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BEFORE THE

CALIFORNIA ENERGY COMMISSION

In the matter of:

2020 Integrated Energy Policy Report Update (2020 IEPR Update)	)	Docket No. 20-IEPR-02 REMOTE ACCESS WORKSHOP

JOINT AGENCY IEPR WORKSHOP ON VEHICLE-GRID INTEGRATION AND CHARGING INFRASTRUCTURE FUNDING

REMOTE VIA ZOOM

SESSION 1 - VGI Roadmap, Use Cases and Benefits of VGI

MONDAY, JUNE 22, 2020

2:00 P.M.

Reported by:

Martha Nelson

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Clifford Rechtschaffen, California Public Utilities Commission

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Eric Martinot, Gridworks

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PUBLIC COMMENT

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AGENDA

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P R O C E E D I N G S

2:00 P.M.

MONDAY, JUNE 22, 2020

MS. RAITT: It's two o'clock. We'll go ahead and get the workshop started. Good afternoon. I'm Heather Raitt. I'm the Program Manager for the Integrated Policy Report, or the IEPR for short.

Today's workshop is a joint agency workshop on vehicle-grid integration and charging infrastructure funding. The workshop is part of the 2020 IEPR Update proceeding.

And I'll quickly go over some housekeeping items before we start.

This workshop is being held remotely, consistent with Executive Orders N-25-20 and N-29-20 and the recommendations of the California Department of Public Health to encourage physical distancing to slow the spread of COVID-19.

Instructions for attending or participating in the meeting were provided in the notice and include both internet and call-in options. The notice is available on the Energy Commission's website.

Please be aware, the meeting is being

recorded. We will post a recording and a written transcript on our website. Also, today's presentations have been posted on our website.

We're holding this workshop in three sessions over two days. This afternoon, we have a presentation on the Draft Vehicle Grid Integration Roadmap, followed by a panel discussion of use cases and benefits of VGI, or vehicle-grid integration. The second session is on Wednesday to discuss charging infrastructure and funding programs and that will begin Wednesday at 9:30 in the morning. The third session, the last one, will begin Wednesday afternoon to discuss scaling VGI and charging infrastructure. And for each session, we have a separate login link.

So we are trying to make our IEPR workshops more engaging in this remote environment. And so today, we will be using the Q&A function in Zoom with the capability to vote on questions posted by others. So if you open up that Q&A icon at the bottom of your screen, attendees may type questions for panelists. But before typing a question, please, go ahead and check and see if someone else has already posed a

similar question. If so, you can click the thumbs-up to vote on it and that will move the question up in the queue. The questions with the most thumbs up are up-voted to the top of the list. We will do our best to respond to all the questions but are unlikely to elevate all of them due to time restrictions.

And, finally, I'll just go over how to provide comments on today's materials. There will be an opportunity to provide public comments at the end of the session. So in Zoom, you can click the raise-hand icon at the bottom of the screen to let us know you'd like to make a comment. And if you change your mind, just click it again and your hand will go down.

For those on the phone not using Zoom, press star nine to raise your hand, and then we'll open up your line at the end during the public comment period.

Alternately, written comments are always welcome and are due on July 15th. And, again, the notice provides all the detailed instructions for providing written comments.

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

Thanks.

COMMISSIONER MONAHAN: Thanks, Heather, and welcome everybody. So I'm extremely excited to have this discussion, actually, the discussion we're going to have today and Wednesday. And, you know, vehicle integration, it's such a terrible moniker because it sounds very boring when you just say vehicle-grid integration and, yet, it's so important to reaching our goals for electrifying transportation and cleaning up the electricity sector.

So, you know, when we do it right, we save money on electricity bills, which is especially important for low-income families, we electrifying transportation more rapidly, and we reach our carbon goals in both transportation and electricity. And if we do it wrong, then we make it more expensive which doesn't provide any incentive for utilities to be able to invest in EV charging infrastructure if it's going to be, actually, more expensive for electricity users, and it gets harder to reach our goals for electrifying transportation and for reaching our carbon mitigation goals. So it's so important that we do it right.

Chair Hochschild, if he were here, I know he would talk about how we need to have an EV happy hour where all of our electric vehicles are charging at times when we have a lot of excess electricity from renewable energy. And, in fact, if we time it right, for many months of the year, we could charge all the electric -- the EVs that we have on the road today on zero-carbon electricity from the times of the day where we have to curtail renewable energy.

So we need to get it right. And that's why vehicle-grid integration is so important. That's why today's discussion is so important.

And I'm really happy that we are being joined by our fellow CPUC Commissioner, Cliff Rechtschaffen, and Commissioner Douglas from the CEC. So I wanted to see if either of you have any opening words you'd like to say. You could either just physically raise your hand or you could raise your little hand via the icon on Zoom world, whatever you want to do.

Commissioner Rechtschaffen, I call on you, sir.

COMMISSIONER RECHTSCHAFFEN: Well, did you see my hand raised by Zoom or physically or

both? That's the question.

COMMISSIONER MONAHAN: Oh, you know, I just saw it physically, so I didn't even get my Zoom --

COMMISSIONER RECHTSCHAFFEN: Because I thought -- I did raise my hand.

COMMISSIONER MONAHAN: I was hoping that you would go.

COMMISSIONER RECHTSCHAFFEN: I did raise my hand on Zoom. Thank you very much, Commissioner Monahan.

It's a pleasure to be here for this series of workshops. They are important and more timely than ever. We've done a lot of work in this area. It's a little bit daunting and frustrating but we still need to do more work. And this series of workshops gets us very much into technical details that we need to work out so we can get practical solutions and get vehicle-to-grid, in all its formulations, going sooner rather than later for all the reasons that Commissioner Monahan said.

It's such an important piece of our clean energy future to lower the costs of vehicle adoption for low-income consumers and others to

play an important role in grid management to manage curtailments, to help with resiliency and others. And just in the past few months with the prevalence of power shutoffs, we've seen and heard a lot more about the role that the vehicle-grid integration can play in helping us have a resilient grid.

There's lots of collaboration going on, most notably with -- between the PUC and the Energy Commission, which is reflected in this workshop and the presentations are terrific.

Of course, the CEC stole Noel from the -- the CEC stole our first presenter from the CPUC, and I'm still a little bit bitter about that, but that's okay because Noel is doing a fantastic job at the CEC.

We have lots of other agencies involved in this effort and I just want to give a shoutout to the working group, that have been laboring intensively over the past couple of years, that's put together a whole set of very helpful recommendations and conclusions about use cases and what we should do in the short term, medium, and long term that we'll hear about.

So I look very much -- I very much look

forward to the discussion today and over the next two sessions.

COMMISSIONER MONAHAN: Commissioner Douglas?

COMMISSIONER DOUGLAS: All right. Well, thank you. It's good to see both of you on the little squares and screens right now.

And I did just want to say that I've followed this series of workshops with interest. I've got -- I'm particularly interested in this one. It does seem like the vehicle-to-grid technology and direction would help us just bring so many benefits to our electricity system, as well as transportation, and allow people and enable people in so many ways to be part of the solution, and so I'm excited about what we'll hear today.

And I'm enjoying the Zoom format of the workshops. I've got to say, I like the idea of how you're doing the questions, so let's hope people take advantage of it.

COMMISSIONER MONAHAN: Yeah. And as Heather said, I do -- well, you know, we do encourage you to use the Q&A and to up-vote when you like something so that it reaches the top and

we will, hopefully, get to that question.

But this forum, actually, has created some opportunities that we didn't have in the old way of doing business. So I'm hoping we can all use these tools as richly as we can, if we have enough bandwidth to be able to do it, because that is the big challenge these days. I'm turning off every function that I don't need when I get on Zoom calls these days.

So let me just start by introducing Noel Crisostomo, the former CPUC staff person helping us here at the Energy Commission on a variety of vehicle-grid integration issues. And Noel is helping lead the update to the VGI Roadmap.

Noel, I turn it over to you.

MR. CRISTOSTOMO: Hi, Commissioner Monahan, Rechtschaffen, and Douglas. Thank you for having me present our draft process to update the VGI Roadmap.

My presentation outlined on the next slide is intended to provide context for why the state is working on vehicle-grid integration; second, to highlight array -- the array of agency activities that are continuing amidst our Roadmap update process and our informing our efforts;

third, to review four specific areas of progress in vehicle-grid integration as framed in policy, economics, technology, customers, first, to develop new electric transportation segments through regulation and quantifying economic potential and the benefits of the system; and the industry's creation of new technology and our understanding of how drivers could benefit from VGI.

