMs are looking many years out. And if it's not like a defined business case now, it's hard to justify including the onboard inverter. But if we know the business case is there, it makes a lot of sense to do it. So, if we have some incentives and some clear pathways there, it will make a lot of sense.

EVSE development. We need some more stuff around that for J3072-based EVSE, necessary for AC-sited vehicle to grid. So, estimate $500 per EVSE deployed might be good. But there' also some direct development funding. We're not EVSE makers, so it's kind of up to them what they think is base. But there's definitely

something that should be done there.

And also, V1G and V2G market development. As I saw early on, you know, there's a couple different things where the markets are not quite tuned for what the vehicles are capable of doing, so we kind of need some changes there.

And then, interconnection support. Definitely amend Rule 21 to enable V2G with onboard inverters. There needs -- okay. There needs to be full support to remove these barriers, so there's a lot of work to do. That's it.

MR. CRISOSTOMO: Thanks, Jeremy. Thanks.

(Applause)

MR. CRISOSTOMO: And lastly, before getting into some moderator discussion, David Schlosberg from eMotorWerks.

MR. SCHLOSBERG: Thanks, Noel. And, you know, thanks for inviting us here today to participate on the panel. You know, vehicle-grid integration is pretty much the reason eMotorWerks exists. Our founder, after he decided to stop retrofitting BMWs to make them all electric, he thought we needed some charging stations to charge these electric vehicles when they started to arrive on the scene and realized pretty quickly that all these charging systems connected to the internet, and

controllable, could be a pretty powerful tool to eliminate and reduce carbon on our grids.

So, he was probably a few years advanced of this panel, and this workshop, and this matrix. But that's kind of why we're on the panel today.

So, just a little bit about eMotorWerks, for those of you who don't know us. We manufacture and sell smart EV charging stations for the home, and for businesses, and for fleets. We've sold over 35,000 charging stations worldwide. But the nature of the EV business is more than half of those are in California.

About a year ago, almost to the day, we were acquired by Enel, which is the national utility of Italy, and a global energy company. They were -- sort of see the issue around vehicle-grid integration very acutely because they're one of the largest owners of renewable generation in the world.

And so, after they -- or, as they continue to build up over 40 gigawatts of renewable power, solar, wind, geothermal, hydro, they realized that the demand side of the grid is going to become a pretty important component for making all of this work, and also pretty important to their financial future.

And so, they acquired eMotorWerks, along with other behind-the-meter distributed energy resource

companies. They acquired ourselves, as well as EnerNOC and Demand Energy, on the conventional, traditional demand response and the behind-the-meter energy storage world, and put us all together in a group called Enel X.

So, that's really how do we get at using the demand side to integrate our renewal energy future, which seems to be the underpinning of a lot of what we're talking about here today.

And so, that's really, as I said, the express reason why we put chargers out in the world. We want to put them out into the world to reduce greenhouse gas emissions by working with our partners, and utilities, and grid operators to time that charging to when it's cheapest and cleanest.

And we really started putting this into action quite a bit ago. So, at the end of 2015, we started working with an entity called WattTime, which is now a subsidiary of Rocky Mountain Institute, to actually work with customers who pay us to make their charging smart and reduce greenhouse gas emissions. So, it's a very different dynamic when we think about demand response and the way we typically get customers to engage in making themselves grid assets, we think we need to pay them.

There are a subset of customers, and I don't

claim that it's everyone, but a subset of customers who want to do more for the grid, or do more for the environment, and so the money goes the other direction.

We actually need to figure out how do we customer segment? How do we work with customers and meet them where they are to be grid resources, and do it all in a way that's cost effective and makes sense?

And so, we've kind of marched along and advanced upon that. But I just wanted to give you that data point that we need to think about things slightly differently, potentially.

So, I mentioned what Enel X is. They are four pillars. We're part of E-Mobility. But E-Industries is where you find demand response in the energy storage world of things. But also, it's more holistic, so we think about the home as a whole, as well as the cities. And when you think about EV charging, it becomes an E-City conversation pretty quickly.

So, I don't think I'm too unique in referencing SB 100, and the 5 million ZEV Executive Order. But I think the question is, you know, how far off on the horizon do we need to start thinking about these things?

And our contention is if we just focus on the 5 million EVs, if we just focus on the carbon-free future, and we don't put these things together, we'll be quickly

behind the 8-ball commercially, definitely from a regulatory standpoint. Such that it will be much more difficult and more expensive to go back and get these vehicles grid integrated.

So, what do we need to do? I don't think I'm unique in having pictures of children, and pets, and things related to EVs. But that's actually my Bolt and there are 12 preschoolers in it. So, it's actually pretty roomy. And I did a little education session with my son's preschool class. And now, you know, they know gasoline and electric vehicles are good because they run on wind and the moon, apparently.

And, you know, I think these things are generational. But we need to do a lot of things right now to make electric vehicles grid integrated, as I like to say, off the lot. And we need to think about things in a slightly different manner that when -- I think, you know, if you realize that there are people who are looking for ways to become cleaner, they're looking for ways to become -- I wouldn't say grid integrated, but environmentally sensitive, they understand that there's a bit of a compact of when you get an electric vehicle what that means.

And so, having the mindset of when you go electric, you're going VGI. I think people have a

mindset of I think I'm supposed to call my utility and find out if there's a better rate plan for me. So, there's already a bit of a connection.

And I think that the utilities are thinking very hard about how do they become that education source? How do they become the trusted advisor? And it can go farther than what we have EVA.

And I'll just make a note here. In our world, when people buy one of our charging stations, our Level 2 charging stations from our website, and they're in a place in California where we're doing smart charging, 30 percent of customers go ahead and sign up for our Smart Charging Program, now. But because of some things Jeremy mentioned, not all of them can get to the last stage of participating. But it's a pretty good sign that people are motivated by something.

Now, what that something is, I think we need to think about. And when the time comes to getting vehicle-grid integration, my contention is that whether you're of modest means or you're buying your Tesla, or you're of modest means, but you're still getting a Model 3, somehow, you want to save money as soon as you make that investment. And you probably don't know how much it's going to cost to charge your car, to fuel your car, so anything you can do to save money on an absolute

basis is good. And certainly, you'd like to think that you're saving money versus gasoline.

And so, participating in smart charging, in the case that you are getting paid for that work, is pretty important even if people don't know precisely how much it's worth.

So, I don't think that this is news to anyone. But, you know, we focus today most specifically on smart EV charging, or V1G. And it has economic, reliable, and environmental benefits. And this room doesn't need to be told, but pretty much everyone outside this room needs to be told that does not require taking electricity out of your car and putting it back onto the grid. But it can be highly reliable, quite efficient in terms of the way our grids are constructed today, and also cost effective.

And so, I think many of the people in this room are familiar with LBNL study that says at a 50-percent RPS, we could use V1G smart charging to integrate renewables at a cost reduction of 1.3 to 1.6 billion dollars, compared to just using stationary energy storage. And they even break up what different value, different capabilities that V1G resource could provide.

So, in my world, so I like to say I do policy on nights and weekends, but during the day I actually

operate our resources in the wholesale market. We actually bid, and participate, and dispatch customers into the wholesale market through Rule 24 and Rule 32.

Now, that load reduction could be recognized from any resource in the home, but we only control the EVs.

So, this is actually the week of July 23rd through the 27th, where we had three days of flex alerts on the CAISO grid, as well as the other days being no maintenance days.

And you can see in the gray is -- this is the Edison West Zone, where we have a bunch of EVs and EV chargers that participate with us. You can see in the gray is the typical load profile of the EVs. Just the EVs, not the whole home. And you can see the price overlay and the shift that we achieved during those days at the direction of the CAISO. They issue a market award and then we go about the work of shifting that EV charging.

You know, we have days where, you know, at certain hours of the day we were hitting the price cap in the day-ahead market, which is not that common. We saw that all of our resources across the state, so every PDR that we operate, proxy demand resource, was called for pretty much every hour of the day that we bid it.

And bid, and operated, and dispatched for multiple hours. And we were able to, you know, control that load and shift it out to pretty much the end of the price curve every day.

And this is emblematic of August as a whole, and every month, but we quoted some stats in a Green Tech Media article about our virtual battery that in August, alone, we were dispatched 974 unique hours across -- that's an aggregate of across all of our virtual batteries in the state, on an average of three and a half hours per day. And the price ranged from $30 to $480 a megawatt hour. But on average, about $50 a megawatt hour.

So, this is -- you know, you think about demand response and you think about resources that don't want to be called very much. They bid pretty high, pretty high in the price curve. And, you know, vehicles, especially in certain charging scenarios, are highly flexible and are more than willing to be curtailed or shifted at very low prices.

And so, how do we use that very -- on a granular basis, very frequently, and highly articulated to integrate our renewable future? I think that that gives you an idea of where this could go because this resource wants to be operated a lot more frequently, like a

battery does, than our traditional forms of demand side management.

So, where do we need to go? We need to do some back flips. I don't think those are electric vehicles in this picture. But, you know, what I think we should call for is really a market transformation initiative for VGI in the state. I don't think, fundamentally, we understand of the state to get the most -- yet, how to get the most out of this resource.

So, what do we need to learn? We need to learn what we need to do. What do we procure? What reliability and economic products should be procured and on what level? How do we do it? What are the contracting mechanisms? That could take the form of a pro forma, but maybe it takes just the form of market mechanisms.

Learning about when these charging resources are available and where they're available. You know, the Honda program is quite unique because they're following their customers everywhere they go and doing smart charging wherever they go. You know, except for my work with Honda, we only pretty much work with people at the home because smart charging outside of the home is pretty difficult, especially if you're trying to integrate into the wholesale market. The opportunities

are more limited until we get more load shift and more activity in the daytime market.

So, I think this is, you know, a ripe conversation for how we transform the market, and looking to work with the CEC to lay that out a little bit.

(Applause)

MR. CRISOSTOMO: Thanks, everyone.

Eli, if you could just put the names up? Or, I guess, the first five questions that we have for the Policy Panel, to keep everyone's mind -- yeah, to them, and the audience as well.

These were great perspectives from environmental advocates and different market players that kind of work together in a chain of events to do and actuate the smart charging.

And so, as we think about kind of market planning, procurement options, liberating value to allow automakers, charging providers, and utilities to work together, I noticed some variation in what low-cost meant. And so, Honda, you mentioned about the, roughly $500 per EVSE would be necessary to enable V2G, which is a great thing to hear from an automaker wanting to push that bidirectional solution that's beneficial to the customer and to the grid.

David, you mentioned that eMotorWerks started to create their own chargers. So, you know very well the cost to actuate the Wi-Fi, and smart controls, to develop apps. It's interesting to hear that perspective.

And then, Hannah, you're focusing on how rate design and new incentives could be created at the utility level to offer that in the context of Jaime's comments, which were the need to create highly granular, location -- locationally, and dynamic -- locationally and temporally dynamic offerings.

And so, it seems like there's a little bit of a diversity of what needs to be pursued and what can be economically pursued.

So, I want to hear everyone's quick thoughts on what should we be designing for? Should we be skating to the puck, where the puck is, or where is it headed? How do we kind of come together to make sure everything works simply and in an interconnected fashion?

MR. WHALING: So, I think the short answer is I think we need to get to vehicle-to-grid in order to maximize renewable energy and to reduce other carbon sources on the grid as fast as possible. So, I think that's like that should be our ultimate goal.

Also, you have to, then, take into account the

costs of doing that and, basically, the lowest -- try and attempt to do it in the lowest cost possible.

So, however you want to do that it's, you know, sort of up to the policymakers and stuff like that. But, you know, I think what gets me is that, oh, we had the GHG increased in transportation. I think that when you have something like vehicle-to-grid, and you're able to not only displace, you know, what was gasoline emissions of the vehicle, but also displace some of the grid emissions, that's really -- that's huge. I think that's an amazing thing to do.

And it looks to be, you know, that's going to also be an economic thing to do. So, I definitely want to see that.

MR. CRISOSTOMO: Hannah?

MS. GOLDSMITH: Yeah, I think in order to really get to VGI or V2G at scale, we really need more vehicles and more charging first. And that's why our priority is always around, you know, rebates and funding, and getting the policies in place to ensure that there are going to be charging stations where drivers need them, and all those things.

And that's not at odds with what you're trying to do. You know, it's complementary to it because we need to get to the point in the market where there are

more electric vehicles that are able to charge, and soak up renewable energy, and we're relying less on fossil fuels, and less pollution.

But I think in terms of the lowest cost options, we have seen that a lot of the V1G solutions are very effective. And making sure that consumers are aware of the vehicles in the first place and then, after they know about the benefits of driving electric, kind of get more into how to charge their vehicle, and how to save money even more is kind of the next step there. And rate design is very important to that. But there's probably more that we can do to really ensure that folks are signing up for those or, in the future, we're just going to see that everyone will be potentially on those rates, anyway. And so, that will help shift this and ensure that folks are using energy when they need to, and not using it when they shouldn't be.

But we do have to keep in mind there that folks, where you're using your car, it's not always the same as choosing when to run the load of laundry and you might need to be charging at inopportune times. But it still needs to be accessible to everyone and it still needs to be affordable.

MR. CRISOSTOMO: David, I'm hoping you can provide some perspective on how solutions can be

customer-oriented, mobility-focused, and the design of charging equipment.

MR. SCHLOSBERG: Yeah, it's not a terribly difficult undertaking to have an aggregation of charging resources that have a predictability to them that incorporate the expectation that the Wi-Fi is out or that the customer -- that there's a set of customers who are just going to opt out. There's just always going to be 10 percent opt-outs, or whatever that is.

And so, you know, the individual customer should ultimately, always have control over their charging. And if their mobility requires them the charge so they can go to the Warrior's game, you know, that night, they're going to do it and that should be fine. And that the service providers and the utilities can be planning for that.

I guess you were saying, you know, where do we skate towards? You know, there's a question of do we skate towards V2G and not work a lot on V1G. I think there's just a ton of work to be done on V1G that has not been done as of yet. And the reality is we're going to have a legacy of a lot of vehicles out in the field, a lot of chargers out in the field that are just not going to be bidirectional and so how do we get the most out of them?

I think the other interesting area is we -- you know, we see acutely and I'm assuming the utilities see it, but they don't quite admit it from the distribution operations stand point, yet, but these EVs are concentrating in neighborhoods in a very aggressive way. And that's going to have some issues around how the distribution grid operates at some point. And, you know, there's a question of is that two years, three years, or ten years from now that that's going to have a major concern.

And, you know, the way that we're setting up time-of-use rates are going to have some adverse effects when that starts to bind.

And it's interesting, we have some conversations in Hawaii, who's obviously thinking about 2045 in an earlier time frame, and they don't even really like time-of-use rates. They would like to be working with service providers and technologies to basically shape the load exactly as it needs to for that day. And granted, it's an island grid and the weather that affects their solar and their wind could be more acute.

But it kind of gives you a sense of we need something that's that dynamic. And I don't think that they would claim that they have the customer education and behaviors in place to really do that at scale, yet.

But they're realizing we have to start on that now, and we have to have the technologies in place so that we can shape the load from what's going to be a large source of demand sooner than later.

MR. CRISOSTOMO: Before turning it to the audience to provide their own policy actions for the roadmap, I want to kind of ask Jaime to elaborate on a point around if we think to 2045, 2050 what the utility model of the future is. If all of our cars can do V2G, can offer kind of transactive charging services where we have, say, FreeWire's original vision to have autonomous Mobis going around giving infrastructure services in a way that avoids a lot of grid upgrades what changes need to be made to the regulatory and policy models to allow for that innovation to occur?

MR. FINE: Thanks for asking. Well, you've asked a big question. So, I'll give kind of a starting point version of the answer.

So, the one thing that I'll point out is that when I say we want to open the door for utilities to earn fees for providing services to optimizing distributed energy resources, including EVs, it doesn't mean we're completely eliminating the rate of return revenue model.

So, when we think about what could a utility

accomplish in terms of revenues, let me take you back to four years ago, where I spent four days sequestered with a California utility, an EV innovator from California, a microgrid solutions provider, and a large social media company. And the question was, the utility posed, we could put batteries on our side of the customer's meter, but we think customers are bringing their own batteries. What can we do to earn some money from that?

And the answer was, well, there's a variety of services you could provide to that battery. And that battery may or may not be on wheels. And so, we suggested you could earn fees, for example, for scheduling that resource into the wholesale markets. You could earn rate of return for running the wires and the balance of the system to connect that technology. You could get services for operation and maintenance of the battery and the other appliances.

And then, ultimately, we said you need a good rate design. But the kind of punchline was, but you also don't need to require any technology. And what we mean by that is you can actually look at performance from your side of the customer's meter and not worry so much about how the customer's achieving that performance, and let the customer decide what combinations of technologies and practices they want to

deploy. And if you put an EV in the driveway, that creates a whole lot of additional opportunity to manage your load.

So, it's an additive capability when you start adding EVs to an already efficient, smart home. So, that's kind of one element.

The other thing I want to raise is the issue of the distribution system. So, our California utilities make the biggest chunk of their shareholder rewards from distribution system investments and that's been the name of the game for years. Like, over three-quarters of shareholder rewards come from distribution system investments.

So, to inspire the utilities to find an alternative to that, we need two types of planning processes. One that we have a distribution node that's already being challenged by the growth of DERs on the grid. And then, another distribution node where those DERs are not yet there.

And in the context where we have DERs challenging the grid, we have concepts like the IDER Incentive Pilot that we're testing in California, where we want to incent the utility to solve distribution needs and get a rate of return for it.

But in the neighboring substation, where there

isn't yet a challenge, we need longer term planning and we need pricing that inspires that part of the node to evolve with smart DERs, such that you're not in a situation where you have to make a major distribution system upgrade. So, the value is in avoiding these upgrades.

An example you might want to look at is the Brooklyn-Queens development project, out in Long Island, where the utility was looking at a $1.2 billion substation upgrade. They've been able to push off that upgrade to 2026 by inspiring and incenting DER solutions on the customer side of the meter, but it's only pushing off the problem. And at the same time, no one's talking about the neighboring substations. And that's where we need to solve problems before they become $1.2 billion threats.

So, I hope that answers the question.

MR. CRISOSTOMO: Yeah, it also provides some good context for the audience members to build upon. So, I know we have a little under 20 minutes and two roaming mics, and I'm sure people are chomping at the bit. So, let's open that opportunity now.

And thank you for our panelists and your contributions.

MS. PIERO: Hi. Can you hear me? Okay. I'm

curious about the --

MR. CRISOSTOMO: If you could introduce yourself and organization?

MS. PIERO: Sorry. Yeah, I am Jacque Piero, from Nuvve. And I definitely agree V1G and V2G are both parts of this roadmap, you know, that comprises the vehicle grid integration definition.

But I'm curious how V1G can end up being used or accepted as a storage resource in terms of, you know, a mandate? Does it meet regulatory definitions of storage or is it more a flexibility resource. So, I'm curious how you get there from here, to have V1G be actually a storage resource.

MR. CRISOSTOMO: So, during my time at the CPUC, Commissioner Peterman had a rulemaking on storage, in which various technologies were defined to be eligible. And so, V2G, particularly the Los Angeles Air Force Base's project, implementing fleet management there was seen as a storage device.

But I know there is ongoing advocacy in favor of one-way charging, just absorption of energy as a storage device, without providing that bidirectional service. And so, it could be as simple as some of the proponents are suggesting, as an inclusion in terms of the eligible technologies. But, yeah, I'm not sure if you guys want

to add to that.

MR. SCHLOSBERG: Yeah, I mean it might be academic until we change our goals on how much storage we're going to buy through one sort of mechanism, right, because there's only one more procurement left and there's been a lot of storage procured outside of that structure.

I mean, I think, you know, energy storage is the movement of time or place, you know, those electrons. And so, it is very definitional at the CPUC. I think some people might have spoken about that, actually, maybe two of the panelists.

I think what's more important is something changed after we had the Energy Storage Mandate, and we figured out how to buy energy storage and we figured out what to use it for. I'm not sure that that exact same rubric is going to answer how we buy flexibility services from V1G or V2G.

So, my thought is, and our thought is we need market transformation some way. And how we get it, I think is an ongoing discussion.

MR. FINE: You know, I'll just answer this question in a somewhat different way, and thinking back on the prior question you asked me. There's kind of a risk-reward situation we need to be thinking about, and

when we think about what is V1G and who gets paid for it.

Let's think about an example of, say, smart thermostats where, in some jurisdictions, when you buy your fancy, smart thermostat, the utility gives you a rebate at the point of purchase. And the utility's doing that because they're saying we're going to take on the risk of harvesting the value as using this device as a demand response service, and we think it's worth $75. So, we're going to go ahead and advance pay that for you.

That flips the risk-reward situation, right? Maybe the utility could get $90 of value out of that and they've paid the customer only $75. But the customer doesn't really, necessarily, have to do anything and their technology's already cheaper.

So, if we think about risk-reward in the context of V1G, at one level you can say we're going to roll these cars off the lot and we're going to have them preset to charge at certain times. And we think with that default, we're going to get a certain type of performance. And we're going to prepay that performance in the form of maybe the purchase price of the vehicle. Maybe you're prepaying the customer to be enrolled in a demand response program and the utility's making a deal

with Honda to harvest that value at the outset.

Again, who's taking on the risk and who's getting the rewards? There's a variety of ways we could think about that in the V1G context.

In a real-time pricing world, you're getting rewarded because you're responding to price. And then, I would also say from the long-term planning perspective, the proof is in the pudding.

You can see the behavior. I remember a San Diego Gas & Electric presentation that's probably five years old, now, customers will respond to time-of-use rates. They charge off peak. We're learning that. How many times in a row do we have to see it happen to believe it, right? The proof's in the pudding.

MR. CRISOSTOMO: So, I want to emphasize that stakeholders can respond to that and not necessarily ask panelists questions. So, if they have ideas on any of those four, please offer them because we are taking these into consideration for the actions update.

MR. ASHLEY: So, Tom, with Greenlots. I'll take you up on that, Noel. So, just wanted to reinforce a couple messages that were offered, one by David and one by Jaime.

So, one, David mentioned that, you know, we're starting to see more rate design related to managing EV

charging, or thinking about how to integrate EV charging. And, indeed, sort of a lot of the first efforts are varying degrees of blunt TOU approaches, which may be perfectly appropriate in many service territories at the scale of EV charging that we're looking at currently. But maybe, wholly inappropriate in other service territories or at greater scales into the future.

And I would just note that Greenlots has been messaging, fairly aggressively, in a lot of different jurisdictions for a technology-based approach. And I would just acknowledge that there's been quite a range of receptiveness to this message. And I think there's a real opportunity for California to provide strong leadership in this area.

The other, I wanted to follow up on something that Jaime mentioned. So, it's a flavor that we're seeing here in California right now, maybe seeing more aggressively in other jurisdictions, Hawaii for example, which is pressure to move away from compensating the utilities in maybe the traditional manner. And I think there's a lot of opportunity to think about how we want to do this in the context of managed EV charging.

I'm not advocating for evolving how we're compensating utilities, but recognizing that this is

happening I think it's an opportunity, again, for California not necessarily to develop a new technology, but to be on the front end of identifying the opportunities for taking different approaches to getting the results that I think we're all trying to accomplish here.

So, happy to answer any question, but I'll give it over to the rest of the audience.

MR. SCHLOSBERG: Yeah, I think we should recognize some of the work that San Diego is doing with performance-based incentives around the residential charging program.

You know, given who we are, we tried at different points in time to make -- to encourage San Diego to go even farther, to think about VGI in a more advanced manner. So, I think we're going to get a lot of off-peak and super-off-peak charging out of that program if it goes forward, but there's probably even more that can be done.

So, hopefully, there will be an opportunity after we get the deployment of tens of thousands of chargers, and EVs through that program to really think about, well, how do we help utilities really keep going farther on VGI? And maybe this roadmap and maybe some more focused work on what do we want to procure from EVs

could come from that.

But I see we are seeing some innovative compensation structures for utilities.

MR. CRISOSTOMO: Matt Tisdale.

MR. TISDALE: Thanks, Noel. I wanted to double down on Noel's question about skating to the puck. Not where it is in the moment, but where we expect it to be in the future.

And my question is really about what your expectations are for the future grid needs, for the future grid challenges, and trying to think about what your expectations are in that context, and how they align with your current incentives.

Are you expecting a future of grid challenges that is diametrically different from what you're being asked to do right now?

Or, are the incentives that you're currently receiving and the signals that you're currently receiving roughly in line for what you expect for the grid of the future?

So, I'm leaving the grid-of-the-future question a little bit open because I'm also kind of curious to see what your understanding is of what is the needs of the grid of the future? How well is the State of California communicating to use problem solvers what it

needs five and ten years from now?

MR. WHALING: I love talking about the future, so I'm going to take it. So, one of the things, actually, just to go back a little bit, so we mentioned that the original roadmap was about four years ago, and so now, we're working on it again.

And I kind of thought to myself, well, what about four years from now, what's going to be substantially different? And I just kind of wrote down three things. So, I wrote down bigger BEVs, autonomous vehicles that are primarily autonomous. And more medium- and heavy-duty space. So, I think --

(Off-mic question)

MR. WHALING: Both. Yeah, that's actually -- that brings up a good point because it's the same thing at the same time. So, you have bigger BEVs, and we've already kind of seen this with some of the -- you know, the Jaguar I-PACE, and the Audi e-tron, is that the bigger SUV's, they're not going to be that efficient. They're going to be in the two- and three-mile-per-kilowatt hour range. And so, they're going to need big packs that are not going to charge very fast from our existing infrastructure. So, you're going to have to build -- you know, like, they're looking at higher-powered DC fast charging, and maybe we're going to have

to have bigger Level 2, and it's going to change some of that stuff.

So, I think we're going to see some of the future grid challenges, you know, are still going to kind of be some of the same themes of trying to put in more stations, more places, less cost, breaking down barriers.

But I think one of the biggest future grid challenges that really needs addressing is the apartment charging. And so, I have two EVs, one that's a big battery BEV and one that's a small battery BEV. And even with workplace charging for both of the cars, it's doable, but it's not nice. And people want -- you want home charging. And you want home charging at apartments. So, I think that that's going to continue to be something that is going to be very challenging and that's something that needs to keep getting addressed.

I'll let others address some of the other stuff from your question.

Well, okay, so for autonomous. So, for autonomous, you know, it kind of comes down to if you have a vehicle that's constantly on the road, you basically -- the opportunity cost for that vehicle is to be always on the road, and trying to pick up customers, and move them. And so, you won't have as much ability

to do grid services, necessarily, with it. Except, you do have downtimes, probably, at certain hours. You know, the demand is not constant throughout the day for everybody. You probably have pretty much two peaks, maybe three or four peaks on the weekends for people moving around.

But in general, you're going to have these vehicles try to be on the road as possible, so you won't have a lot of down time. And so, it's like, well, how do we integrate that more with what we want to do in the future?

And with heavy-duty, medium- and heavy-duty, I think it's just -- you know, if you want to see a utility planner's eyes go wide is try to express what a bus depot is in terms of load. You know, you're looking at megawatts sometimes, in these cases of large bus depots, with very little ability to have the tons of equipment that you need to serve that kind of load.

So, I think those are the big three things that we're going to see in the future.

MS. GOLDSMITH: Yeah, I guess I didn't totally answer the question about skating with the puck or moving ahead of it. But I think this is something that we face in the funding situation, as well for zero emission vehicles. And it's kind of you want to be

incentivizing and taking part in actions that are advancing the technologies that we have here today and making sure that the solutions we have are being used.

But we also want to be thinking about the future. And to that extent, I think the way that we've been moving so far has been appropriate, in terms of pilots and demos to be proving out things that aren't quite yet ready for commercialization, but still ensuring that we're focusing on those things that we can do in terms of rate design, and things like that. Which, you should be shying away from those types of applications. We should be exploring them through targeted actions, and demonstrations and really understanding the picture so that when we are more familiar with them, and they have been proven out that we can start moving towards that path more aggressively.

MR. CRISOSTOMO: I want to check if WebEx has any questions?

MR. CHEN: So, we have one question from Steve Davis. I'm going to unmute your mic. There we go.

MR. DAVIS: I think I have a little bit of an echo there, but I'll do my best.

MR. CRISOSTOMO: We can hear you.

MR. DAVIS: First of all, thank you, Noel, for setting this up. I'm really sorry that I couldn't be

there in person.

But, yeah, this is more of a comment than a question, in response to -- or, an answer in response to Noel's question about, you know, how do we approach the future and how do we set the stage for revolution-scale adoption that preserves our options for VGI.

And, you know, this is -- no one in the room that's heard me speak before is going to be surprised by this, but I'm going to go ahead and say common unique communication standards are the indispensable ingredient in that.

I'll start with a couple of points that, you know, simple is what always wins. And in this conversation about VGI, we have to keep in mind the consumer has absolutely no interest in VGI, and aside from some early adopters and innovators. But once we get in the early majority, we have a cohort of people that barely understand how the grid works or that there even is a grid. So, we want this to be a seamless experience as much as possible.