In updating the Roadmap, we're holding this workshop on VGI and charging and want to take stock of how the evolving energy and mobility industries intersects with our continued efforts to mitigate climate change. And we'd like to harness this industry movement and understand what actions we can take to turn this multitude of opportunities into markets for deploying customer solutions and grid solutions that leverage the full capability of EVs as mobile source resources.

I'll conclude by setting a table for discussion for the next day-and-a-half of our workshops and our process moving forward to receive stakeholder comments on the Draft Roadmap.

Next slide.

California is on a path toward 100 percent clean energy, including making electric transportation accessible for all Californians. Vehicle-grid integration is critical to making these goals a reality. First, we want to make sure that we're maximizing savings for drivers, mitigating grid upgrades and the associated costs that are socialized among ratepayers, and make sure that we're creating business opportunities along the way to provide innovators opportunities for solutions for our drivers and our fleets.

And we also know that smart charging can hasten the dual decarbonization of the electric sector by integrating renewables and improving upon local air quality benefits by fuel switching away from petroleum.

California has been working on this for the large part of the last decade when former Governor Brown ordered that, by this year, EV charging will be integrated with the electric grid. CAISO and other agencies facilitated a workshop process to publish the first Roadmap in 2014. And in 2018, the Energy Commission initiated workshops to update the Roadmap in

parallel with the many interagency activities that affects electrification and grid integration on the next slide.

In working on the Roadmap, Staff were recognizing several specific efforts, working groups, and proceedings to make sure that the importance of VGI is carried consistently throughout. These, for example, include the CPUC's Working Groups on Rule 21 which gather stakeholders to develop pathways to interconnection for charger and vehicle-based V2G systems.

The learnings from VGI Research Project is funded by the Electric Program Investment Charge and are continued near-term priorities in that research program, the identification of future technical needs per the Distribution Energy Resources Research Roadmap that is pending final publication, and then the understanding of value from VGI and how it compares to the other DERs in enabling policies, which we will hear about shortly.

Next slide please.

The Roadmap is also tracking the development of rules, including Mobile Source

Emission Regulations, the roles of the utilities in electrification, the development of electricity dynamic rates managed load, and initiatives to enable smaller resources to participate in electricity markets. Also, coordinating with the development of market signals, we want to make sure that VGI is being invested in as we deploy infrastructure today, including through the California Electric Vehicle Infrastructure Project, CALeVIP, as well as learnings from the utility projects under the CPUC's jurisdiction.

The Energy Commission is delving into these projects' proceedings to hear your stakeholders' feedback and recommendations to reflect these efforts within the context of the tracks that we set forth in 2014 with the Roadmap covering policy, economics, technology, and a new one focused on customers, which were added in 2018.

Next slide please.

The policy track calls forth the need to understand the interactivity between and various implementation, as well as the gaps, in the state's transportation and energy planning

initiatives.

The economic potential track raised questions about how the market could plan for investment, including utilities, EV charging service providers, and automakers, based on the understanding of the comparative benefit between unmanaged charging, smart charging, and even discharging on the system, known as vehicle-to-grid.

The technology track recommended that the state leverage its partners in industry, research, and academia to understand the technological gaps and where to assist with commercialization with state funding, like EPIC or its predecessor, PIER.

And, lastly, to reflect the focus on ensuring that all Californians have access to clean transportation and to provide more equitable service with the best available control technologies for all, as we heard in a previous EPIC workshop, we added a fore-check, an intentional focus on customer behavior and ensuring that VGI covers our equity communities.

I'll review a few highlights of progress within each of these areas on the next slides.

Since 2014, the initiative to decarbonize has only broadened and accelerated. And as discussed earlier, California is on a pathway to carbon neutrality by 2045. And in the next decade, California aims to reduce greenhouse gas emissions 40 percent below 1990 levels. Abating emissions will come from, at least part of, serving 60 percent of electricity sales from renewables and using that clean electricity to charge or refuel 5 million zero-emission vehicles by that time, including cars and trucks.

However, in my next slide, I show that the Air Resources Board's regulatory efforts in the past several years are intent on transforming nearly all segments of transportation to zero-emissions to elevate the -- and these elevate the challenges but also opportunities for vehicle-grid integration.

As you can see, electrification will be occurring very soon across ocean-going vessels, harbor crafts, airport equipment, forklifts, buses, trucks, transportation refrigeration units, cargo handlers, and airport shuttles, which are all due to begin a phase-in of zero-emission technologies in the next several years.

All of these technologies and segments will rely on charging or refueling technologies which will add load into the system. On the next slide, the VGI highlights the benefit of adding all this load intelligently.

Since the EPIC Program was first deployed in 2014, the Energy Commission has invested over $30 million in VGI projects directly, matched with an additional $15 million from industry partners. Analyses, like this one from Livermore Lab, E3 and EPRI on distribution aware -- distribution system-aware light-duty EV charging management show the benefits and cost savings from V1G and V2G.

Specifically, the cost savings from transitioning from managed charging to smart charging with utility controls offers an additional $200 per EV per year in benefit on one end, the left-hand side, all the way over to, on the righthand side, roughly $1,000 per year per EV if the EV is able to discharge its battery and provide ancillary services with V2G. The greatest benefits, estimated at around $1,400, come from un-constraining the battery from protecting itself from there, which we'll discuss

in a few minutes.

This analysis highlights the location-specific benefits from providing distribution-level grid services, as shown in the light blue, and the importance of enabling business models to capture and share value among participants. As we analyze more transportation segments, distribution impacts will become even more important, shown on the next slide.

The technical and cost progress on medium-duty and heavy-duty electric vehicles was not very much envisioned in 2014. But in that time sense, the industry has quickly developed solutions to electrify the many segments that must fuel switch for California to comply with its federal air quality mandates.

Like the heavier loads that these vehicles themselves must move about, the impacts on the grid may, commensurately and acutely weigh on the grid if the state is ill-prepared for the new load. This graph shows the relative power demands for medium- and heavy-duty electric vehicles that can range from 19 kilowatts for a Class 2 shuttle charging overnight to 4-and-a-half megawatts for the prospective high-power

charger for commercial vehicles that is planned to be used to refuel freighters at truck stops throughout the state.

These demonstrate that vehicle-grid integration efforts must be evolved beyond the light-duty sector to proactively prepare for the necessary grid upgrades as to not serve as a barrier to the electrification of all these different transportation segments. Vehicle-grid integration will be critical for improving the health and economic outlet for members of our disadvantaged communities where these medium- and heavy-duty vehicles, primarily, are traveling along freeways and emitting criteria air pollutants. Shown on the next slide, I provide just a few indicators of what benefits VGI could provide for these communities.

In order for us to be truly successful with widespread transportation electrification, vehicle-grid integration efforts must translate so that they benefit California's drivers, and transit riders also.

Based on U.S. Housing and Urban Development Data, very low-income drivers in rural areas can spend 40 to 50 percent of their

income on automobile ownership, as shown in the top part of the box and whisker plot on the very left. This translates to about $4,000 per year in automotive costs. Savings from vehicle-to-grid previously shown an estimated per -- at around $1,000 per year, could represent, roughly, an eight percent increase in the effective income for these very low-income individuals if they are able to take advantage of those great benefits.

And, conversely, transit riders in urban areas can spend over ten percent of their income just on riding the bus or the muni. This cost can be managed by leveraging smart charging in buses to ensure that the fair impacts for modernization investments borne by public agencies are reduced to the minimum.

Next slide.

The four areas of progress that we just reviewed are key indicators but are not the only landmarks of change in the industry. Shown on this slide, I list the many areas of transformation that has occurred in the past six years in the energy, mobility, and climate change spaces.

Each of these factors are giving rise to

a multitude of market opportunities for automakers, VGI technology providers, utilities, and others to help accelerate and fuel decarbonization of electricity in transportation. These include gamechangers that, frankly, weren't anticipated by really any stakeholders in our workshops in 2014, but these are quickly becoming reality for our realities today. These include drastic reductions in the cost of batteries or power electronics to enable vehicle-to-grid discharging, new charging use cases, including wireless, mobile, off-grid, or service-based charging models, autonomous vehicles. Even vehicle-to-grid vehicles, the batteries that are warranted to provide good services are planned to be released in 2021.

All of these technologies will be needed to fully accelerate the capability of electric vehicles at mobile storage resources to support resilience, especially with our upcoming fire season. And even with COVID, and as an example of an unanticipated factor to take into account, there are studies from the U.K. showing that vehicle-to-grid can even provide value, even when vehicles are not driving, because they can

discharge the short energy.