I think it's mistake to talk about V1G versus V2G at this point. If a standard is going to support both, then that's the right way for us to build our future. And I think that currently the ISO 15118 standard which has embraced both bidirectional power, as

well as wireless inductive charging sets us up with a way to respond, actually, now, to a market signal that we've gotten from the automakers.

About four years ago, I presented to an interagency panel regarding standards and the question was, well, how do we get this going? And my answer was, well, we send the market a signal by declaring a standard for equipment.

At this point, California has, you know, been not making any decisions on this, but for a few early signals from Cal HVIP, that the automakers have now pretty much landed on ISO 15118 for both DC Level 3 fast charging, and AC Level 2 smart charging.

So, it's now incumbent upon California to validate that market signal with investments in AC Level charging stations that enable the seamless experience that's going to be the lynchpin of success or failure for these resources being able to be, one, certified as dispatchable in the markets. So, that's kind of important if you're going to dispatch them intelligently, in alignment with market signals. And then, the seamless roaming experience for the customer.

So, again, I would just say everything I've heard today is aligned with what's been said, now, for six years which is, hey, how do you -- you know, when's

the best time to plant a tree? Well, the best time to plant a tree is 20 years ago. The second-best time is right now.

And if we're going to have 5 million vehicles and lots of consumers interacting with them, that they're autonomous or, you know, or not, we've got to have a simple customer experience. And that's achieved through communication standards.

And the good news is we've already got one. It's been sitting there since 2014 as a final product. Thank you.

MR. CRISOSTOMO: Any -- oh, from Olivine.

MR. SONEJI: Hi, guys. Hitesh from Olivine. Thanks, everybody, for coming today. We implement the Excess Supply Pilot, which is a pretty cool project. And we also work with David and EMW, and Sonoma Clean Power.

I'd say one of the things I would like to emphasize here, just from a policy planning perspective, is really figuring out this hard, hard thing to solve, which is the workplace charging. If we want to achieve the reduction of curtailment here and be consistent with where you see some good pricing in Excess Supply Pilot, which obviously makes sense is when the sun comes up and the California load's not that great. We really need to

figure out that.

And I think in that is a question which is what is the resource here? Because, eventually, this is going to get into like defining resources and how they participate in the market. Is the resource the charger or the vehicle? And then, how do you manage that in a sort of -- like what is the CAISO product that can handle this resource that moves around and is quite variable. I don't have the answer to that, but I think that's something we should be thinking about.

And secondly, we do a lot of work with electric transportation in the public transit sector. And I think, you know, wow, Jeremy, 3-kilotwatt-hours-per-mile for an SUV?

MR. WHALING: Three piles per kilowatt hour.

MR. SONEJI: Oh, okay. Sorry, I flipped it. I was going to say like --

MR. WHALING: But buses can be more than a kilowatt hour per mile.

MR. SONEJI: Yeah, absolutely. Yeah, that's been our experience as well, yeah. But, you know, you can move 80 people at once. So, you know, this is more of a commentary and it doesn't come from Olivine. But, you know, public transit is also a really good way to reduce emissions in the transportation sector. And I'm

not sure how this body can encourage that, but that's something we should keep in mind as well.

MR. SCHLOSBERG: Just can I respond to Hitesh and Matt's question earlier? You know, the issue you're raising, I'm not sure a facility versus car is the major issue, although there could be some efficiencies if we figure out a nifty way to do it, and tracking resources where they go. But it really just hits on what do we need at every hour, every moment of the day to balance the grid?

And so, you know, we had the clean standard that was passed a year or two ago, right, where we're going to figure out how we're going to get more of our RA resources from clean sources. I mean, I just think that we're 2045, now it's a marker through executive order, how are we going to get all of our reliability services from non-carbon-based sources? You know, yeah, it's going to be a mixture of things. Batteries are certainly going to -- energy storage is going to play a role. But all of these electric vehicles, all these VGI resources, they're going to have to do the heavy lift.

So, that's the vision. That's what we're training for right now is what we need and that's what we're going to have to build towards.

MR. WHALING: I'll briefly mention that I love

workplace charging and I think that you're on the ball there, where it's like we need to have more load during the day, so we need more charging during the day. And usually that means that, you know, a good chunk of cars are going to be at worksites, and so we need workplace charging in order to charge them.

There's two main things that are sort of hampering maybe a little bit of workplace charging. One is cost. You know, it's expensive to run power out to the station. It's expensive to bill the drivers with, you know, some of the existing products right now.

And I think the second is sort of the what-do-I-do of, basically, like what -- somebody in the company needs to tell the facility manager, hey, we need to do this. And the facility kind of goes, I have no idea what to do because maybe he's not familiar with workplace charging or any of that. So, there's a bit of a barrier there on trying to get that started with different companies.

But once it is started, it's usually quite successful. And I've seen that with -- you know, at American Honda, we have charging for our workplaces. We've seen quite a bit of uptake in electric vehicles. We did some driver surveys and 87 percent said that, you know, workplace charging influenced their decision to

get a vehicle, which is a substantial -- it's very high. So, it's a great marketing tool.

And with my wife's work, I helped them sort of figure out their charging situation. It's a small business, so they didn't need as many stations. But they basically were kind of stuck for a while just because they didn't exactly know how to approach it.

So, there's definitely opportunity there to help worksites get that. And I think we're seeing that with some of the stuff with the utilities right now, trying to do the site-ready stuff, and up to the stub, and everything like that.

MR. CRISOSTOMO: All right, one last question before we take a break. And we eroded into some of it. But I want to get us back on track for a 3:10.

MR. WEYL: Okay, thanks Noel, I'll try to make it fast. Vincent Weyl with Kitu Systems. I want to build on Matt's question about the future. We have a hundred percent renewable, clean energy goal by 2045. With 5 million electric vehicles, we are nowhere near a hundred percent in California.

So, my question is from a policy and planning perspective should our policy aim toward getting to a hundred percent clean vehicles at some point?

And the second aspect is from a planning

perspective should our planning guidelines enable the progress in transition, so we don't have stranded assets, which is a point that David brought up, because we have a V1G?

MR. CRISOSTOMO: Any respondents?

MR. WHALING: Okay, I'll go quickly.

MS. GOLDSMITH: Yeah -- oh.

MR. WHALING: No, go ahead. Go ahead.

MS. GOLDSMITH: Absolutely we should be aiming to get higher than 5 million zero emission vehicles. We should be aiming to transform our market as much as we can to take advantage of fueling these vehicles in a clean way.

And in terms of the stranded asset type question, I think that kind of hinges on something that we've been recommending in terms of the pilots and demos to really prove out what the options are, and what the most effective means is. And this kind of ties into the 15118 comment. And we're not -- LETC doesn't have a position on what standard should be used, but we do think it's going to be important to let the market determine what the best path forward on that is. And to support all of the options there with an eye towards future proofing and ensuring that we aren't stranding any assets. But allowing for unique and innovative

opportunities to arise and ensuring that the market can rise to the task to combining all these together and not kind of limiting any sort of interaction on that side.

MR. CRISOSTOMO: Jeremy, you'll have the last say.

MR. WHALING: Okay. I promise I won't cut in too much to your break.

Okay, so for stranded assets. I think the biggest risk in terms of stranded assets is actually looking at the electrical infrastructure in terms of like the conduit, the wiring, all that sort of stuff is probably your -- usually, that's like the biggest cost for a lot of these different setups.

And so, if you have a communication standard that allows you to have a smaller, you know, transformer, or smaller conduit and wiring, and stuff like that, you know, maybe it's not exactly a stranded asset, but maybe it's not the best -- effective use of funds if you have to build out the site more for every station having full power.

But also, there's also the case of where you -- say you have a sit that maybe it was sited originally for Level 2 and it turns out eventually we need to get DC fast charging there, and now you're lower-power wiring is no longer applicable. And you have to get DC

fast charging, you know, a big grid feed, and all that stuff, and you have to rip out some of that.

So, that would necessarily be a stranded asset or, again, not a good use of funds.

But also, I think with sort of like V1G versus V2G, you know, I responded to the question of where we're skating to at the park is that V2G is really where we kind of need to go, because I think that's where the park is eventually going. But that doesn't mean that V1G isn't really critical.

I think that there's going to be some cases where there's a lot of V1G, especially around site level demand management, there will be a lot of stuff there. And, you know, grid services as well, certain places where it just doesn't make sense.

You know, I think middle of the day you're probably not going to do a lot of discharging, so maybe there's not a lot of V2G during the middle of the day. But there's certainly a lot of cases for, you know, EV and peak demand, where you could have a lot of V2G there and save a lot on your grid, and in terms of your carbon emissions from other sources, and stuff like that.

So, yeah, thanks.

MR. CRISOSTOMO: Great. So, to transition with panels, I want to call up the next set of folks to come

here, and then maybe we'll have a break in place to just stretch, and so we can keep going. Thanks.

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

(On the record at 3:20 p.m.)

MR. HARLAND: All right, it looks like everybody is back in their seats. So, thank you for doing a bit of a blitz break there. I really appreciate it.

We're going to get started on our afternoon panel. So, I'm going to hand it over to Carrie, from the CPUC. Introduce yourself, I guess, and the panel, and let's get going. Thanks.

MS. SISTO: Thanks, Eli. I'm Carrie Sisto. I'm an analyst with the California Public Utilities Commission, focused on electric vehicles and transportation electrification. So far, my work there has been pretty focused on utility applications for programs to help accelerate transportation electrification across the board, as directed under SB 350. And now, I'm starting to get to oversee the implementation of those programs, which is really interesting to be a part of.

And so, I was asked today to help lead this Economic Potential Panel that kind of delves into identifying strategies to make sure that the programs that were adopting to accelerate transportation

electrification are economic, both from the point of view from a utility, and also from the point of view of the customer's participation in the transportation electrification programs. And to identify the barriers that exist on both sides of that wall and find strategies that kind overcome barriers for everyone interested in these programs, both on the utility side and the customer side.

So, we have a great panel. We've got representatives from some utilities. We've got some men who have been working on modeling this stuff and helping both the Utilities Commission and the utilities come up with strategies to overcome these barriers. And then, we've got a panel member from NRDC, who's helping kind of bring the customer voice to the table and on overcoming those barriers.

So, with that, I'll start off with Cindy Fang here, from SDG&E, who's going to focus a little bit on their programs to date.

MS. FANG: Thanks everybody. And I kind of want to start with thanking the first panel for many reasons, but also because they really just set the stage for my discussion about some of the rate design ideas that we've put out there.

So, traditionally, when we talk about EV rates,

the focus tends to be on super off-peak and sending super off-peak charging and limiting demand charges. And so, when we started looking at vehicle-grid integration, you know, I approached it with the same mind as Jaime's earlier comment that we already know people are responding to TOU pricing.

And so, we were looking at something that we wanted to really be the next steps about EV rate design. And with that, it really was more of a long run look and looking at scalability.

And so, because of that what we did is it was a focus not just on managing load at the system level, but also managing load at the circuit level. And so, with that, what we ended up coming up with is an hourly dynamic rate, which had with it system peak price signals. So, for the top 150 hours at the system level. And also, circuit peak adders. So, top 200 circuit adders. So, when you expected the top 200 hours at the circuit level to occur, there would be price signals for customers at that level.

And so, what customers would see across the service territory is that those circuit level peak adders, so SDG&E, we've got like a thousand some odd circuits, what they would see is every customer would see the top 200 hours. But what it means is those top

200 hours would occur at different times based on the load at each of those circuits.

MR. HARLAND: And Cindy, I'm navigating up here for you. We had a little technical difficulty. So, I can go to the next slide when you're --

MS. FANG: Yes, awesome. Thank you. Next slide.

And so, with that, when you look at the cost drivers at the system, you know, the drivers vary -- oh, can you go back to the other one? Thank you. the drivers vary based on the differences of the services provided at the different levels of those assets.

And so, however, when you think about capacity-related costs on the utility system, there's a lot of similarities. So, with capacity-related costs, we are talking about the driver being peak load.

But then, between the system, so when you're looking at generation and commodity resources, you're talking about the system being defined as the full aggregation of all -- so, for us, it's all of SDG&E's customers.

But as you start to move down through the system to those more localized levels, that load looks very, very different. Because it's much more localized, it's fewer customers, it's a much smaller load.

The next slide, please. And so, because of that what we did is we took a deeper dive into what that looks like. So, a few things that we saw as we made that observation is that only some of our circuits peaked at the same time that our SDG&E system peaked.

In addition to that, what we saw is that when you look at the shape at the circuit level, those shapes could vary dramatically compared to what we see at the system. So, you have some that really align, they come really close. But as you started to look at the individual circuits, that load shape could vary significantly.

The other thing that we found is that sort of the persistence of that shape or that persistence of that peak ended up being far more transitory than what we saw at the system. So, as you can imagine, when you're looking at each of the individual circuits, so that's the -- you add up the thousand circuits to get that sort of system load shape and that system peak, that ended up having a much, much stronger persistence. Which works because the CPUC has already given the California IOUs the guidance that TOU periods should basically be in place for about five years.

And that actually seems to work out when we look at the larger system. But when we look at the circuit

level, we can see it doesn't take a lot to really sort of change that load shape to change when those peaks occur.

And so, as we started looking through what design is going to be most appropriate to address some of these issues, that's when we started to really step away from just a conventional time-of-use rate.

The other thing that we were challenged in, especially when we look at rate design, is the problem of equity. So, when you think about how some circuits are more heavily loaded than other circuits, so that issue was sort of brought up earlier, imagine the potential equity problems that you become faced with if you price one circuit higher than the next circuit. Imagine small businesses. You know, those small differences, a lot of small businesses operate on a very narrow margin. So, those small price differences actually could have a meaningful, a very meaningful impact on just the operational viability of those businesses.

And so, that was the other reason why, when we looked at the rate design, why we chose to price every circuit, even though not all of them were fully loaded and needed immediate, you know, response. But what it did is it set up a price signal so that you're looking

at the top 200 hours for every circuit, which sort of pushes out that idea of when that investment will occur.

So, the other part, as far as sort of the temporary nature of this, when we moved away from TOU, the one thing about TOU pricing is it is, I think someone earlier talked about habit. TOU pricing sort of conditions customers to sort of, for SDG&E, our on-peak period is 4 to 9. It conditions all customers to know that 4 to 9 is the high-cost hours.

But when we looked at how the circuits are going to go and what is something that's really going to be sustainable for the long run, what we looked at is how do we really capitalize on the potential flexibility of EV charging?

And so, when we moved away from a TOU structure and, instead, focused on these top hours, what we were able to do so our on-peak periods end up creating a situation where it's anywhere between 15 to 20 hours are high-cost hours.

But when we moved to the 200 and 150 hours, it ended up being four percent of our hours are high-cost hours. So, when we introduced this idea of a much more flexible rate design, what it creates is it opens up the economic potential, too, for many more low-cost hours for charging.

So, if the customers can be flexible, if they can actually really respond to a very active, a very dynamic price signal, then all of the sudden it opens up the potential for all these low-cost hours.

Now, the one thing that I will say -- so, let's go to the next slide. So, this sort of talks through the different, you know, rate design tools that are out there. And the reason we moved to this sort of top 150 and top 200 hours concept is it does model after our existing CPP rate design that you have for commodity services.

But what we did is we basically took that idea and brought it down to the circuit level. And with that, it does give you some ability to respond to that capacity-related price signal. A different way to do it than through just straight up demand charges.

I will say, though, as we continue to look at the different issues that we see with further EV adoption, there will be more that needs to come with this. You know, I think that the longer-term solution, it's not going to be just rate design. It needs to be partnered. Technology ends up being absolutely critical, especially with a complex rate like this.

When we put out our Power Your Drive pilot, with that one it does come with technology that is very much

a set it and forget it. You know, without that, it really is too much for people, for any customer to really be monitoring, every hour of the day, the pricing.

But what it did create is that customers could identify that they don't want to charge at a price lower than X cents. Let's say it's 20 cents or 16 cents. And then, when you're plugged in, then it would just charge when the price drops below that level.

The other thing, we also did a residential pilot and this did not come with actual technology, but it did give them an app for the price. So, our residential pilot, I had people coming up to me all the time.

And so, if you look at those bars, they knew when that price was high. There were all sorts of conversations between husbands and wives about, no, you will turn off everything at this time of the day. And so, people did understand, when you introduce some of those tools, but it absolutely is necessary.

The pilot was just a one-year pilot. But, you know, if you were to actually partner it with technology, with enabling technology where, you know, you would be cycling your thermostat, other things, then, you know, that's really where we want to see these things. You would see a rate design like this actually

have some legs.

As far as the incentives, one of the things I mentioned earlier is sort of the temporary nature of some of the need that can show up at various circuits. I think a partnership, with incentives, ends up being a really important partnership. Because that sort of temporary nature of the need means that there is sort of a first-come first-serve aspect to what's needed at the circuit level. And I think that that allows you a mechanism to be able to facilitate that and avoid some of the issues as far as equity across pricing for customers.

I would also say that more technology and programs, as far as actually limiting the load, is going to be critical as this continues to scale.

So, you know, we talk about super off-peak charging, but when we look at EVs -- you know, years ago, SDG&E talked about how an EV was equivalent to an average residential home for SDG&E's service territory. That is no longer the case. And we know that the size of the charge is going to just get bigger and bigger.

The clustering of residential customers adopting EVs is going to be a high probability. And when you think about the introduction of fleets, more fleets, medium, heavy duty, it could very easily become the

situation where the super off-peak becomes the new on-peak.

And so, the ability to be able to get these customers sort of used to the idea that this is going to be a flexible, moving target as far as when we want you to charge, is going to be really important.

And in developing rates like this, I hear a lot about the challenges of complex rate design and what it means to our customers. And with this, that's where technology is critical. I think that the -- and you have to sort of sell the economic benefit on this. But that flexibility can get you more opportunities to save. But with the sort of the size of the loads that we're talking about, I think that there's no way for us to really move forward without some discussion about load management, actual controls.

So, pricing incentives, as well as some sort of controls that we've seen various programs already, I don't know, some equivalent to summer saving, the cycling, things like that, that we need to really explore in order to be able to manage the cost of potential grid investments.

MS. SISTO: Great. Thanks, Cindy.

I think we should hold questions to the end, so I'll hand it over to Dean Taylor from Southern

California Edison, who's been a great asset in the VGI Working group that took place last year, and he's participated in this roadmap update to date. So, he's been a great asset so far. Fill us in a little bit on what SCE's doing.

MR. TAYLOR: Yeah, thank you. For those of you may not have been aware, there's a thing called the VGI Working Group, where we had maybe a hundred stakeholders, and dozens of meetings in about a year-long process. So, many of us in the room know each other, but maybe not everybody.

I'm actually not going to talk so much about Edison on this, although I'll give you the one-minute kind of version. In the back, in this deck, in the appendix is our new EV 7, 8, and 9 rate, which we think are kind of best in class. They'll go into effect when we launch our Charge-Ready Transport, which is like for medium- and heavy-duty vehicles.

But this rate is broader than that. It does apply to, you know, DC fast charging, fleets, workplaces, even MUD common areas. So, it's all commercial accounts.

And, essentially, you have 8 cents a kilowatt hour in the middle of the day, 13 cents a kilowatt hour in the middle of the night. Where you get slammed is

during the ramping period on weekdays, where between 4 in the afternoon and 9 at night, you know, over 40 cents a kilowatt hour.

But, you know, if 10 cents a kilowatt hour is about, essentially, a dollar a gallon equivalent that shows you how amazing these prices are. They're essentially -- I think Hawaii was the first place to do this, where we'll be the second.

But the other part is there's no demand charges. There's a five-year phase-in period. But even in year 11, the demand charges are quite a bit less because we keep the time variant rates, like I just described.

So, that's, you know, hopefully, a very exciting new way of doing things. To give you a sense of what to -- like Level 2, 6.6 kw charging in California, as well as DC, 50 kw charging in California, added in all the other things like penalties to move, parking, et cetera. And that was also coming out at about 40 cents a kilowatt hour. So, that probably explains why, you know, home charging is so valuable. If you can get home charging for, you know, 10, 15 cents a kilowatt hour why -- why we see, you know, so much of that. I think customers have been pretty smart so far.

And so, all of that's in the back. I will say this presentation, I've tried to reflect the comments of

like an ad hoc coalition, Edison, and about six or seven other utilities, and six to eight automakers have been sending in quite a few letters. First, to the PUC and the VGI Working Group, and then on this. So, I'll try to get right into the main ask, which is what are recommendations for the new roadmap.

I did want to mention -- if you can go to the next slide.

MR. HARLAND: And Dean, I'll note, too, there is a clicker there you could use for the slides.

MR. TAYLOR: I don't think it's working.

MR. HARLAND: I think I've finally caught up with the technology and it should work. Hey, there we go.

MR. TAYLOR: So, you know, in the old days, not so long ago, everybody was concerned about building so many power plants and you hardly hear anybody talking about that because of all the huge amount of solar. So, the duck curve is a big deal.

But even from the utilities' perspective, more is the distribution system impacts, you know, the cost of things there. So, we don't have time to get into this. I've seen some very interesting studies from SMUD that, you know, literally, it's like five times more valuable getting lower level charging, you're reducing

the kw, in your purchase decision than it is for shifting your load. We talk an awful lot about the duck curve, but people forget that the really big deal is the distribution system impacts. You heard a little bit about that from Cindy.

But what is getting the utilities' attention lately is, you know, all the medium- and heavy-duty vehicle charging. And they're talking about a standard coming.

I was talking to the Idaho National Engineer Lab guy before, you know, 1 megawatt charging for trucks. And the same for, you know, large, away-from-home charging stations, like with Ride Hailing, or even autonomous vehicles, or just large concentrations of workplace charging. You can literally have, you know, a megawatt or two in a parking lot.

And on the other hand, that's not necessarily a big deal for people. I mean, we added -- the ships plugging in, in the Port of Long Beach are -- you know, a typical ship is 7 to 15 megawatts. We added a substation or two down there and nobody was even noticed, that type of thing. I mean, it's much, much more than anything we're talking about in this room, and it was just done. And the pollution reductions are, you know, amazing.

So, to put it all in context here, it's just something utilities can do. I mean, you give us enough notice and we'll gladly to that. And it's literally like taking hundreds of thousands of cars off the road down in the port.

But backing up, it's all about how do we change behavior? So, what has made a lot of progress is simple things. You've heard a lot about rates. You know, I call it passive V1G, it could be indirect controls. You know, not everything has to be managed V1G or V2G. There's a lot that can be done with simple solutions. In fact, I would say V1G and V2G has faced a lot more barriers and that's probably why we're here today, coming to how do we make it go faster.

So, I don't know about you but, you know, all this V1G stuff I find very complicated. It gives, I think, a lot of us a pretty big headache.

You know, there's many agencies, it's interwoven with consumer issues, there's competing business models of the automaker and the charging station maker. The whole thing of net value has all these many elements of both up front and ongoing costs. There's many times of benefits. There's, you know, non-monetized costs and benefits. There's all these different studies that say different things, with different terminologies,

different conclusions, different ways of looking at net value.

So, this coalition I was referring to earlier, of automakers and utilities, I think our main request is just to understand the situation more. More analysis before any mandates are coming, and regulations, you know, or in grant programs. So, you'll see that, I think, reflected as I go through here.

But since I was the lead on this effort on the glossary that is now published and up at the VGI Working -- what is the URL? It's just PUC/VGI?

Okay. So, in there you'll see a glossary. But there's a lot more work for all of us to do to add to that glossary, to be disciplined in using it. Because a lot of people, for example, when they see VGI, they just think it's smart charging and V2G, and don't even realize this broader definition.

But one thing that didn't ever really get published, wasn't because it wasn't completed, but the VIG Glossary subteam, including Eric and myself, we worked to consolidate, I think, 12 different benefit frameworks. Everybody had a different way of slicing, and dicing, and analyzing this pie and it was very confusing. So, we did our best. I think there's over 150 rows in there, but essentially some of the key

things were questions we tried to answer like who needs the benefit? What is the benefit? What meets the need? How to meet the need? How to measure the need?

And so, one recommendation would be to continue that and update it to meet the current needs because there's more work to be done there.

As far as examples of some of the benefits, this is where it's surprisingly tricky, is that there's avoided costs to the driver, a whole bunch of them. From, you know, the low cost to charge at night, or in the middle of the day, except during that ramping period. Lower costs for charging equipment or avoiding networking fees, or at least reducing networking fees. There's the avoided cost to the grid, again compared to an alternative like, you know, avoiding distribution system upgrades, or having a storage mandate with V2G, which was talked about earlier.

So, just a really quick thing. A lot of people don't realize that residential customers are being defaulted onto time-of-use rates, all throughout California the next few years. And they're not all that very good for electric cars, but just you can save about $200 to $400 a year just by going from gasoline to these new default rates.

And then, there's even better rates that are

designed with EVs in line. Like Edison will be launching a revised version of our whole house rate, called EDV Prime, I believe it's called. And that will be launching in a few months. You can save another, you know, $300, $400. So, just these two rates -- you know, by getting on a rate, you can literally save $600 to $800 a year. So, there's huge benefits, you know, to the driver by going on rates.

There's also value to the site host. So, site hosts are, I think, an important part of this. One of the big ones is just to sign up for LCFS. You know, right now, just with the grid average you can reduce your carbon by 80 percent. And if you link it onto solar, or RECs, or things, you can get it down to 100 percent.

But the value of LCFS is directly tied to kilowatt hours. So, this isn't so much VGI related, but you can save 17 cents, 25 cents if you're medium and heavy duty. That's a lot. You know, there's a huge value proposition there.

They also, obviously, can collect money from drivers, they can attract new customers, et cetera.

There's also avoided costs to the site host by avoiding or reducing demand charges. The same for avoiding hard costs to energy charge times or deferring

panel upgrades.

And people forget there's these different barriers. You know, you can do a lot and then you have to upgrade your panel, then you do some more and you have to upgrade your transformer. You do even more and you might have to upgrade your substation or feeder. So, there's different levels. But it doesn't mean you don't want to go big at some point. To get to the number of cars we're talking about, you're going to have to go through most of those stages. Possibly, not the last one, depends on what you are.

And there's also value to the aggregator. So, there are these clever things called LCFS Smart Charging Credits, which take effect in January. And I'll give you an example for a residential customer, like I said, you can reduce by 80 percent. But you can give him an additional one, you know, half-a-ton to one ton by going above and beyond, and charging at even cleaner times of year. And say you got that extra one ton, that would be worth about $180 a year to the aggregator. It could be an automaker, it could be a charging station maker that chooses to be the aggregator.

And then, of course, you also can sell into the CAISO for energy or ancillary services.

As far as recommendations to the roadmap, I'll

try to go quick. But update the glossary, update this consolidated benefits framework. Expand utility of marketing of optional time-of-use rates to more residences and commercial accounts.

So, the one I was just mentioning probably has like a 20 to 30 percent uptake rate around California. So, you can imagine how much more people would be saving if you could get it up at 50 percent, 80 percent.

So, LCFS is an interesting possible way of also getting more people aware and uptaking on this. I don't know why, but people don't even think to call their utility, so we don't even know where roughly half the cars are. And people literally spend about five minutes a year thinking about their utility, so it's just not really high on people's list of what they want to do.

You also could launch more commercial rates designed to encourage EV adoption. I mean, there's some best in class examples, but there's 50 utilities in the State of California, when you add in all the small co-ops and others.

There could be more of this demand charge phase-in, with time variant rates, or demand charge neutralization that Hannah spoke about. So, you know, having more favorable rates everywhere, not just a few best in class examples, would make a huge difference.

There's also a lot of other best practices that both utilities and automakers have been doing. These are kind of the simple, easy things that are out there.

You know, one thing Edison does is we upgrade transformers to a larger size at the end of life. And that's one reason our load research reports show we've had very little impact. You know, that's just a very simple that we've done that's worked.

The DUM for the investor-owned utilities, these are online maps showing circuit capacity. So, we have over 4,600 circuits in just Edison alone. Like the project developers can go online and understand which circuits are most constrained and least constrained, and how we can obviously do more education.

The automakers do a lot of things already, too, it's worth mentioning. You know, they obviously have dashboard controls. The cars are very smart, a lot of interface with the consumer. There's a lot that they provide already. Most of them provide free Level 1, or in some cases, Level 2, and they do a lot of educating in that space.

So, just increase marketing of LCFS is another idea. One of the big ones is to compare all the different studies on VGI. I know there's a literature search is starting to go on, now. But even more than

that is to compare them, to try to understand them on an apples-to-apples basis so that we have just a better understand. Because it gets very confusing when they're all saying, oftentimes, different things.

The next two are highlighted in red because I think these are priority actions. I didn't really have time to assign, you know, to agencies, but I did put a few things in red as the highest priority. Which would be to finish the original task 2 and the original task 3 from the VGI Working Group.

So, task 2 was all about net value, looking at all the costs, and all the benefits, and analyzing the tradeoffs of all the different use cases that are out there.