Next slide.

To wrap up, I will ground efforts in our shared objective for the next day and near future in updating the Roadmap. This, of course, is to electrify transportation and to integrate it with a decarbonized electricity system. The panel tomorrow, with participants from Electrify America, EVgo, the Energy Commission, and the Public Utilities Commission will dive into learnings and recently charged -- recently implemented charging infrastructure programs, and to enable the two key levers that we can pull.

First, we can advance the capability and availability of technologies to help our drivers solve problems for the grid. We'll discuss this during today's upcoming panel and one tomorrow.

And, second, we can also create diverse market opportunities to enable new business models for infrastructure investments, which will conclude our two-day workshop.

Next slide please.

And to conclude, I'll provide a timeline of our summer in which we'll receive comments on the workshop by July 15th and continue to

incorporate findings and recommendations from the related activities in VGI that I described earlier. Our intention is to publish a Draft Roadmap in September, and which we will hold another workshop discussing that and receive stakeholders' comments, in advance of the final publication for November during the Commission business meeting in which the Final Roadmap will be considered.

Next slide.

With that, I conclude my presentation, and I'm happy to take questions from the dais.

Thanks.

COMMISSIONER MONAHAN: Thanks, Noel.

So, my fellow Commissioners, if you want to join me back on the virtual dais, just by turning on your video, please do.

So I want to give thanks to Noel and to the team of folks that have worked on this Roadmap. This is not being required legislatively. This is just something that the CEC is working on because it's so important. And we'll be coordinating -- we already have coordinated closely with our fellow agencies but we'll be coordinating closely with them on draft

reviews before it goes public.

So I'm wondering, Commissioners Douglas and Rechtschaffen, do you have any questions for Noel? We have a few minutes before we start the panel discussion.

COMMISSIONER DOUGLAS: I do not at the -- I do not right now.

COMMISSIONER RECHTSCHAFFEN: Nor do I. I don't have any questions. Thank you.

COMMISSIONER MONAHAN: All right. I'm just going to ask one question. We've got three minutes before we start our panel.

Noel, if you were to look into a crystal ball and speak about which -- like what are the use cases you think are going to be the most valuable when it comes to vehicle-grid integration in terms of -- and when I say valuable, actually, I'm thinking not just value to the electricity users but value to the owner of the electric vehicle or the fleet owner -- what other use cases do you think are going to be sort of the most viable in the near term in terms of giving money back to the EV owner for charging his or her vehicle right?

MR. CRISTOSTOMO: When I think of

viability, I consider that in two parts, both technological viability and the viability of capturing people's imagination, captivating people in a new capability. And the use case that meets that two-prong test, in my mind, it's really vehicle-to-grid, as shown with that estimate from Livermore Labs. The ability to discharge energy essentially extends the ability for that resource to offer services.

And so not only is that valuable, as was illustrated, it also has the opportunity to create really new experiences and never-before seen benefits for drivers. And we're already seeing kind of prototypical applications of this with the ability to use tools on a plate for construction or have like an electric induction cooking stove at your campsite with a Rivian truck. There has -- people are essentially using vehicle-to-load to have an interesting glamping experience, if you will.

And so I think when we see that capability already being rolled out to the market without people clambering for it, it just captivates the mind. And when we start to apply that to the electricity systems, we can think

about resiliency benefits and, essentially, smoothing the duck curve.

COMMISSIONER MONAHAN: Great. Thanks Noel.

I think we are -- it's time for our panel.

MS. RAITT: Great.

MR. CRISTOSTOMO: Great.

MS. RAITT: This is Heather.

Yeah, Noel, if you could just go ahead and introduce your panelists and go ahead and take it away. Thank you.

MR. CRISTOSTOMO: Thanks Heather.

So, everyone, we have four esteemed panelists on the virtual dais to talk about vehicle-grid integration use cases and benefits to customers for the next, roughly, half-hour. And then about half-an-hour, about 40 minutes, for Q&A.

And so we'll start with Eric, then transition to Julia, then Tom, and then Jackie, with myself introducing them in the intermediate parts. So we'll start with Eric Martinot.

Eric Martinot is a Senior Fellow at Gridworks where he serves as the Facilitator of

the Working Group on Vehicle-Grid Integration on behalf of the California Public Utilities Commission and Joint Agencies. Previously, Eric was a colleague at the CPUC where he was Advising Senior Fellow in former President Michael Picker's office, coauthor of a white paper titled, "Beyond 33 Percent Renewables: Grid Integration Policy for a Low-Carbon Future," with Energy Commission staff in 2015. This paper informed resource planning efforts and it formed Eric's enthusiasm for VGI, which he's brought to the Working Group.

Eric, please take it away.

MR. MARTINOT: That's great. Thank you very much, Noel.

And greetings. Good afternoon, Commissioners, ladies and gentleman.

I, yes, I had the privilege of co-facilitating the Joint Agencies' VGI Working Group, along with Matthew Tisdale, Executive Director of Gridworks. And the Working Group really has done a tremendous amount of work that last ten months. We started in August. There were over 80 organizations from industry and from advocacy, research, various state agencies, and

charging providers, many different types of stakeholders. This was a very broad-based effort.

First slide please. Next slide.

So the Working Group really was to look at use cases and policies to support those use cases and, you know, what -- really, where are we and where are we going in bot the short term, medium term, and long term. And we were tasked with three particular questions by the CPUC.

And the first, Question A: What VGI use cases can provide value now? And that really reflects the short-term period through 2022.

And then the second question: What policies need to be changed or adopted to allow additional use cases to be deployed in the future? And we spent much of the last ten months on both of these questions.

And then we also addressed Question C in terms of how does the value of VGI use cases compare to other DER use cases? And we actually did not make much progress on that last question. But I would like to highlight the first two in particular, use cases and the value, and the policy recommendations.

So we developed a framework for use case assessment, actually, that encompasses over 2,500 different potential use cases that could provide value now or in the future along these five dimensions, the sector, application, type, approach, and resource.

In sectors, there were about 13 sectors, residential, commercial, rider share, and truck and bus fleet spaces. So we differentiated between single-family and multi-unit dwellings for residential. We differentiated for commercial among workplace, commute charging, destination charging. And we differentiated truck and bus fleets in terms of light-duty, heavy-duty -- I'm sorry, short-range and long-range trucks, buses and shuttles.

Applications were a wide number of both customer applications for bill management, backup resiliency, renewable energy self-consumption, upgrade grid -- grid upgrade deferral, and a whole series of systems services, ancillary services, renewable energy integration, greenhouse gas reduction, again, upgrade -- grid upgrade deferrals, quite a range of different applications that we looked at.

And then this encompassed for V1G and V2G equally, and both direct and indirect approaches in terms of direct being more active managed charging and indirect being more passive but, eventually, still managed charging, but things like response to time varying rates.

And then we also looked a the EV -- at EVSE as a resource. Was this unified in terms of ownership and operation and control or was this fragmented separate entities for both EV and the EVSE? That was the overall framework.

Next slide please.

We looked at these original 2,500 use cases and screened them out according to a series of criteria and ended up with about 340 use cases for both light-duty and medium- and heavy-duty. And this is a, perhaps, difficult to understand graph but it, basically, shows the scoring of benefits for each of the use cases.

So we scored each use case on benefits, on cost, and on the ease or risk of implementation. And these scores were relative for costs on a scale of low to high and relative for ease of implementation from very easy to difficult, and so those were relative.

But the scores for benefits where we looked at all 340 use cases and scored them -- we actually had a scoring exercise over a period of a number of weeks where everybody in the Working Group had a chance to score each use case in terms of benefits, costs, and ease of implementation -- and this shows the results of the benefit scoring.

And what's at the bottom is the 240 use cases that we scored for light-duty vehicles distributed b the dollar per EV per year benefit metric. So every use case was scored for dollars per EV per year. Each participant had a choice of different options for scoring that number. And the red distribution shows you the full distribution of scores that we received from the low teens all the way through $800 per EV per year. And you can kind of see distribution of that if you look at it. You can see about a third of the use cases are over $200 per EV per year.

The blue is showing the population, the number of EVs that could participate in a VGI program for that use case by 2022. So that ranged from zero up to about 600,000 EVs existing

in California by the year 2022 that could participate. We're not saying that they would be participating but they could participate in terms of the technical ability in the VGI program. Whether customers would choose to participate is not reflected in this graph. But this is how we scored the benefits. So if you multiple both of those together you get the total benefit to the state. That gives you some sense of the scoring we did.

Next slide.

We looked medium- and heavy-duty vehicles specifically. And we looked at quite a number of different types of vehicles. And participants were able to score any of these vehicles for any of the medium- and heavy-duty use cases, trucks, buses, fleets. And in terms of policy, now we had a lot of interesting results in terms of, you know, the scores from medium- and heavy-duty. But, really, when it came to policy, we saw that a lot of that, that pretty much the policies that we were recommending for light-duty vehicles also applied to medium- and heavy-duty vehicles.

But we also pointed out that the differences between light-duty and medium- and

heavy-duty needed to be understood by policy makers, and that included things like a smaller number of customers with higher loads, rigid duty cycles, clustering of large loads for charging, and the need to upgrade distribution system capacity to accommodate and accelerate the medium- and heavy-duty charging.

Next slide.

This is a slide showing some of the policy recommendations that we came up with. We put together a series of over 120 policy recommendations for VGI. We then consolidated and discussed and windowed them down and refined them and clarified them. We ended up with about 94 individual policy recommendations for VGI in that 11 categories.

And one of those recommendations, you can see here, is for customer bill management. And customer bill management, of course, everybody knows that these are really among the highest value, and they were among the highest scored applications in terms of benefits for both light-duty and medium- and heavy-duty. Plus, renewable energy self-consumption, actually, for both light-duty and medium- and heavy-duty were also

highly scored in these cases.

I won't go into this. I think a lot of work has been known about customer bill management.

Next slide please. Last slide.

I will focus my remaining time on the V2G use cases. And there were a number of V2G use cases that were highly scored, particularly for residential single-family home for backup and resiliency, particularly for a commercial workplace, for bill management and backup for resiliency, and also for commercial fleets, transit and school buses, in particular, for bill management and system, they had energy, for example. These were all highly scored for V2G.

In general, however, the V2G use cases, while scored highly for benefits, most of them were scored less for -- they were scored for higher scores and lower scores for ease of implementation relative to the V1G use cases. And we had a number of policy recommendations where there was strong agreement in the Working Group for V2G, including systems becoming eligible for some form of SGIP incentives, coordinated utility and CCA incentives to support resiliency for

advancing PSPS events, standards and requirements for buildings that would support a time-of-use use of EV batteries, pilot funding for EV backup power, and pilot funding for both V1G and V2G for microgrid solutions.

And so many of the policy recommendations that we came up with applied to both V1G and V2G. And there were a number that were also specific to V2G.

So there's a wealth of information, both in terms of use case scoring and in terms of policy recommendations, that the Working Group is putting forth. We're finishing the final report by middle of next week, June 30th. I'm currently right in the process of finishing the second draft and the third draft by tomorrow. And this meeting is helpful in terms of thinking about how we put this across and explain this in a report to both those who are involved in VGI and those who may not understand this very well.

So I'll be happy to take questions during the question session.

Thank you very much, Noel.

MR. CRISTOSTOMO: Thank you, Eric. This will be good fodder for discussion, given some

participants in the Working Group on this panel, as well as quantitative analysis from Juliet Szinai -- or Julia Szinai. Julia is a researcher at Lawrence Berkeley National Lab and has a -- is a PhD candidate in the Energy and Resources Group at UC Berkeley. She has focused her research on how to demand side resources, such as electric vehicles, energy efficiency, and demand response can help integrate renewables. Julia has contributed analysis to a CEC-funded VGI research project on the flexibility of BMW drivers, as well as the development of the open extensible building operating system for vehicles. Julia's current research regards how resource planning in California considers climate adaptation and response.

Welcome Julia.

MS. SZINAI: Great. Thank you so much for the opportunity to present today. I'll be talking about a recent paper I co-wrote with authors from Lawrence Berkeley National Lab, Colin Sheppard, Nikit Abhyanakar, and Anand Gopal on reducing California's grid operating costs and renewable curtailment with EV charge management.

Next slide please.

So the purpose of our work was to evaluate the wholesale grid impacts of managed EV charging in California when it was at scale. So we studied the bulk power system operations in 2025 with a projected portfolio of resources, including a 50 percent RPS. And we tested four different levels of EV adoption, starting with 0.95 million up to 5 million EVs at three different charging scenarios.

The first was unmanaged charging where vehicles plugged in and starting charging right away when they got home in the evening, for the most part, and two managed charging scenarios, overnight time-of-use charging at residential locations, and then also smart charging, or V1G, when the charging of EV is at residential, work and public locations was shifted when wholesale market prices were low and/or when renewable generation was high.

So we then quantified the potential value that these managed charging scenarios could provide by saving on generation costs and avoiding renewable curtailment. To do this, we estimated the total grid operating costs for California within the broader WECC from

generation emissions. And then we calculated the value of managed charging as the difference in these operating costs when the managed and unmanaged scenarios were compared for the same number of vehicles. We also looked at renewable curtailment levels between managed and un-managed EVs to see when the vehicles would help or hurt in renewable in the efforts.

Next slide please.

So in this analysis, we linked a high-resolution mobility model called BEAM and a grid economic dispatch model called PLEXOS. So BEAM simulated in detail the driving and charging behavior of about 70,000 individual EV drivers in the Bay Area, given their individual travel demands and available charging infrastructure. And BEAM produced unmanaged TOU and smart charging loads and constraints for each of those vehicles.

We then aggregated and scaled up those loads and constraints for each vehicle up to the utility areas in California and put that into PLEXOS. Then we ran PLEXOS as a WECC-wide model to minimize the total grid operating costs given these different EV scenarios. And PLEXOS

calculated the total cost for California, as well as curtailment levels in other grid metrics.

Next slide please.

So I'll just walk you through our high-level takeaways of our results before providing some more specific details.

Overall, we found that, without restricting drivers' mobility, managed charging can avoid up to ten percent of total grid operating costs compared to unmanaged charging, which is pretty significant. However, when we divided those avoided costs by the number of participating vehicles the value was relatively low.

When we compare those two managed charging scenarios, we did find that smart charging was the most effective at both reducing costs and decreasing renewable curtailment. And while overnight time-of-use charging saved nearly as much as smart on grid costs, it led to more curtailment than even unmanaged vehicles, which was counterproductive to renewable integration. And when the EV adoption level reached 5 million, if all the EVs were unmanaged, we saw that there was some unmet demand during the peak summer

months.

However, when both smart or TOU charging was used it was able to shift charging away from those peak times and showed that these strategies could defer the need for generation or transmission expansion. And, lastly, we found that the majority of charging occurred at homes. And because of the long plugin time, that was there was the greatest flexibility to shift load and provide smart charging benefits.

Next slide please.

So this slide talks about our hourly grid operation results. When we added the EV loads to the grid, it totaled about one to five percent of state load. Even with this relatively small share, it affected the way the hourly grid operations worked. So this figure shows a variety of grid metrics with the 2.5 million EV level averaged hourly for three representative months, January, May and July. The orange line shows unmanaged charging, the dark blue is TOU, and light blue is smart.

So we find that, starting with the first row, net load evening peaks decrease with time-of-use and smart charging. And the third row,

especially in May, in the middle, you can see that curtailment decreases in the middle of the day with smart charging. And lastly, in the last row, summer peak prices decrease with both smart and TOU.

Next slide please.

So now I'll highlight some of our annual results that really focus on this value and renewable integration aspects.

So the plot on the left, Plot A, shows the annual grid operating costs from generation and emissions from the model with zero EVs in the gray bar and the increasing levels of EV adoption and different charging strategies in the bars on the right. So when EVs are added to the grid, California's total grid operating costs increases in all scenarios because of the additional generation needed to meet the load. However, for the same number of vehicles, the charging strategy affects the degree to which these costs increase. And this difference in generation costs from smart or TOU charging compared to unmanaged charging is what we consider the value of a given managed charging strategy.

So that being said, we find that smart

charging provides between $120 million to $690 million per year of overall avoided generation costs for California, and nearly the same with time-of-use, and that really comes from shifting away from peak times. Those values, when we divide by the number of participating vehicles, come out to about $100 per vehicle. I would note that that doesn't mean that the customer benefits, which would depend on the business model or the particular rate design of the managed charging program, and it would likely include other value streams which we haven't quantified.

Now, looking at the curtailment on the right, we see that smart charging is clearly a more favorable choice by reducing about 40 percent of renewable curtailment when adoption reaches the 5 million mark on the far right. On the other hand, time-of-use increase curtailment since it doesn't overlap at all with midday solar generation.