And similarly, task 3 was originally focused on developing low-cost policy solutions. Again, I would think it would be great to look at all the ideas we're hearing here today, and what was presented to the VGI Working Group for all the different use cases.

But also, beyond that, I think it's important to start validating in real world. So, to take all the automakers to the next, and the charging station makers to the next level. So, if somebody is doing 1,000, you know, take them to 10,000. If somebody's doing 100, take them to 500. You know, let's get real world

customer experience, a real-world validation of benefits, cybersecurity, functionality. You know, gather all this data from all the different things and, you know, spend some serious chunk of change to get beyond pilots and into as large as we can possibly go.

Prioritize adoption of simple actions that can change driver or site host behavior. Improve agency coordination. You heard that from Hannah, so I won't repeat. But I would say that I think it's important to finish what CARB is doing over on the SB 454 process, which is almost done. That's the charging station open access thing, where they're possibly going to be mandating credit card readers.

Because there is this -- you know, it isn't often just about VGI. Now, it's we're having to deal with both VGI and consumer issues. When I say consumer issues, I mean things like payment, or payment authentication, or other things that don't directly relate to VGI.

And then, almost done. Develop a clear business case for the automakers to put a VGI communication protocol into large-scale production. At this time there's not enough information to do widescale mandates, you know, of communication protocols at this time, or grant programs.

Then the last slide is continue demonstrating EVs and existing DR programs. Edison's doing something today with Honda in our Power Save Program.

And, also, develop a whole separate effort on medium- and heavy-duty, and non-road EVs. Understand all the use cases. Single, double shift, triple shift operations, the need for away-from-home charging for those vehicles.

Develop and find test solutions that are both -- you know, for both active and passive. Find favorable use cases. Maybe, you know, school buses are often talked about.

And then the last two is convene an ongoing data analysis working group. I think the automakers and the charging station providers have a lot of data. I think who suffers, a lot of times, is both the utilities and the agencies. And by this, I mean a true working group, kind of like what we had with the Vehicle-Grid Integration Working Group, where it's a roll up your sleeve, or maybe like the Demand Analysis Group, where we're constantly learning and comparing, understanding the load shapes. We're all going to start drowning in data here pretty soon. And to realize understand, analyze it, and take the best message.

And then, I realize you're planning another

webinar once you have the draft roadmap. I would go one step further. I think it's more of a workshop. I think we should -- you know, I realize this is sometimes a pain to come up here. But I would recommend going a step further and having us in a workshop.

I was participating in this in 2013. I think we had at least three rounds of actual workshops. We even had, you know, all-day breakout sessions, and really rolled up our sleeves.

And I think there's so much here that we're going to need that this next time. Thank you.

MS. SISTO: Thanks, Dean, for those recommendations on our path forward.

Now, we're going to hear from Eric Cutter who's -- I think so, yeah -- who's with E3. He's helped the CPUC quite a bit in some modeling for our integrated resource planning, and coming up with some strategies on how to move forward in that process. And we've asked him here to talk a little bit about his findings, and give us some recommendations based on that experience, and others.

MR. CUTTER: Great. Thank you, Carolyn. Thank you, CPUC and CEC for the opportunity to speak.

Now, so my goal today is -- if we'd been talking at like the, say, 10,000-foot level, I'm pulling us back

up to maybe the 50,000-foot level, just for a little bit.

So, I'll first say that, so, Energy and Environmental Economics, we're a consulting firm in San Francisco. We've been helping the CPUC and the utilities on a number of fronts. But the most relevant for today is on the integrated resource planning for the utilities as they look to meet our carbon and RPS goals, what is the least cost portfolio of resources in order to do that.

And, increasingly, we want to pull in distributed energy resources generally, and VGI in particular.

And so, my goal over the next seven slides, I had the opportunity to speak with Lance (indiscernible) from Nissan, last week, and described some of this. And at the end of the conversation they said, boy, this is really complicated and confusing and there's so much regulation.

So, you guys can give me a thumbs up or a thumbs down if I present this simply enough to, let's say, how we can get to a value of VGI that a lot of people can understand at the end of the day.

So, we were talking earlier about the puck, where the puck's going to go. Like the overarching

framework for where the puck is going to go for us, and for the State, is greenhouse gas policy and modeling the 2050 pathways. Economy-wide modeling for CARB, and the CPUC, and the CEC about what's going to be needed overall in California to meet these targets. That informs what needs to happen in a lot of sectors. But for us, particularly in the electricity sector.

And then, we go through several steps of more detailed modeling in the electricity sector. The first one I just mentioned, what is the least cost resource portfolio for the electric utilities?

After that, we need to make sure that resource portfolio is meeting the reliability standards. And so, that ELCC or effective load carrying capacity.

And then, the third is, you know, how does all of this work actually work in system operations to provide value on the electric grid?

So, the big picture, if we look out to 2030, is briefly presented here. That in those portfolios of the 2050 pathways, there's a lot of decrease in load with energy efficiency, but there's an increase in load because we want to use the increase in renewables on the electricity sector to decarbonize loads in the transportation and building sector.

And the interesting facet that I was looking at

this chart is you can see in that portfolio transportation is kind of leading. It's coming out first. And again, to think in the larger policy context, we're not just doing this, this VGI for vehicles, just for vehicles, we're doing it as an example of a flexible load for buildings that can also participate in these markets.

So, the economics of heat pumps aren't quite there, as they are for electric vehicles. But we want those loads to be flexible when they do come in. And we're already beginning the process for planning for flexible water heaters, and heat pumps. And the business model should kind of translate pretty well.

So, how are these flexible vehicles providing value on the grid in all this modeling we're doing? Well, that's the chart up here. In a high electrification scenario, where we have a lot of flexible load, on the left-hand side, we're still curtailing some excess solar, but we're able to manage that with a fairly small amount of curtailment overall. This is a particularly sunny, spring day on the electric system in 2050.

Now, if we imagine a portfolio of resources that's not very flexible, then we end up with the chart on the right, and we are curtailing a whole bunch of

excess solar. And that has costs for the system because we have to build more renewables and that's more expensive. Or, we have to build more energy storage or other flexible resources to manage that intermittent, renewable generation. So, both of those have a potential cost.

And that, at the end of the day, is what the value of VGI, or flexible electric vehicles is from us, as a modeling-the-grid perspective. And so, that's shown in this chart. So, these are a bunch of scenarios developed for the CPUC, the integrated resource planning proceeding.

On the left is a 42 million metric ton target. On the right is a 30 million metric ton target. And I'll just point out for purposes today that a 30 million metric ton target, if we look at the additional resources we need to build to meet that lower greenhouse gas target, you see a lot of purple. Well, that purple is behind the meter, in front of the meter, lithium ion batteries and pump storage.

If electric vehicles or other loads can essentially serve the same function, or some of the same function, then it reduces the amount of more expensive storage that we need to put on the system. And that difference in values, as we run our models, is a value

of VGI. So, you see that in the bottom right-hand corner.

With adding flexible EVs, we're reducing the cost from about $1.1 billion down to, yeah, $900 billion. And so, that translates to a value of VGI in the market.

So, in the next few slides I just want to provide -- and I'm -- illustrate a few examples of then how we translate this into where that hockey puck is going to be that everyone wants to shoot for.

So, you know, one example that comes out of this modeling is a lot of focus today on frequency regulation as a valuable market. We model how much frequency regulation is going to be needed. And then, what's the market price as we get more and more on the system. It turns out that's a fairly small market and it gets saturated, if you will, after 600 megawatts.

Whereas for another potential market for VGI, load shifting, that we've been talking about today, moving the time of charging. That is both a much larger market, we -- in this particular study we didn't really find the end of the market. Now, it's not infinite but, you know, on the order of one to two gigawatts, as opposed to 600 megawatts. And under a high-renewable scenario or a low-carbon scenario it can be potentially

pretty valuable.

And so, then we look ahead, this is a snapshot of 2025, of the different size of those two markets. And so, if you think of this as something that the automakers or the EVSEs are shooting for, they can look at roughly a 16 -- so, this is an annual market value in millions. So, roughly, a $16 market in frequency regulations or a, roughly, $225 million market in load shifting.

So, whenever someone is coming to ask, you know, where should I go, absolutely the money today is in frequency regulation. You've got to make hay while the sun shines and that value, get that product to market, establish the business models. But definitely make sure you're ready for some longer-duration services because those are going to be a bigger market and more valuable in the near future.

So, we put all the pieces together. I want to show like we're really looking at three fundamental pieces for a value -- we want to see the size of the market and then, where the market clearing price is going to be given the size of that market.

And so, one factor is going to be what I've been describing, here in the bottom, like the value to the grid. So, we can help calculate that, as I've been

describing.

Part of that is going to be how much of that can be supplied by electric vehicles, if we're looking particularly at a VGI market? And that means translating all this to a reliable number of megawatts, or megawatt hours that electric vehicles can supply to the grid. So, those, I think, we can understand fairly well.

Then there's a third piece of, you know, how does this stack up against the competition? So, a lot of other products or services are going to be competing for that same market of energy storage, flexible dispatch of renewables, building loads eventually.

And I guess I want to point out here like if you ask me, or the people on my team, we'll want all the data on all of this before we give you a good answer. But we don't want to, really, wait that long. So, I think we get to a pretty good answer with the first two things, like the value to the grid and a rough assessment of how much of that can be met with VGI. And not trying to get too caught up in how all this compares to other things. Let's let the market figure that out. And you've already got a lot of companies doing a lot of great work there.

All right, so now, we've put this all at the end

of the day, what's the value to a vehicle? And this is an example from an EPRI-led study on the value of V2G. And this isn't a report that I -- it should be released, soon, from the CEC. I think it's under review. And so, we take the -- we look ahead and see, given our modeling, what is the price for frequency regulation going to be and then, how much can a vehicle make?

And, really, I wanted to simply show on this chart the incremental value of V1G to V2G, and there are obviously different assumptions that can go in here, but this is sort of our best base case. And you see, going from dumb charging to smart charging gets you an incremental value per year, per vehicle, of $154.

And then, going to V2G, we saw that, you know, more than double to over $300. And that was a bit of a surprise to us. A couple of the factors that really drove that incremental value of V2G in this particular case, will be if drivers aren't driving very much and they're driving to work with their battery relatively full, which a lot of drivers are, then managing that little bit of battery space doesn't get you as much value as V2G, where you can empty that battery, fill it up again, and empty it. So, you get a full use of that battery, rather than just a little bit of the charging.

And then, you can do a lot better time of timing

the charge and discharge to exactly when the grid wants it. So, essentially, those two functions added a lot of value.

And then, I'll end with emphasizing, you know, we have a lot of capacity value in here. That's going to be really -- and this is a bridge that we really have to work to meet is translating all this VGI value to a reliable megawatt that a distribution engineer trusts, so they actually, at the end of the day, don't build something, like Jaime was talking about. Because if they don't trust it, they're going to go ahead and build it anyway, and then we really haven't saved the ratepayers any money.

So, and we've talked about the need to meet the customers where they are. We also need to meet the distribution engineers where they are of convince me that this is reliable and I can build a smaller transformer. That's what will get us value to the ratepayers at the end of the day.

So, I'll stop there and hand it off.

MS. SISTO: Thanks, Eric. Now, we'll hear from Jason MacDonald, from Lawrence Berkeley National Laboratory, who as Eric mentioned, has worked with E3 and has been doing their own research. So, looking forward to hearing thoughts on this.

MR. MACDONALD: Great. Can you hear me? Okay, good. Yeah, I'm Jason. And I've been at LBNL for a while, around seven years, and worked on a lot of different kinds of projects in the VGI space.

We have a lot of work happening in VGI and some people are doing larger, more systems-wide analyses, trying to understand the potential. I'm going to take you from 5,000 feet, down to about 100 feet, and talk about a demonstration project that we did at the L.A. Air Force Base, where we were providing frequency regulation to CAISO, and talk about the revenue potential we saw there and some of the issues around, you know, the high-level analyses that we did early on and how we, you know, pared out that revenue pretty quickly.

So, for those that don't know what the L.A. Air Force Base was, it was we were basically the aggregator, if you will, of 29 vehicles located on a DOD base in Los Angeles. And all we were tasked to do is come up with a control system that ensured that we had, you know, a sufficient mobility for the vehicles, for the base, minimize charging costs, and then get as much revenue as we can out of the regulation market. And we were an actual market participant.

And so, I want to talk a little bit about the

revenue potential. And we started this -- this project took a long time. So, I'm giving you a 10-minute talk about a 5-year project, and so a very small piece of it.

So, back in 2012, I did an analysis for Chris Marnay, who was the current PI then, principal investigator, PI. And we wanted to see, well, what kind of value could we expect out of the fictional, at that time, vehicle fleet that could end up there. And so, we identified, okay, well, if they're able to participate in the market, if they're full capacity, which the capacity that was going to be there was 15 kilowatts per vehicle, and looking at historical market clearing prices, $101. We could do that, okay.

We had some assumptions and those were like that you can't participate during business hours, 8 to 5, and that there's no energy constraints on bidding because we didn't know what the vehicles would be, how big the batteries would be, assumed they'd be big enough. And that providing continuous services wouldn't have any impact. So, it was a pretty basic analysis, 101 -- a hundred dollars a month.

And if you do the same analysis during the period in which we were actually participating in the market, you actually get more money. So, the prices got higher. I like these kinds of graphs. They don't make

a lot of sense unless you know what they are. But what it's called is it's a violin plot, and what it's showing is for each hour of the day, over the course of the period, it gives you the distribution of both regulation-up and regulation-down prices.

So, from 1 to 2, the distribution on the left is the regulation-up price, the distribution on the right, the lighter blue, is the regulation-down.

You can see, like some trends, there's a wide range of prices to capture. So, prediction is challenging. But there are certainly some trends that the regulation-up price, the dark blue, is capture -- the highest value times is capturable outside of business hours, so that's good for us.

And so, that resulted in, in terms of revenue, two-thirds of your revenue potential is coming from that. Those prices, the regulation-up. The regulation-down, not as much. Most of the higher value times are in the middle of the day, during from January of 2016, when we started participating, to July of 2017. So, you're going to get less of your value from regulation-down.

So, this is using the same fictitious fleet. We had a real fleet at this point, but the same analysis with 41 vehicles, that they all make about -- so, they

can -- and they're all 15 kilowatts, they can make about $124, now, with this pricing.

But what about when we use the real vehicle fleet? Now, we have to start taking into account the rules in CAISO. And the rules are that you can provide frequency regulation, but you have to ensure that you can provide it for a full hour in both directions. Which means -- there is another product that -- or, you could be classified as a different kind of resource that could only provide it over 15 minutes, but that resource regulation, energy management, isn't appropriate for electric vehicles. We can answer the question why I think that's true later.