Next slide please.

So I presented the results of this analysis. But given how quickly EV and battery markets are changing, as well as policy and

mobility landscapes, there are a number of important considerations and uncertainties as the world moves beyond 50 percent renewables and 5 million vehicles that we looked at.

First, the value impacts of these higher levels are likely to be nonlinear and depend a lot on reaching some thresholds, especially at the limits of the carrying capacity of the grid. It's also very likely that at higher levels of RPS, beyond 50 percent, VGI will become increasingly important as a way to avoid renewable curtailment. It's worth noting, though, that VGI is just one tool out of resources, like stationary storage and demand response from other electrified loads, so the value of VGI depends, in part, on the adoption of those other resources.

And lastly, it will be important to watch the mobility trends more broadly if there's a big shift from personal vehicle ownership as we've modeled to electrified ride-hailing fleets. And if there's also a greater electrification of medium- and heavy-duty vehicles that certainly have different charging profiles and constraints, that will affect VGI potential.

Next slide please.

So that's all I have for now. I'm happy to answer any questions. Here's where you can download our paper, as well as another study that I coauthored on electric vehicles in California.

Thank you.

MR. CRISTOSTOMO: Thanks for a review of your study. That will be great for points of discussion just upcoming, so we'll hear back from you in a bit.

But now I'd like to turn it over to Tom Ashley, Vice President of Policy at Greenlots, a member of the Shell Group. Tom has led public policy efforts at Greenlots since 2015. And prior to that, Tom was a consultant on a special project at the Electric Drive Transportation Association and was a Director of Policy at PlugShare. Greenlots is working on several charging hardware and software integration efforts, including second-life battery-backed DC fast chargers that can respond to dynamic rates and optimizing how battery-electric Volvo trucks can smart charge while meeting their trade operational requirements in Southern California in the LIGHTS Project.

Thanks, Tom, for joining and take it away.

MR. REYNOLDS: Tom, I'm sorry, you're still muted.

MR. ASHLEY: Okay. Can you hear me?

MR. REYNOLDS: Yes, we can.

MR. ASHLEY: All right. Thank you. Well, thank you. I'm happy to be here and joining you all from bedrooms, living rooms, and offices all over the state and beyond.

So I'm going to try to work through this pretty quickly, present maybe a little bit of a different perspective than what we've heard from the last couple presenters.

I want to kind of think about this, maybe a little bit more real world and practical for, you know, how we all are engaging in this market and the challenge of just transitioning drivers and fleets over to electrification.

Next slide please.

So we really heard a pretty wide range of values, both from Noel and the presenters, prior to being on this panel, and those values really run the gamut. So today, we're most focused on VGI or grid-related values, but very important

never to forget that we have a lot of other values for electrification, including large societal benefits around climate which tends to be very difficult to quantify, although collectively, we in California, I think, have gotten ahead of, certainly, the rest of the country from a quantification standpoint which, indeed, is really helping support investment in transportation electrification. But there are all sorts of benefits, including healthcare, air quality, you know, uptime with work.

And then, you know, at an individual level, as Noel was indicating, you know, this can really hit people in their wallets in a positive manner by reducing transportation costs, reducing fuel or energy costs associated with transportation.

But as you heard, just from sort of the litany of value areas that I just listed, you know, some of these are, you know, monetizable, arguably, you know, today. Some of them, the value is very inherent, but we haven't necessarily figure out quite how to monetize.

You know, a couple areas that I think, you know, really reflect pretty significant

challenges that we all have encountered and that we need to, you know, find our way over or through, you know, a lot of the practical associated with deploying infrastructure, I would say, has really focused on cost. So how much does a project cost? How much does an individual unit of hardware cost? How much does a software license cost? What is the cost of communications or networking, to the extent that that's needed?

And we've had a hard time, I think, grasping as how to, you know, shift that focus towards value, and that includes, you know, a lot of the values and benefits that I just listed but, also, you know, some like building a sustainable market and a sustainable industry from a financial standpoint which, hopefully, better unlocking VGI benefits will help facilitate. But, also, sort of this ongoing recognition that even where we have figured out ways to monetize some of this value, it still tends to be very challenging to access for most stakeholders.

Fundamentally, we've had a significant challenge with time. So I first met Noel, I believe, in 2014, and, you know, we've advanced

the conversation, no question. And the presentation that Noel just worked through really shows, you know, kind of the breadth of effort and work that has gone on to date. But, you know, it's very clear that, you know, from an actual accessing a value standpoint, we still have quite a ways to go. And a lot of that is really a scale issue.

So the reality is while, you know, we've deployed more EVs here in California than in any other state in the country, it's still just a very small percentage of vehicles on the road. And some of the value that is both inherent and will be monetizable in the future really is tied to a greater scale than, unfortunately, we enjoy today.

So the good news here, and, I mean, arguably, great news is at least, you know, from my perspective these are all very addressable challenges. And, indeed, we've, I think, made some meaningful progress in a number of these areas.

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So I wanted to spend a little bit of time just quickly on sort of a vision. And it may be

a case where a lot of us in this discussion today, you know, really do have a shared vision here which, you know, I would characterize as, you know, we need a construct, a mechanism, a pathway to, you know, leveraging this value that is pretty clearly defined, so we know how to do it.

You know, I think it's a very useful analogy to think about the LCFS mechanism here in California. You know, pretty much everyone knows what it is. And once you understand the value associated with it, the mechanism of reporting, registering and generating credits and, indeed, selling those credits, it's a very accessible market construct, which includes geographic accessibility. That's one that's accessible across California, not specific to, you know, any particular service territory or kind of regulatory environment.

Ultimately, it may go without saying, but we really need to find a way to do this that can drive the upfront investment in charging infrastructure, as well as drive that decision making to transition to electric vehicles.

So one thing I want to particularly note

here, you know, from the Greenlots' standpoint, very important that we acknowledge, really, quite a broad swath or ratepayer benefits that, you know, Greenlots' at least, feels strong should be able to flow to ratepayers, especially in regulated utility service areas. But the good news is there's really a lot of value, potentially, on top of the kind of low-hanging fruit ratepayer benefits that we're really kind of not getting to yet.

And so even in, you know, regulated utility service areas, there really should be quite a bit of opportunity to address value and really share in that value beyond what really should flow to ratepayers.

Additionally, you know, much like LCFS, at least in the near term, really looking for something that is fairly reliable and can be bankable in such a way to help drive, you know, financial decision making.

Just to wrap this, I think, you know, this is an area that it can be challenging for us. You know, in as much time as I and Greenlots spend on technical policy, you know, it is very important to understand that we do need to make

sure that we can deploy the type of technology and facilitate the type of communications necessary to unlock this value. And, you know, a particular challenge of doing that, of course, is we sometimes have to get ahead of the accessibility of the value to be able to unlock the value in the first place.

Next slide.

So I'm just going to skip through these last slides very quickly. But a point that I think many of you know, if you know Greenlots, really want to emphasize that, you know, V2G is going to be real at a certain point and we're very excited about it. But V1G can and is real right now. And as, you know, the Gridworks' VGI Working Group, I think, really identified, you know, the nearer-term VGI benefits are mostly in the V1G category. And this is about managing when and how something is charging, including at what power level.

Next slide.

So we finally have deployed a CEC-supported VGI project that includes four DC fast chargers and stationary storage that was once powering LEAFs.

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And I think, you know, this, if you look on the left very quickly, you know, the reality is that there are a lot of different types of benefits and a lot of different ways of engaging those benefits. But I do think, realistically, we tend to see more of the benefits earlier on when they really can reduce upfront and localized costs. And the values and benefits that are about reducing system costs, I think, tend to be a bit more remote and harder to plan for, at least on a per-project standpoint.

So with that, I look forward to Q&A and discussion.

Thank you.

MR. CRISTOSTOMO: Thank you, Tom.

We'll see more about that last technical setup in a few slides but want to provide an introduction to our last speaker, Jackie Piero, Vice President of Policy at Nuvve Corporation. Is active internationally in policy analysis and advocacy to change interconnection regulations, metering, and market access for the behind-the-meter resources that can enable vehicle-to-grid-capable EVs fully integrated with the system.

This experience is informed by Jackie's involvement in V2G research projects in San Diego and across California with electric school buses, as well as global deployment and operational efforts in the United Kingdom, Denmark, and the European Union.

Jackie, thank you for joining us and the floor is yours.

MS. PIERO: Thanks Noel. And thanks for including me in this workshop. This has been -- I've learned a lot already.

So I would like to talk a bit about our experience and our perspective on a very specific use case in California and contextualize it with some broader thoughts on our EVs should actually be perceived as we're looking for policy and regulatory solutions to integrate them better into the grid.

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So each of these pins actually represents a place where Nuvve is either operating commercially or doing some kind of pilot project that include bidirectional vehicles running some kind of bidirectionality for different use cases. It could involve market participation or it could

be a behind-the-meter value but we are doing bidirectional operations.

The interest that we've seen in bidirectional EVs around the world is largely concentrated in markets with high distributed energy resource participation, so lots of distributed solar, for instance, in islands, and in markets where they're already having a high amount of EV penetration as well. And what these areas have in common is that they're starting to experience constraints. And the interest in V2G is a direct result of looking for ways to alleviate those constraints.

In the U.K., France, Denmark, and Japan in particular, we are actually seeing the transmission system operator, the CAISO equivalent, actually starting to include EVs and bidirectional EVs in their forecasts and their scenarios for both the potential problems that they will have coming with their grid management projects and with the potential resources that they'll actually have coming on to the grid in the decade. They're designing their markets to include EVs, making specific decisions on market design to include aggregations of highly

distributed smaller resources from behind meters.

DSOs, meaning the IOU equivalent, are actually starting to develop localized flexibility markets. One example is in London, UKPN, the utility that London is actually looking at localized voltage support and substation backup that includes EV in their bidding structure.

And most importantly, I think, for this presentation, energy management of EVs is allowed and planned for in these areas, meaning they're actually allowed to be including the way that your EVs are charging at each location in distribution planning.

In the United States, as in other places, we're seeing lots of investment interest. And this is just coming from a newbie's perspective. We're seeing large infrastructure companies and venture capitalists that are starting to get into the energy space where they're actually okay with longer investment horizons of up to ten years to actually get a payback on their investment.

Even with all this in motion, though, these pieces are not necessarily coming together the way one might think they would when you see

them all sitting there together, ready to be implemented. And I'd like everyone to keep in mind that everything I'll say here is related to a fundamental disconnect that I think is hampering policy and regulatory development and, therefore, market entry of V2G.

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That's it, there's a disconnect. And I think that it has to do with the perception of policymakers, market designers, regulators of EVs and sometimes thinking of them as electric vehicles and sometimes thinking of them as distributed resources, but not necessarily figuring out a way to unite those two, we'll call it, personalities of the EV and actually be able to regulate and use them as best we can. This can be manifested in, for instance, conflicting communications, communication protocols that are required for an invertor that might be in a solar panel or in an EV and an electric vehicle or an electric vehicle charger. It can be the technical standards that are required of an invertor by the smart invertor standard in California and the technical standards that are required of an EVSE or an EV in California.

These can be incompatible standards but they're certainly going to be inefficient standards.

This also can apply to metering and rate design. And one case that I'd like to focus on to illustrate this is the new EV rate for high-power low-utilization facilities that address demand charge issues, the destination charging businesses have been having. It's designed to acknowledge that they have very little flexibility in when and how they charge an EV, meaning they will have very, very high peaks of usage that they cannot mitigate, and so we need to figure out a rate that acknowledges that. But this isn't the case for most EVs. And so if we apply that rate to seemingly related use cases, we may actually end up accidentally discouraging vehicle-grid integration and coordination, coordinated operation with other resources.

And I think a fundamental principle of rate design around EVs need to acknowledge the flexibility that most EV use cases and most EV users have in their charging patterns.

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So the use case that I'd like to use to illustrate this is the NDH -- or I call it the

use case scenario that my company has actually run into in California. We're very interested in bidirectional school buses, the use cases that can be applied to them, and the value streams that can be accessed and, therefore, the business opportunities that we see.

We actually have investors that are very interested in putting together packages where they would be financing EV infrastructure, the distribution infrastructure, even the bus itself, in return for part of the value stream that that configuration can generate over years.

However, in the current MD/HD funding scheme, as we understand it, if you take that MD/HD funding, you actually have to use the EV rate that I just described. And that EV rate requires that your school bus then be not a separately metered account with no other loads or resources associated with it. Therefore, you end up in the configuration on the right where the EV is, essentially, being added to the grid rather than integrated. You can't export. There's no compensation for exporting if you have VGG capability. You can't do demand response because there's no loads to baseline with. There are no

other loads to balance. You can't combine with solar and optimize that.

The only price signal you can respond to is that time of use rate. You can't do a WDAT, meaning the in-front-of-the-meter connection that may give you more access to more wholesale reg -- wholesale markets because that's not actually funded. It has to be a retail interconnection.

Therefore, if a school has taken this funding, a company like mine and the investors and the consortiums that want to work with us to integrate EVs into the grid would, largely, look at a configuration like that and say the best you can do is a set a timer.

If we were on the configuration on the left where no MD/HD funding has been taken and we have the opportunity to actually combine that EV with those school buses, with the load, with other resources, it actually allows us to integrate this EV with the other resources that are at the same facility. It allows us to do demand response. It allows us to potential bid into energy markets and a variety of other value streams.

One of the reason for these TOU rates is,

obviously, to mitigate the chaos of unrestrained energy use, to shift usage to less constrained times of day. But as we try to make that perfect rate that takes into account all the operating constraints and potential usage patterns, it's clear that there are too many use cases and profiles to be able to manage every type of EV load. Just trying to export this one rate from the destination charging use case to a seemingly similar use case of high-power charging actually ends up discouraging investment and integration.

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So my suggestion, instead of trying to design the right rates, instead of considering EVs to be a very specific class of resource, is stop trying to micromanage EV use. Stop trying to design the perfect rate.

The solutions that we're seeing in more constrained systems, like the ones I mentioned at the beginning of this presentation, is that they allow customers to stay on their rate and they focus on the connection side to that building, meaning they allow an agreed-upon limit to the demands, to the rate at which a facility will lose energy. They then allow the customer to

manage their own EV- related usage in relation to the rest of the loads and resources that they have at that site. There are automated load management technologies that do this automatically, as the name implies. A customer can then stay with their existing connection side, even if they nominally exceed it with new EV loads by limiting their use and planning their usage. This can actually stabilize loads, avoid peaks, and obviate the need for upgrades. And IOUs can then focus on connection side as their basis for distribution planning.

In Hawaii and in the U.K. and in France, I believe, this is part of a larger scheme that's limiting import and export of all resources, meaning optimized solar, batteries, EVs, the rest of the building. That concept opens up the integration use cases. You don't need to choose a use case that you're actually encouraging. Instead, it opens up access to multiple value streams and decreases the complexity of distribution planning and rate design and allows all ratepayers to benefit from the decrease in distribution upgrades because of this limitation.

It also allows IOUs to stop needing to

look beyond that meter and be able to simply focus on running the grid. And if we come back to that disconnect that I mentioned at the beginning, I would point out that the EV versus distributed energy resource concept is what drives this. If the EVs are just a distributed energy resource, along with all the other resources and loads that are behind that meter, you have integration. As soon as you start needing to look at the EVs just by themselves, you're isolating them from the evolving system that we need to actually have at the edge of the distribution grid.

Thank you.

MR. CRISTOSTOMO: Great. Thank you so much, Jackie. There's lots of tie-ins with the other comments from the presenters.

Before we get into discussion and some Q&A from the audience, because I see them chatting, get those in, I'd like to turn it over to Commissioner Monahan, Commissioner Rechtschaffen, and Commissioner Douglas to see if they have any questions that take priority?

COMMISSIONER MONAHAN: Yes, I have several questions, actually. That was

fascinating.

I'm wondering, Jackie, can you talk about some of your global experience, who's doing it right in terms of sending the signals that EVs are more like distributed energy resources? Are there lessons that we can learn from other countries, other regions?

MS. PIERO: Thanks for the question. Yes. I would say that the U.K. is actually doing some of the very best work in integrating EVs along with their other resources. And the reason I would say that that is happening is because they're an island with limited interconnections to other systems to help them and a large solar resource, distributed solar resource, and wind resource. Therefore, they're actually experiencing a lot of the problems that are conceptual here. They're already actually experiencing them in real time and dealing with them.

Same with Hawaii. The isolated systems, I think are needing to figure out how to use their existing infrastructure, their constraint. And so there's a policy imperative to actually figure out how to integrate EVs. That would be

the why.

The how is reexamining the incentive structures that utilities have, the way the distribution buildout is planned to actually focus on efficiency, on performance. And that conceptual change actually will change the way that EVs are considered, along with solar and along with batteries.