But, so one hour, meaning that you have to have head room in your battery in one direction and you have to have stored energy in your battery in the other direction. So, your battery has to be twice your power capacity to capture full value.

Our vehicle fleet, of 29 vehicles, that was actually at the base, most of them don't have this two-times battery capacity. Some of them were PHEVs, the vans, and some of them were all-electric, the Nissan Leafs, but they tended to have less. So, then, when you account for just the rated capacity of the batteries, you lose a significant portion of your overall revenue

potential. Going from 610 kilowatts that could be used to 425.

You continue to de-rate, though, because the rate of capacity isn't actually what you can use or the usable range of the battery, right. So, then, you have to de-rate another, in our experience, around 70 percent of the rated capacity of the battery to get to what's usable here. And now, you're at about half of that original revenue potential, someone in the $60-per-vehicle range.

And this is still pretty ideal conditions. I mean, you're participating fully in the market at all hours that you're not available.

A lot of people ask us what our -- how much money do we really make and I don't present it, because we didn't really make any money. And that's because -- that's for a lot of reasons. This is a -- we had some issues with integration. And then we -- with our scheduling coordinator, with the markets. And then we had, you know, mostly first-generation technology. So, we had a technology issues, things were going out, and things like that. So, to be robust, we often offered much less than we could potentially offer.

And the other reason why we didn't make all that much money is the costs. So, these are the costs that

we ran into while providing services to the CAISO. And there's all the fixed costs, getting bidirectionally-capable hardware. I don't present that because it's all gen one stuff. And, hopefully, we'll get down to that $500 adder for V2G someday.

And there's also -- but you do have electrical service upgrades, metering and telemetry that's more cumbersome. And we were lucky here because we're doing it as -- we're aggregating behind a single meter. We only have all the resources behind one meter, so we only had to buy one meter, and those meters cost a lot of money.

But then, you get to the monthly costs and the most significant of these is a thousand dollars a month, just to be a participant in the market.

So, if you want to enter into the ISO market as a resource all by yourself, it's going to cost you a thousand dollars a month. It's hard. You're going to need a pretty big resource to start really making good money in that instance.

There's also like the small, the small fees, big segments, your flexible capacity obligation. I think we were hit with that because these resources are both a load and a generator, so you have to pay like the small amount that your load represents towards flexible

capacity.

And then, and then you have scheduling coordinator fees, which these are remarkably low, to be honest. I mean, our scheduling coordinator was Southern California Edison. This isn't a thing that they do for anybody. They were game, which was great, for the project, but it's not something that they offer to most. And these, you know, $350, having a dedicated scheduling coordinator providing these kind of services at that price seems a little challenging. So, you probably need to include the cost of becoming your own scheduling coordinator or imagine that that's going to be more significant.

And then the last is this network access fee, you know, that getting onto the energy communication, we thought when we started the project was going to be considerably more expensive. But the CAISO worked with AT&T to get an easier route that ended up only being about $100. It was going to be about $500 to get onto the network, because they have a dedicated network for all these communications.

So, all this stuff adds up to about 50 percent of your overall revenue potential, the ideal case in which we could provide 50 percent.

But I will say 50 percent of our revenue

potential and the size of the resource that we had. All of these things, none of them really scale aside from, you know, like the capital infrastructure scales with the size of resources, the number of resources. But the monthly transaction costs, the ones I represent here, very few of them scale with the amounts that you're trading on the market. So, larger aggregations are necessary to really make it significant here, in this kind of a resource.

So, I just wanted to present this sort of high-level resource potential as an anecdote to the other work that's being done here today.

UNIDENTIFIED SPEAKER: I have a clarifying question. Were all those costs per meter versus (off-mic, inaudible) --

MR. MACDONALD: So, this is for the whole resource aggregation.

UNIDENTIFIED SPEAKER: Just one meter.

MR. MACDONALD: Which is one meter. But the resource ID isn't based -- I don't believe it's based on the number of meters. So, like, you could have multiple meters. It's not a per-meter thing, it's a per-resource thing. So, it's really -- like the Navy, the meter data fee and the scheduling coordinator fees, if you wanted to take those numbers as truth, which I wouldn't, you

know, for future, I think those might scale. But the others, they're per resource.

And if you want to see the final report, it's marked under -- I think you'll have access to these slides, right, they're all --

MR. HARLAND: Yeah, all of the presentations from today will be available.

MS. SISTO: Thanks, Jason. And now, we have Pamela MacDougall, from the Natural Resources Defense Council.

MS. MACDOUGALL: Thanks, Carolyn. I'd like to first thank everyone for being here. I recognize a lot of faces. We need name tags.

THE REPORTER: Pull your mic a little closer.

MS. MACDOUGALL: Is that better? Okay.

I know that a lot of you have invested a lot of time and effort in getting EVs on the ground and getting the infrastructure in place, and it's been quite successful. At least in California, we're getting the EVSE infrastructure in place to where it is right now. So, yeah, thank you for being here and actually like coming together and thinking about our future. I personally appreciate you doing that.

I recognize that I'm the last panel speaker and that we're all tired. I'm exhausted. So, I'd like to

lighten things up today. Who here has gone apple picking? Yeah, cool.

I went apple picking about two weeks ago, with a bunch of my friends. And we were destined to make apple pie. I'm obsessed with pies. It's a thing. I love things. I'm adding carbs, I love them.

And so, we decided to drive up state, to about three hours away, and go apple picking. And it's my first time being to like a New York orchard, and I didn't realize there's hundreds of varieties of apples. So, we spent the better part of the day trying every single apple. We weren't allowed to have Macintoshes. And it turned out that by sunset we had about two apples picked, because we needed the perfect size and everything.

So, we scrambled to get enough apples to make a pie and by the time that we got home and baked the pie it was midnight, and we were too tired to even eat the pie.

So, I think the main thing that I learned from that is like sometimes we get bogged down on all the little, itty-bitty details that we're going to miss out on eating the pie. And I feel that's what's going on right now with VGI. There's my apple pie story.

So, California has some pretty ambitious goals

and I think they're going to get even more ambitious in the coming years, like 100 percent clean energy by 2045. Everybody's been dropping the stats down, but I'll repeat them.

1.3 gigawatts by 2024. And I imagine that that's going to grow. And, obviously, 5 million ZEVs on the road by 2030, with EV infrastructure in place to match that. Again, hoping that that's going to grow. And we want to do this in the most cost-effective way that's beneficial to the utility, to the EV owners, to the EVSE operators, and any other like third-party that wants to get their thumb in the pie, as well.

And I think that VGI is the key to that. We all are hear because we recognize a value in VGI. And I feel like we're getting stuck on cost benefit analysis. And while they're important, we're slowing down process. And we need to start looking market opportunities, now. We need to start making business opportunities for VGI now, and focus alongside that on these other technical details.

And how can we get the economics in order? Well, one thing that we can do, and this has been mentioned a number of times in this group today, is a storage mandate, allowing V1G to participate, V2G can participate, I think even thermal devices can

participate. But for some reason, V1G can't.

And I think a lot of the technical details that are coming up could be resolved if we create this business opportunity for people.

Another thing I see is getting the market value down to the person that's actually investing the largest capital cost, which is the EV, itself. Tesla cars are pretty expensive. I can't afford one. But the people that do invest in these electric vehicles, we need to be able to get a price incentive down to them where they can shift their load to an optimal time when the sun is shining, and when the grid needs it the most.

So, I think we need to start getting the wholesale market prices down to the customer and see how they respond.

And we talked about VGI as a storage. I know this LBNL study has been brought up a number of times, so I just wanted to go into detail a bit about that, because I have worked with the guys that have done the study.

So, they looked at the amounts of cars that were going to be on the ground by 2030, and they evaluated their driving needs, and made sure that their cars were all full and that they were able to manage their daily driving schedules. And still, with using V1G, they were

able to get 1gigawatt of storage. And with V2G, 5 gigawatts of storage. So, even V1G made it up to like three-quarters of a storage mandate that we have in California.

Now, let's look at the cost there, like costing utility-based storage, and V1G or V2G. So, V1G was about a tenth the cost of like fixed storage. And V2G, I'm sure there were other costs, but it's still significantly cheaper than like fixed utility-based storage. So, we need to like offer that opportunity now to get that technology in place for the longer term.

And I feel, when we're going to CPUC meetings, and PUC meetings in different states, we always have pushback from a lot of energy storage providers, particularly the batteries. And I honestly don't think it's going to be a knockout competition when it comes to that. I think they can work alongside with each other, fixed storage and GI.

Because I would like you to tell you which rate that you have or which program you have where you have 100 percent adoption. We're not going to get all of the cars participating on the storage mandate. So, having the few that want to access it participate, it's going to create a more fair market for everyone.

Moving on to the utilities. The utilities have

made a lot of headway on progressive rates. I mean, Dean mentioned some pretty progressive rates coming out for SCE. And the PUC has invested billions in an infrastructure program, and they have billions more happening. But there isn't really anything in place for them or any value for them to invest in VGI. There's no payback for them. For them, if they get a higher load of people charging on peak load, it's more value for them to invest in the grid, themselves. They'll put copper in the ground as opposed to having a more cost-effective solution -- not cost effective, but for the ratepayer a more efficient solution, such as VGI. So, we need to have a totally performance incentive mechanism in place that would ensure that.

And I know that SDG&E has proposed a performance mechanism and I really think that we should start pushing forward with this so that we can create an incentive to align the utilities' interests, as well as like the societal interest.

Now, let's get down to the customer and rates. I think wholesale time-of-use rates are a really great first step at getting the value of VGI and other demand response options out there, like heat pumps, and turning off your refrigerator -- not your refrigerator, but your dishwasher when the prices are lower.

But right now, the adoption rate is like one in four. So, we need to have automatic subscription to time-of-use rates. And as well, focus more on educating these customers on how to use time-of-use rates. There has been a severe lack of education for customers on what that means and what means for their bills. So, that's the first step and we're getting there.

But we also have EV rates coming out, now. Actually, California, as a whole, has the most progressive EV time-of-use rates in the states. And I'm going to give you an example of New York, so I don't offend anyone here.

New York has an EV time-of-use rate and it was published in the Synapse Report that only four people are using that time-of-use rate. Four, in all of New York. And why? Because the metering, the second meter you need to get to EV time-of-use rate is too expensive. It's $2,000. How long is it going to take you to get that money back? The rates are progressive, but they're not that progressive.

So, we need to look at other metering opportunities. How can we do that? We can, one, offer rebates. I don't think a lot of us are going to get on board with that. I would be okay with it.

Submetering, seeing if we could get a

submetering program, especially like for multi-unit dwellings. Or, third-party metering. So, let's look at like SENS has something that you can use, it's about $300. Using the meter in the EVSE. Using some of the telemetrics in the car. We don't need utility great meters for hourly rates.

And there's been some pilot programs that have looked at submetering in California, but I think we need to now move beyond pilots and get that into practice. It's time.

And so, I'd like to end a bit about we're doing really well with EVs. They're not crashing the grid. And I think that Nancy Ryan really had the wisdom to force the utilities to publish a joint research report every year to evaluate what the low are doing, how man EVs are on-peak and off-peak, and like how these rates are working. But they've been primarily focused on light-duty vehicles. And as Dean mentioned, medium- and heavy-duties are like the killers that are going to happen on the grid. We need to start investigating them now, so they need to be included in the scope of the joint IOU report, so that we can prepare for that in the long term.

MS. SISTO: Thanks, Pamela. And thanks to all of our panelists here for providing their feedback and

their wisdom on their experiences to date.

(Applause)

MS. SISTO: I came up with a few questions while listening to everybody, so I'm going to take the moderator advantage. But I do want to make sure everybody else in the room has time to ask questions and give their feedback to us state agencies.

I guess one question coming from the CPUC side, and something that was brought up by everybody, was kind of the idea of VGI serving as a flexible load. And we've heard about different rates that exist that are supposed to encourage specific flexible loads from vehicles. But as Eric mentioned, we'll have flexible loads from a lot of different places.

So, one question I'd like to pose to everyone on the panel is do we need different utility tariffs in place to apply to all these different flexible loads or should we be looking to design utility tariffs that can provide value to a flexible load, however it exists?

MS. FANG: Having spent a lot of time in sort of the rate design space, you know, there's a lot of this in where looking at the pricing I don't know that it necessarily makes sense to offer one use. So, you know, we were talking about the heating a different price than EV.

So, when we look at the pricing, it seems like regardless of how a customer chooses to use that energy that they should be charged an equivalent price.

And so, to me, the flexibility, if we're going to create, you know, the rate I described, it should be available for everybody. You do have distinctions by customer class because of revenue allocations, cost of service. But as far as like within those classes, it seems like the more equitable approach is to make it available to all.

MR. TAYLOR: I would agree that it would be for all. So, we offer two kind of rates on the residential side that are oriented towards EVs. One has half of one percent of EV drivers, you know, adopting it, essentially. And the other has about, I think, 20 some percent, maybe 25 percent. I haven't checked the latest numbers.

Now, and that is -- and in the future, I think I mentioned that residential rates are going onto mandatory or, I guess technically, default. If you really don't want to be on it, you could opt back in to the old, tiered system. But for the most part, people are going to be on time-of-use rates, and so it will apply broadly to all appliances whether it's, you know, a water heater or air conditioner.

We've had these time-of-use rates that were designed with EVs in mind for over 20 years. They've gone through many changes over the years. I think early on one of the issues was, you know, you had to worry about your air conditioning bill wiping out any savings you get from charging off peak. But I think we've dramatically, you know, improved that with the latest version of that, you know, of that rate.

And then, but I would add you can also put things on top. I mentioned the Low-Carbon Fuel Standard. That program essentially would go to the aggregator. The way CARB set it up, it's probably going to go to the automakers because you have to provide, the times, the kilowatt hours, and then the killer is the VIN number. And so, it's really hard for the charging station makers to not have that. But, you know, that doesn't require revenue-grade metering. The automakers' own metering that they could report via telematics, could provide that. So, that would be on top of all of this, and then it's kind of up to the automaker if they want to provide that to the -- you know, to the actual end-user.

MR. CUTTER: Let me chime in with two brief points. One is, wherever we've worked with utilities on this issue outside of California, and I don't think it's

necessarily different in California, they've been uniformly, we don't want different rates for different technologies. We want one rate that works for customers that have the ability to manage their load.

And two, that TOU rates do great for a lot of kinds of resources, but particularly energy storage and electrical vehicles, they do leave a lot of money on the table compared to a day-ahead signal, or some kind of hourly signal, like the VCI rate from San Diego.

So, if we actually modeled energy storage under San Diego's rate versus under a TOU rate, you know, it more than doubled the value it's providing to the grid. So, we want to make sure we don't just stop at TOU. We can't let -- we have to manage the bill impacts for a lot of people on TOU.

But if we can get to storage and EVs with more dynamic rates that unlocks a lot of value.

MR. TAYLOR: So, I would be shocked. I mean, I gave you an example, you can save $600 to $800 a year just being on these time-of-use rates. And so, if you can double that, I find that hard to believe.

MR. CUTTER: Well, I'm saying in terms of the value provided to the grid, not the savings to the customer.

MR. TAYLOR: Okay.

MR. CUTTER: Yeah.

MR. TAYLOR: Because, I mean, one thing I didn't put in my presentation is I think the big value is always to the driver. You know, there's also some avoided costs to the grid, but a lot of those are hard to monetize and actually pass it on to anybody. And then, the smallest of all the values is like the CAISO, or something like that.

You know, the big one is still, yeah, the most complicated. So, kind of doing the simple things first is you save money to the drivers, you know, is -- and that's why you hear a lot of us talking about the cost benefit relationship. A lot of these things that we're talking about, yes, they may be benefits, but what is the cost?

And so, you know, the beautiful thing about indirect controls or just publishing prices is it's extremely low cost. There's essentially no cost. It's just up to, you know, can you affect behavior.

I know, in the early years of my career I was on the air pollution side, and you always started with the most cost-effective, simplest things first, and then you worked on down. And so, I think that's the solution here on VGIs, you also do the simple, low-cost solutions first. And then, you know, you incrementally go after

what's next, and what's next, and what's next.

MS. FANG: Though I will say, when we applied this hourly dynamic rate to our residential customers, from TOU they did see huge savings. And so, you know, you ran into certain problems where, in San Diego, the hot months are August. It's like August and September.

And so, what you saw from customers is because what you're moving is all of that high-cost hours out of those low-priced months. And so, they saw a huge savings throughout the year. And if they were responsive, it continued throughout despite the higher bills that they saw in August and September.

And so, we did have challenges with the people who weren't able to respond which, of course, that rate was not the right rate for them, then.

You know, it is a rate for -- you know, not for everybody. It only works as an optional rate for the people to opt-in. But for many customers, actually, they saw a huge savings above and beyond TOU.

MR. MACDONALD: I'd just add that the -- while I totally agree that it makes sense that the electricity service, the price of the electricity service should be available, the same price should be available to everyone no matter what you're going to use that for. I do think that targeting these EV customers with these

more advanced rates is really valuable because it engages them in a way that -- I mean, everybody is willing to think about -- you know, if people drive out of their way to get a few cents difference in gas, they're willing to think about the fuel they use in their vehicle. And when you get an EV, you have now moved that to electricity.

And so, it engages you in the electricity and understanding the value of your electricity in a way that no other appliance really does. So, it is important, I think, to target them directly.

MS. MACDOUGALL: I'd like to kind of expand on that. I do think that being able to couple all of the flexible loads on one rate in the long run could be advantageous and fair. But right now, we want to get more EVs on the road. And the business case or at least the cost comparison of combustion engines versus EVs, yeah, it's still a hard decision for EV buyers. And to have a rate that can, if they do smart charging, lower the cost of ownership is valuable, I think.

MS. FANG: I completely agree with both of those that, I think, for a couple of reasons. EV customers are not every customer, right? These are already customers that are a little more energy educated, a little more informed, and definitely more engaged. And

so, my comment had more to do with making it EV-only and excluding others, which I think is different.

But I do think that they should be sort of a very targeted audience for those type of rates.

MS. SISTO: That was a good segue to my next question. So, now, everyone in California owns an EV and is enrolled in these great EV rates we've developed. Can utilities recover their full cost if all of the EV drivers, including medium- and heavy-duty, are charging at the lowest cost hours?

MR. TAYLOR: Rates are not only a science, but an art. So, I'm pretty sure you make assumptions on how many people are going to be charging on-peak, off-peak, mid-peak. And if it doesn't turn out that way -- I think the simplest rate analogy I've seen is like that first the utility has to go bake the pie, and then the rate design is how do you cut up the pie. And then, a few years later, you have another chance. If you didn't cut up the pie the right way the first time, you redo it to collect the revenues. So, yeah. So, you're not -- if everybody's only charging off-peak, then you're going to have to redesign the pie.

MS. FANG: I'd throw out two things. One is that as customers continue to still leverage, you know, other aspects of the utility system, you know, grid

investments, things like that, there would need to be some structure that would still provide the compensation for those investments to continue to be safe, and reliable, and robust.

The one thing I would say, though, is that if, literally, everybody is moving into the super off-peak and, you know, we're talking about that 5 plus million vehicles, it will be the new on-peak.

And so, that's where for some of this, as we start to scale up, we will need to look at sort of how do we do managed charging so customers are sort of staggering that load, rather than still sticking to that sort of conventional this is that time period that you're charging in.

Because, otherwise, what will happen is it will set up a situation where we're basically chasing that peak. And the concern would be that, you know, you start to run into sort of unsustainable situations.

MR. TAYLOR: I was going to add there's another mega trend that might affect all of this. I'm surprised we haven't even talked about it at all today. Which is, you know, secondary use of batteries. I mean if, literally, I have this many cars, how many second-use batteries are out there, and where could they be, and how could they be maybe sucking up some of these other

services, ancillary services, energy services, peak shaving, et cetera. There's a lot of -- it's very complicated and so that's just another huge, you know, mega trend I think that's out there. If you're going to have 5 million EVs someday, you'll have that many second batteries that are -- before you recycle them, you could still be using them for these other services.

MS. SISTO: I'm glad to open it up, if people have questions.

MR. HARTY: Hi, I'm Ryan Harty from Honda. And thanks, Jeremy, for keying up our comments and whatnot.

Honda is currently operating a V1G system in Southern California, kind of as a beta test. We call it Smart Charge Beta Program. Currently, using our app, customers tell us for any given location, and they can set different location-based profiles of how they want their car to charge. So, they just tell us what SOC they want the car to charge to at that location, and the time they want it to complete the charging. And then, from whatever time they plug in until that time, all of the charge management is on Honda.

And we basically set the schedule based on predicted prices and then adjust that schedule in real time.

Currently, today, we're doing this with five-

minute fidelity, on/off, on/off in five-minute fidelity. And we can incorporate demand response events and reschedule around those. So, we're taking into account both, you know, the wholesale market and distribution needs of the system.

And I would just offer that from, you know, a system and operation stand point. Like time of use, when you're operating like that, time of use actually kind of becomes a little bit meaningless, if you're always choosing lowest cost intervals. You know, what if those lowest cost intervals are now outside of the parameters of the time of use rate that was just designed, and just implemented, and we just finished training customers about. Or, what if they're different from this side of the service territory to that side of the service territory.

And we can do things with system design, and sending, you know, start/stop charge commands to cars that are, you know, based on circuit design polygons of that long that we can have. Like, we can do this level of integration, like we're already doing it today at the SubLAP level, with our EVs.

And so, I would just suggest that VGI rates and how we're thinking about VGI, we need to move away from time of use as the basic way of thinking about it, and

think about it in terms of how do we maximize the value of this flexible resource to do what we need it to do.

And today, I've heard lots of different goals. I don't even know what all the goals are of VGI, right. Avoid the circuit peak, and avoid the system peak, maximize renewable energy consumption, minimize carbon. We have lots of different goals. And I think if we stack up all the goals, you know, smart tariff designers and whatnot can develop tariffs that can maximize these. As long as we can get appropriate things to optimize a system around, we'll be able to get the result that we need.

And, anyway, I think that's something we can do. But, anyway, I want to move away from TOU as a way of setting VGI policy. Thank you.

MR. TAYLOR: I like what I heard in that there is a lot of different competing goals out there and that it would be nice to have a little bit more clarity on how they rank compared to each other. Because there are, you know, obviously goals of saving carbon, saving money to the driver, avoided cost to the distribution grid. You know, it's all -- it can get very complicated very fast and I think some more attention to that would be useful.

And maybe, just hearing Honda speak, I mentioned

earlier just this idea of competing business models between charging station makers and automakers. And what a lot of people don't realize is that the -- I'm aware of at least six, maybe eight automakers that are interested in just bypassing the charging station and going straight to the grid. Which is a very interesting idea and you might be able to save, in many use cases, a lot of money by doing that. And also, people forget, you know, the automakers need to decide what to put on their car as far as communication protocol. They also have some very valuable customer information, battery state-of-charge information, and other things like that. So, it's a very intriguing thing that these automakers are talking about.

DR. HUMMEL: Good afternoon. My name is Holmes Hummel, founder of Clean Energy Works. Thank you for holding this workshop and for creating a national beacon as the CEC undertakes updating the roadmap.

There have been a couple of different comments this afternoon that I wanted to pick up on just for this economic panel. And one is that we've heard multiple people call for testing at scale. And we've already heard multiple call for coordination among agencies.

In the next couple of weeks, I think, CEC is going to announce $75 million worth of awards for the

School Bus Replacement Program. It's a ready-made testing platform, an opportunity that would unfold in the next five years to test some of the ideas that we've heard about from the utilities, at scale.

We also could expect that within five years, California might even be restive enough to update the roadmap again. Which means that we should be thinking about some of the things that we can do in the next five years that would inform the next roadmap.

One thing that I'd like to ask, especially the utility and utility regulators that are here on this panel, is about incentives that the utilities can receive for helping accelerate the deployment of this on-board storage, rather than just waiting for the field of dreams to arrive. But actually, seeing that the value proposition of vehicle-grid integration can affect the rate at which drivers choose EVs, and fleet managers choose to transition their fleets to electricity.

Clean Energy Works has done some financial analysis that shows that those incentives can be very rewarding for both the fleet managers and for the utilities. And it could actually take some of the grant dollars that are available in programs here, in California, multiply them by a factor of ten or more.

We'd be happy to share that as part of the

roadmap process continuing. But I think it's useful to consider what we might be able to do when we think about the vehicle-to-grid integration of the value proposition, not just the operations and the charging costs.

MR. HARLAND: Just if you press the button, the light will turn green.

MR. FARHAT: Now, it's working. Sorry about that. Karim Farhat from Pacific Gas & Electric, PG&E. And so, I'm going to be holding my laptop because I'm going to be needing my notes. I have three comments, so I'm going to make them very briefly. And then, I would love the panel's reactions to that.

The first one is -- so, all of them are focused on quantifying the value of VGI. The first one is around scale. And I think that both pilots and system-wide studies can add a lot of benefit to quantifying the value of VGI, but we need to keep in mind scale. Because the pilots are going to give you a piece of the equation and then, on the other side of the spectrum, you're going to have the benefits and the costs for the system. And somehow, we need to translate between these two pieces, between the micro value and the macro value.

So, to give you an example, when you're talking about a pilot, you might say I have a charger, I'm going

to upgrade the charger to be able to incorporate VGI capabilities. That's great.

But if you're talking about a system-wide -- if you're talking about system-wide affects, you might need to add additional chargers because you're shifting charging from residential to commercial. So, it's not only about upgrading existing chargers, you might need to add the whole new infrastructure. So, just making sure that we're able to capture -- when we're talking about value we're able to capture the benefits and the costs, both on the pilot level as well as on the system level.

The second point is, obviously, about the inclusion of costs. There has been great work and great studies that have looked at the benefits of VGI. I want to emphasize something that the panel have already mentioned, which is we really need to know what the cost of VGI is, and what the cost of VGI capabilities are.

And then the final point, which I was actually surprised we didn't touch on a lot, is how do we look at the value of VGI as part of the value of all DERs? And how do we make sure that the methodologies that we are using to quantify the value of VGI are also consistent with the methodologies that we're using to quantify the value of other DERs because that's important from a

resource planning perspective. So, something to keep in mind.

MR. SCHORSKE: I thank you. Richard Schorske, EV Alliance and ZNE Alliance. I want to just echo Holmes Hummel on the question of getting to scaled pilots quickly with the E-school bus opportunity. Just to put an extra exclamation point on that, working with the Prop. 39 team, they put out bids to the OEMs, or bid information requests to say how much would it cost to do V2G enablement on their buses, and came back with $5,000 per bus. Which for many of us was a surprise and a welcome surprise.

So, my understanding is they're processing that. I don't know if they've made a decision. But certainly, for all of us who are V2G advocates, that's an extraordinary opportunity, and one that I think we should really jump on at the State level.

And along the same lines, I'm sure a lot of you are aware of the large-scale Nissan pilot in the UK, a thousand vehicles. I believe Nuvve's involved. I understand Nuvve has also a very cheap EVSE device, in the $2,000 range, if I'm right about that. Which, again, is a breakthrough price point. And I would love to see a large-scale, light-duty pilot at the State level that would be of that magnitude and enable us to

get moving more quickly with some really scale pilots.

A final example would be medium-duty trucks, and that is another area where most of the medium-duty electric truck manufacturers are either delivering, or promising very soon to deliver V2G-enabled trucks. And there's no reason that there shouldn't be some kind of a mandate with HVIP that says, if you're going to collect a rebate you should have either -- there should be a significant incentive up or down for VGI -- or, excuse me, V2G enablement there, as well as a mandate for V2G-enabled charging stations in the medium- and heavy-duty segment.

So, those are just a few ideas on getting to scaled pilots, which I think is super important.

And last, I'm just going to mention one other area and that is how do we get scaled adoption of the EVs, themselves, at the consumer level beyond what's planned with rebates right now. I think we're all -- should be biting our teeth as to whether we could get to 5 million with the current rebates, notwithstanding Model 3 and everything else.

And, you know, in other markets we see that there needs to be higher rebates to get to 5 to 10 percent plus penetration, especially over 10. Other markets are broad. And so, the whole issue of the

possibility of a feebate, I think needs to be assessed very carefully. For a very small amount of money for the high-end ICEs, you can fund a very large of feebate for low-end EVs. And that's an idea whose time, I think, has come to really look carefully at how we cannot drain the GGRF revenue and, yet, provide a very substantial rebate above and beyond current CVRP. Thank you.

MR. MACDONALD: I want to make a comment -- oh, go ahead.

MR. TAYLOR: I would just comment that we, at least at Edison, aren't really using the word pilot much anymore. We're calling for 7 million electric vehicles by 2030. So, even on VGI, we're talking about large-scale demonstrations. I think some of the automakers are ready to go with telematics that could go, you know, across the entire system, covering all the circuits in the thousands, if not tens of thousands.

MR. MACDONALD: And I, as someone who's done pretty close to scale demonstration pilots, I think it's really, really important that we've already done our homework, our simulation work that needs to be done to ask the -- so that we can ask the right questions of the pilots. I wholeheartedly believe that we have a lot of technology that can provide these solutions.