Does that answer your question?

COMMISSIONER MONAHAN: It does. I'm wondering how you would stack California up compared to the rest of the world? So if the U.K. is number one in terms of speaking about this vehicle-grid integration, how would you stack up California compared to other regions?

MS. PIERO: It's probably in the top third, I guess. I think --

COMMISSIONER MONAHAN: So to become number one, this is what we --

MS. PIERO: Europe is having a lot of the --

COMMISSIONER MONAHAN: -- we want to be number one.

MS. PIERO: Yeah. You know, I think --

COMMISSIONER MONAHAN: What would it take to be number one from your perspective?

MS. PIERO: I think, you know, that everywhere has different strengths. In France, for instance, you can have that exact type of system that I was talking about at your home. Your EV is plugged into your smart meter and it actually will charge in a way that keeps your home use at a consistent level, whereas in the U.K., they are -- they're really designing utility incentives so that they are -- they're incentivized to create their local markets.

And I think that that has actually been one of the biggest factors in spurring innovation. It has to do with creating the environment for innovation. And they've done that largely by asking for minimum standards of requirements rather than mandating exact technical specifications. Minimum standards combined with incentives seem to be the thing that allow industry to really run without creating regulatory lock-in where you actually have limits on what industry can accomplish because they've been told exactly how to do it.

COMMISSIONER MONAHAN: So it's good to

hear, as we're in the process of considering load management standards, how to do that right.

I also have a question for Julia about the analysis that you did. And the baseline was unmanaged charging. And I always think of a baseline as no EVs. And I know you had that kind of -- you didn't break it out or at least I couldn't figure out how to easily break it out in terms of ratepayer impacts, like if we think of EVs as generally good for ratepayers because you're spreading out costs.

But did you get down -- did you have part of your analysis -- I don't think it would be that hard -- but looking at this difference of a would without EVs, and then a world with EVs unmanaged, and then a world with EVs managed and smart changing? Did you do that as well? And what were your findings?

MS. SZINAI: Yeah. That's a great question. So, yes, we looked at no EVs as like the baseline-baseline case zero and compared that cost. It wasn't reported in our paper but we did look at what the total cost per megawatt hour was without EVs versus with unmanaged EVs per megawatt hour and with managed EVs per megawatt

hour because that's a better example of how the ratepayer benefits would be distributed across all customers, not just drivers. And we found that the per megawatt hour cost was mitigated with smart charging compared to a slight increase with unmanaged vehicles compared to no vehicles.

Yeah, so managed charging can benefit all ratepayers by lowering costs for everyone, even if they're not directly participating in it. But that value is valued across --

COMMISSIONER MONAHAN: In terms of what's --

MS. SZINAI: -- a lot of systems.

COMMISSIONER MONAHAN: -- what's best for ratepayers, we would go with smart charging first, managed charging/TOU second, no EVs third, and then the worst for the ratepayer is unmanaged EVs; is that it?

MS. SZINAI: Yeah.

COMMISSIONER MONAHAN: Am I getting it right?

MS. SZINAI: I would say that. Okay. But I would also clarify that we just looked at overnight time of use, because that was what was available at the time of our analysis, and I know

that rates have been updated since to include some up-peak hours in the middle of the day, including some commercial EV rates, so those can also contribute to some of the curtailment benefits and --

COMMISSIONER MONAHAN: Yeah.

MS. SZINAI: -- compensation.

COMMISSIONER MONAHAN: I'd love to see your analysis updated with medium- and heavy-duty and some charging in the middle of the day to take advantage of our -- well, to deal with our curtailment problem.

I think I'll stop there to give my fellow Commissioners a chance to ask questions. And then I know Noel has some facilitated questions he wants to ask.

COMMISSIONER DOUGLAS: So I've got a question and I'm not really sure who to address it to, so whoever wants to take this.

But I guess my question is, on the cost side today, if somebody already has an EV and they already have a solar panel and they want to be able to use their car as a battery if the power goes out, you know, just some, you know, they're not necessarily -- they don't necessarily

need to reduce their rates, they just want to be able to, you know, have the backup, what's the cost? Is there a vehicle-to-home option available today? Is it cost effective? Is it hardware? Is it software? Is it, you know, need for getting multiple approvals? What does someone who wants to do this do today here in California?

MR. CRISTOSTOMO: Jackie, I'm going to suggest that you take that on as our resident V2G expert.

MS. PIERO: Thank you. I couldn't figure out how to raise my hand. I forgot, so thank you for calling on me anyway.

COMMISSIONER MONAHAN: Well, we do this.

MS. PIERO: Yeah. So the cost -- there are EVs and there are EVSEs out there right now that can do this. In fact, Nissan started designing bidirectional-direct current charging EVs after the Fukushima disaster specifically meant to provide home backup. And so there are accompanying stations, and the CHAdeMO charging standards also facilitate that.

That said, it's not necessarily that easy because of regulations and because of like

there's a very specific subset of cars that are actually equipped to that. Most EVs can't do this for you today. But if you did have that EV and that EVSE, let's say, that are -- the EV itself is a regular Nissan LEAF, the EVSE might be a bit more expensive. It will be a bit more expensive because of the enhanced power electronics that need to be built into it and the small amount that has been built so far.

But if you have your solar, you most likely have net-metering contract in California. And having that EV as storage actually can disrupt that one contract, as I understand it. And so you end up in a situation where to have that capability, you may not actually be able to keep you NEM. Also, it's a matter of being able to island your house from the grid in a way that utilities are comfortable with. There are some solutions out there. There's a new company called Connect California that's actually looking at ways to do this using remote disconnect switches that are a pretty economical option. But it has to do with assurance for the utility, that you're not going to accidentally back feed onto the grid while it's down.

So I would say the blockers are less price and more regulatory and technical.

COMMISSIONER DOUGLAS: Regulatory and technical and hardware, at least for some, vehicles. But like for somebody who had a Nissan LEAF already and had so --

MS. PIERO: Um-hmm.

COMMISSIONER DOUGLAS: -- would they even know what they needed to do? And I'm asking this in a as far as -- you know because I, you know, I tend to work with people who, you know, I don't know, tribes and people in more rural areas, people who have some particular concerns around reliability. And, you know, there is this question out there, it's like, well, how do we do this? I have my solar. I have my car. Do I need to go buy a power wall? What do I -- you know, where can I use my car?

MS. PIERO: Yeah.

COMMISSIONER DOUGLAS: I don't know, really, what to tell them.

Now, I haven't, also, gone through every word in the vehicle-to-grid roadmaps. I find them to be a bit dense for me to get through and come out with the answer to a question, like as

if it's -- if the answer is in there.

MS. PIERO: Yeah. There are -- you know, there were NPR stories after the least PSPS shutoff where we saw people doing this, actually using their car to power their home. So, yes, it's absolutely possible. Those are kind of tinkerers, though --

COMMISSIONER DOUGLAS: Yeah.

MS. PIERO: -- and I think there's a bit of jury-rigging that's going on, but they're designed to do this.

COMMISSIONER DOUGLAS: Um-hmm.

MS. PIERO: So it really has more to do with you being allowed to do it. If you ask permission you need to be able to get permission and go ahead and enable the car to do that.

COMMISSIONER DOUGLAS: That's interesting.

MS. PIERO: So you know --

COMMISSIONER DOUGLAS: Most --

MS. PIERO: -- most likely, like a company like mine where I'm an aggregator --

COMMISSIONER DOUGLAS: Um-hmm.

MS. PIERO: -- I wouldn't be involved in

that because we're talking about a time when the grid is shut down. This is a hardware thing.

COMMISSIONER DOUGLAS: And, of course, the greater benefits to the grid are the bigger picture that you're mostly talking about, you know, where, you know, the customer can reduce rates and we can shape peak. And, you know, I mean, there are many greater benefits. I was just trying to understand, you know, for people who find the value case to be proven already, what do they do?

MS. PIERO: I think the resiliency case is really important. It can be seen both as something that can be done at an individual house but it could be done at school with a school bus. It could be done in a microgrid with all of the EVs that are in that microgrid.

And so, actually, really examining the four corners of that case, what does it really look like, I think is one of the things you really need to dig into and track to microgrid proceedings, and there are a few other opportunities to look at that actually have proceedings going on right now.

COMMISSIONER DOUGLAS: Great. Thank you.

MR. CRISTOSTOMO: Commissioner Rechtschaffen, do you have any quick questions?

COMMISSIONER RECHTSCHAFFEN: Who said the have to be quick? Anyway, I do have a few questions. They will be quick.