And so, I'm not sure, maybe I'm wrong, but I haven't been shown that there's a lot of value in throwing taxpayer dollars into pilots instead of -- unless we know what the question is that we're asking.

Now, I think that it's a great -- the bus pilot that has already happened, they're already putting a lot -- there's a lot of cost share that you could get out of that, so there's a good reason to go for something like that. But I just want to caution that we need to have done our homework before we go and throw more money at pilots.

MR. SCHORSKE: And just to be clear, what I'm talking about is actually a mandate with respect to the medium-duty. I don't think we have to add more money into the system.

MR. HARLAND: Hold on.

MR. SCHORSKE: Just to respond, I think I'm in general agreement on the pilot point that you just made. What I'm talking about is an actual mandate on medium-duty, as well as on E-school buses. And essentially, you know, the figures that we've seen based on that incremental cost are such that there's a real ROI there.

And if you've followed the national V2G school bus numbers, again it's very, very clear there's a strong ROI.

So, the manufacturers are willing, on the vehicle side, to make that standard equipment. All we need to do to enable it is to make sure that it's a requirement on the EVSE side and that the fleet managers know how to do this, and are encouraged. And that could be done by means of the HVIP incentive.

MS. MACDOUGALL: I think I'd like to just -- I completely agree with you, there's a lot of value in V2G, especially in the school bus realm. But I do want to reiterate what Jason said. Especially if we're looking at the VGI roadmap, and looking at it in the future, and more advanced technologies and, particularly, the cost benefit analysis and value of VGI, extremely expensive pilots are not going to give you that answer.

I mean, they're great for like scaling up and getting user behavior and like seeing the impact of new rate design. I am on board for that and educating the customers.

But if we're going to be looking at what it's going to look like in 2050, if we get all the EVs on these rates, or on these new real-time prices, I think like research and simulations are like the first step to looking at that problem.

MR. MACDONALD: So, to add. So, all I would say

is that we have to be very clear about our question when we do a pilot. And I think that there -- you identified some questions in your response. It's, you know, how do you engage people who aren't aware of this and what's best -- including a work that might lead to a best practice for engaging fleet managers in grid activity. It seems like a realm of questioning that you could answer and you're not going to answer that through simulation, it's through a pilot of some kind.

But being very clear about what our questions are because I think that we tend to push -- or, at least in the past we've pushed pilots that maybe don't have clear questions. And we get a response to them and some of them don't prove all that useful.

MR. BOYCE: Bill Boyce, with SMUD. I wanted to build off some comments Karim made, and then also Cindy, and also kind of the earlier session about where the puck's heading.

When we're looking at DERs at SMUD, we're really looking at no difference between a hot water heater control versus an EV control, and energy is energy, and getting the pricing signals right, as well as possible, is what we're looking at.

And the types of things we start to talk about in more in the R&D world is, you know, EVSE goes away at

home. And you have something like a universal inverter, plug and play, that can handle your photovoltaic array, it can handle your car, it can handle your battery pack.

So, all these energy streams really come together and energy's energy, and what price you have going forward for, like I said, for your car is the same as what you have for hot water control.

So, you know, there's also that. And I wanted to point out, when we get into cost of these, for us and kind of back at Ryan, starting to get to the point where everybody can do what San Diego's done and send out day-ahead hourly pricing signals, and I think that goes a long way. And that's a really good way to help customers save money charging.

But there becomes a big difference when we start going to I need four-second response time for a distribution capacity, reliability concern. And when we start getting into those really critical timelines, those are the types of costs that Jason kind of showed in the L.A. Air Force Base, that get to be really hard costs.

And this is where I start to think, you know, passive control, being able to just have pricing signals, allow people to save as much money as possible. It can be way cheaper than having to have that much

controllability for like a four-second dispatch for, you know a regulation services market.

So, you know, how far do we go, how fast, where's it all going? All the energy's heading to some sort of controllability.

But, you know, the last one I'll put in there is really, you know, some of these communication standards, when you talk to us, we'd like it to all be one standard that the hot water heater can use, the PV array can use, that inverter can use, and the car can use. So, not having to have individual technology-specific communication protocols is, you know, going to be beneficial in those types of universal solutions.

MR. MACDONALD: I'm going to add onto that, again. I think that the challenge with the four-second is often -- or, the very expensive things are metering and verification. So, we could consider maybe we don't need the kind of -- I mean, it's kind of heretical, but maybe we don't need very accurate meters. Maybe we can handle things -- I mean, like the response, the ability of an EV to respond to a fast signal is not too difficult, as long as you can get it via the internet it is. But it's verifying that they responded in exactly the way that you expected is harder.

MR. BOYCE: Yeah, some of the things we've

started to along there, and maybe these are for housing standards but, you know, Wi-Fi reception in a house is kind of spotty, especially out to the garage. So, when we get into codes and standards where we have a 40-amp circuit going out to the garage, why not put in a CAT-5 line at the same time, so we've got it directly into that service and being able to do that.

You know, the other thing that we haven't done and I'd like to really have the model, or think about it, but if we get a good -- I'm starting to lose it here -- if we get a good response to just the passive pricing signals and being able to shift load around to where we want it, that's also going to take a lot of pressure off having to do the critical reliability type things.

And so, if we're able to passively get 80 percent of the load shape we want, think about how much that would then take the pressure off having to have those high controllability assets.

And the other thing I think about is if we're able to get 80 percent of the load shape, you know, having dedicated, easier to control high-value control assets becomes much more cost effective.

So, it's kind of a multiplier effect if we can get a lot of this load shape passively.

MR. TAYLOR: I wanted to comment on the metering

cost really quickly. That's an example of where maybe some different agencies are thinking different things. Where, you know, weights and measures is talking about half of one percent and really, you know, very expensive kind of process to verify everything.

And CAISO was talking about something much more generous. You know, the Low-Carbon Fuel Standard, over at CARB, does not require that kind of incredibly, utility-great asset, you know, metering. So, those are three different agencies, you know, all with different numbers. And I haven't even mentioned the PUC.

MS. JOHNSON: Hi, everyone, this is Kelsey Johnson, with Nuvve. I am a project manager with Nuvve and I manage three of our several projects here in California. So, like you, Jason, I'm on the ground making these things happen.

So, I wanted to kind of reiterate some of the things you said in terms of how we actually -- we do need to walk before we run in some of these things. We need to make sure we understand the value streams and how to implement them.

But at the same time, we have the technical ability, now, to do these things. As the gentleman over there mentioned, we're going to be working with Nissan, in the UK, to work with a thousand vehicles in that

situation. And in the past, we had aggregated 19,000 stations in the Netherlands, to provide V1G services to the TSO there. So, the scale is there, technically speaking.

But I think the one funny thing that has not come up today, which I find funny, is that battery warranties is really the elephant in the room at the moment, in terms of being able to really scale this technology. And so, that's something right now that I'm dealing with in the midst of our EPIC, CEC-funded project that's at UC San Diego, is we're scaled to or we're slotted to have 50 vehicles, statewide, scaled out through this project.

CEC, unfortunately, will not pay for 50 vehicles, which is totally understandable. But I'm not really sure where I'm going to get those 50 vehicles from, especially given some of the OEMs do not currently warranty their batteries and Nuvve cannot buy all those cars.

So, that's something that I think is an interesting discussion that I would like to encourage the OEMs to have a further discussion with those of us who are interested in seeing bidirectional vehicles scale and commercialize. And how can we protect those batteries for you? How can we make sure that that is

something that will allow you to keep your bottom line, and be able to allow to go through that commercialization process?

MR. HARTY: Ryan Harty, from Honda. Maybe just specifically to address that, when the product is designed with the end-use in mind, for example, to introduce a vehicle into the market as a V2G-enabled vehicle. Well, then, that becomes our problem to worry about and we design the battery, and the system, and the appropriate safety systems in order to make sure that that product meets the customer's expectation in the service that we expect it to be in.

I think we're in a funny place now where, you know, vehicles being used for pilots are -- of course, they were not intended for or not envisioned to be used in deep discharge in pilots, even though there's nothing onboard the vehicles that would prevent them from being used in potentially damaging, battery-damaging systems. So, of course, in those situations there's no warranty.

But if we design, if we know the car's going to be a V2G-capable car, and we design it for that purpose then, you know, that's our problem and we have to worry about it.

And then, that brings me back to the question of pilots, themselves. From the automaker perspective,

doing something for a vehicle launch into the market is as much work as doing something for a pilot in terms of the amount of engineering we have to do to develop a car, get it certified, put it in, do all the testing involved to do it. And, you know, I'd rather give the design team the set of requirements once, and let them develop a product that we think needs to go into the market.

So, frankly, for us, you know, one of the elements on our roadmap that Jeremy showed earlier, was the perpetual pilot playground in the middle of it. And if we don't get some of the policy things in place, such as fixing Rule 21, or getting like massively easy point-of-sale interconnection permits for V2G, then V2G will always live in a perpetual pilot thing because you won't get mass market adoption. You'll get this utility program, that utility program, and the other one.

But, you know, we want to develop one set of training materials for our dealers. We want to develop one set of communications and advertisements about cars. And we just need it to be part of the zeitgeist of what this product is. And that's what we would like to do with V2G.

And so, if we can get the policy things lined up, you know, top to bottom, we can enable a world of

V2G in, you know, like for us four to five years. We put the requirements on the car, design the hardware and the specs, and then we make cars. And we make them, you know, in high volume, and that's how the business works.

And everything outside of that is the perpetual pilot playground and we don't really want to live in that. So, anyway, thank you.

MS. PIERO: Can I say one thing real quick?

MR. HARTY: Oh, yeah, if anybody would like a paper copy of the roadmap, Jeremy's got it.

MS. PIERO: I just wanted to quickly clear up, actually, we're not doing the same project as this in the UK. It's two separately-funded projects in the same funding program. But there's a lot going on in the UK right now. It's a very exciting space and I'd say keep your eye on it.

The other thing that I'd like to say, as a company that has a vested interest in V2G moving forward, is that we're not interested in pilots, either. We're actually way more interested -- and we're not interested in subsidies. And we're not really interested in mandates. We're interested in value streams being accessible. Value streams being revealed. In markets actually being appropriate for other DERs that are situated behind meters, on the distribution

grid. And we're interested in being able to get interconnected. And we're interested in being able to work with the battery manufacturers, with the car manufacturers, as Kelsey was saying.

And even if V2G is in the future, I think it's not a binary choice for this roadmap between V1G and V2G. If we're really talking about integrating EVs to the grid, all of these things have to be on the table and all of these things have to be implemented as quickly as possible.

So, I would say more we're looking for even just regulatory placeholders for where these opportunities will go, if we're not ready to address it, yet. Don't close doors, accidentally, by turning away from this technology, now.

MR. HARLAND: All right, I just want to do a time check. It looks like we have one more comment there from Vince, and then we should wrap it up because we were -- we were scheduled to end at 5:00. But thanks, everybody, for hanging out.

MR. WEYL: Vincent Weyl with Kitu Systems. I think there's a consensus here that we need more electric vehicles on the road. I want to build on Pamela's comment that we need to find an incentive for every player.

My question about this VGI Roadmap is aren't we missing a key player around the room? And it was Rule 21, where one of the key stakeholders and key contributors, actually, is the solar installers. And I have a hard time understanding the rate design, all the rates, and I picture the average dealing trying to represent to me why I should go buy an EV, and why it's more beneficial than a combustion engine.

So, I'm wondering whether or not we should associate the dealers into this VGI Roadmap.

Sorry for looking at you, Noel, but I think it's more a process.

MR. CRISOSTOMO: No, I mean I don't -- I don't like to stop the conversation when it's alive like this. But we do have to wrap. So, Carrie, thank you for moderating the panel and the panelists, thank you so much for presenting today.

(Applause)

MR. CRISOSTOMO: I'm going to let Siva come up and provide some closing thoughts. Before he comes up, I just want to remind everyone that we are back on tomorrow morning at nine o'clock. We'll be starting here in this room.

For those on WebEx, we'll be using a different meeting number, so make sure you check out the meeting

notice or look online. And as I mentioned earlier, all the presentations that you've seen today are all available on our docket. So, if you're looking for those, you can find them there.

Thanks a lot, and I'll see everybody tomorrow morning.

MR. GUNDA: Thank you. This is -- I'm Siva Gunda. I'm Deputy Director for the Energy Assessments Division. And I've been asked to close off the meeting today with some introduction to what our division does, and some of the relevant aspects of the Water Division does with the discussions today.

I see a lot of familiar faces and names here. So, I just want to, first of all, say thanks to Ray, Eli and Noel for a wonderful day that was planned here.

I also want to thank all the vendors and the panelists who took their time to help us with this event today.

I know Kevin made this joke earlier this morning that we both wore the same shirts. It is really true. It was not planned, it was just probability. We do show up with the same shirt once in a while as a part of our breaking down the silos here.

So, what our division does is kind of understand the supply and demand side analysis that helps with

reliability planning for the electricity and the natural gas markets and sector.

And as a part of that, we do forecasting. So, as most of you know, forecasting is a Type 2 system, so we are never right. So, we're always in the vicinity of being right.

So, what we try to do, though, is kind of do the best guess around the uncertainties that exist around the forecasting. As a part of that, we kind of convene something called a DAWG, a Demand Analysis Working Group. We have a lot of economists and engineers, so we can come up with cool terms. DAWG is how far we go.

So, as a part of that, we have a Transportation Subgroup, which we call a PUP. But the idea is to bring stakeholders, like you, to kind of weigh in on some of the characteristics and potential projections of the various attributes that help with the models that we use here.

So, at a high level, the Transportation Forecasting Group, within our Division, does a Forecasting Transportation Demand Analysis, which is primarily driven by choice models.

So, the choice models use a survey that we do every three years. It's a consumer preferences survey. And based on the survey, we develop the necessary

equations for modeling consumer preferences for light-duty vehicles, as well as commercial vehicles. So, that's something that's very important for us as we move forward.

So, we request all the stakeholders here, that showed a lot of enthusiasm today, to participate in those DAWG meetings to help us double up some of this -- both the preferences side, as well as projections towards what we should use in our models.

So, I'm kind of looking at time and I don't want to stay here for too long. So, I just want to say thank you for being here. And me and Kevin will plan to wear the same shirt tomorrow, to show. Thank you.

(Thereupon, the Workshop was adjourned at 5:13 p.m.)

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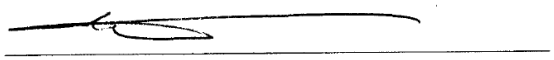

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