I don't know if we're going to talk about this at later workshops. Noel, if you want to talk about it with any of the panelists, we've heard for many years the resistance of the automobile companies to using their car batteries for either V1G or, certainly, V2G. And I was at a workshop at the CEC about 18 months ago where the vice president for Tesla said, emphatically, he's not interested, they're not interested in this.

So in all this discussion, are we -- has the world changed now? Are the OEMs more willing to have -- to move forward on V2G?

MR. CRISTOSTOMO: I'd like to say, yes, they're cautious in statements but there are public record statements advancing the idea of warranted batteries for discharge being offered for mass market use.

Tom, I don't know if you -- I saw -- I think I saw you're nodding your head, but if you

want to jump in, given Greenlots' engagement with utilities and development to charging systems, do you want to speak to this -- I'm sorry -- with automakers?

MR. ASHLEY: Yeah. So if you can hear me, you know, Commissioner, I think, as we've been hearing in this discussion, you know, some of these challenges are technical, some are regulatory, some are commercial. I think Greenlots -- and I'm the first to admit that, you know, we've been focused on V1G, not V2G -- but I think that, you know, in our engagement with a number of stakeholders, including automakers, it's our sense that, you know, when the value is more clearly accessible, so will be the methodology to access it.

So that may be a roundabout way of answering your question. But I think the challenge we have is not to wait for automakers to say, yes, but to craft environment, the market structures that will drive and accelerate the decision making by auto manufacturers and users to allow V2G.

MR. CRISTOSTOMO: I want to see if Eric wanted to speak towards some of his automaker

representatives engaging in the Working Group speaking about this point? Any thoughts?

MR. MARTINOT: Yeah. Thanks Noel.

Actually, it really didn't come up. You know, over the course of the Working Group the automakers were involved in scoring and screening many of the use cases or all of the use cases that we went through. And quite a number of V2G use cases were scored highly for benefits, as I had said, and perhaps lower in terms of ease or risk of implementation.

And that was -- that would be one of the factors, I think, that the automakers would consider in that, is how easy is this to implement given the need for, you know, battery cycling and warranty issues, potentially, as well? And so that would be something to sort of separate out from the general level of assessment in terms of that ease of implementability, of that bit of, okay, how easy is it to overcome the barriers that exist? But we really didn't hear that that was an issue or factor. It really didn't come up.

MR. CRISTOSTOMO: I will note, before turning it back to you, Commissioner

Rechtschaffen, that during our 2018 VGI Roadmap workshop in October, Honda made announcements stating that they are planning to release their next models with V2G capability built in, warranted for grid purposes. So it is not publicly available but there are plans.

So you had another question?

COMMISSIONER RECHTSCHAFFEN: Well, if we -- I don't want to -- it's up to you and Commissioner Monahan if we have time or if we're going to go to public comment right now, so you guys let me know.

MR. CRISTOSTOMO: Jackie, you wanted to say something eagerly?

COMMISSIONER RECHTSCHAFFEN: Excuse me?

MS. PIERO: Yeah. I just wanted to jump in and say that, actually, the automakers are very interested, as near as I can tell, in understanding what they will be allowed to do with their cars. They've showed up to several different regulatory proceedings asking for regulatory certainty of what they will and will not be allowed to do in terms of accessing value streams and interconnection of a bidirectional car or an EVSE.

And in the last year, there's actually a new advocacy group that was formed by automakers called the Vehicle-Grid Integration Council that includes, I think, six major OEMs. And they've started commenting and actually participating in policy formulation in the VGI Working Group as they're trying to represent themselves to make sure that the auto manufacturers perspective is actually being taken into account as V2G policy is being made. So they are interested.

COMMISSIONER RECHTSCHAFFEN: So I have one quick comment and one question. I just want to -- I was going to ask Eric some questions but I'll postpone those.

I just want to thank you for the tremendous work that the Working Group did and really focused on immediate value propositions and immediate policies that need to be changed. That's super helpful for us at the PUC. You gave us, probably, too much -- too many good things and it's going to be hard to figure out what we take from the menu. That's the real challenge. And we're going to probably come back to you and ask for more, you know, guidance and suggestions about how to take up which bucket of things to do

because we can't do all of them at once. But I do want to express my deep appreciation for the work that you and the Working Group did.

And then I wanted to just ask Jackie, this is something we could continue discussing later on, I heard you say we should get out of the business of micromanaging rates. And I think we would be delighted to do that. At the PUC, we certainly don't love trying to figure out rates for all kinds of use cases. The Working Group, if anything, goes in the other direction. It comes up with many, many different use cases that suggest different rates.

And I'm wondering if you have an example or you in mind, an end goal of what the rates would be, given the different load profiles of the parties and the rigid duty cycles and the dangers of just -- or the limits of just having POU rates? And we heard from Julia about the lower benefits, as we have TOU rates or more uncontrolled rates. It's a little scary for us to imagine one unconstrained rate. Maybe there is something and we'd be happy to hear about it. I'm just giving you a comment. I guess it's a question of where we might look to define that or

what you're thinking about. And if it's very involved, we should just continue the discussion later on or through comments that you provide to our proceedings.

MS. PIERO: We definitely can. And Mark Mondeket (phonetic) and I actually had -- one of our policy recommendations in the VGI Working Group were sort of evolving into a policy brief that's actually addressing that a bit and rates is something that we need to think about a little more.

But what I've seen in other places that we're working is that there are a variety of cases that have been able to be integrated into the current operating profile of the customer. So we had a delivery company that was going all-electric with all of their vans and they actually were able to just stay on their normal commercial and industrial rate.

But we also have homeowners who are on, you know, extreme time-of-use rates and it really just kind of plunks their usage all into one time frame and it actually stops them from reacting to more nuanced signals, like what you might see with the duck curve happening.

So that's something that we need to think through a little bit more. But I guess the spirit of it would be not looking at just EVs as just EVs. We have to assume in California, particularly given the new mandate, that there's going to be solar too. Maybe there's also a battery. And we need to think through how we actually optimize those different loads and resources together, rather than trying to manage each one separately.

COMMISSIONER RECHTSCHAFFEN: Thank you.

MR. CRISTOSTOMO: Great. Thank you for questions from the dais, Commissioners.

So we have about seven minutes for some discussion before opening it up to audience Q&A, so I want to keep digging on this tension between allowing for more packaged solutions that bring together a variety of use cases, value streams, potential revenues, as markets open up.

Tom, you're mentioning that time is kind of our enemy here where as we accelerate with more RPS, and as Julia was saying, more EVs, there are going to be nonlinear opportunities for additional value but it's not yet capturable and we might risk not getting to the higher fruits

that could flow to ratepayers.

And so if Tom and Eric, Julia, Jackie could all provide thoughts on how to continue to deploy capabilities with the opportunity to bring in these revenue streams and values in time to customers, how might you, from a policy standpoint or a business model designer standpoint or a researcher, approach this multidimensional problem?

MR. ASHLEY: I'll try to start. Thanks. Thanks for the question, Noel.

So, again, sort of thinking from an operational standpoint, you know, working with, let's say a fleet that is working to electrify, you know, yes, total cost of ownership matters, both from a vehicle's and fueling infrastructure standpoint, but so does up-front costs. And, indeed, the upfront costs may be dispositive, even if the total cost of ownership looks great.

And so I think that's a fundamental challenge that we have which is, arguably, time dates; right? It's how do we front load, to some degree, some of the benefits that are available? Because if we don't do that, we might not get to the benefits in the first place, at least, you

know, in the context of, let's say, that example project.

So fundamentally, you know, the lower hanging fruit out there, from a grid integration standpoint, tends to be lowering the costs of electrical upgrades to the site of the project in the first place. And, obviously, that can then cascade to, you know, circuit level, you know, and beyond. But without that scale, it's really hard to think about that opportunity past the one project site.

So I do think that there are some real tangible opportunities to do more system-level mapping and forecasting, which can help better ascertain kind of the values and costs associated with both managed charging and unmanaged charging at a larger than project scale but smaller than, you know, distribution system or grid scale.

But as I mentioned, and I realize it may not seem all that practical at this point, you know, really figuring out that mechanism that is accessible and can help sort of front load is really critical.

And I would just say, I mean, I think we have some exciting pathways. And I would

highlight, you know, SB 676, which was passed last year, which would -- you know, really, it creates a requirement for the PUC to plan around VGI. And, you know, setting some targets may really be necessary to then associate value with those targets and be able to work backwards.

MR. CRISTOSTOMO: Thanks Tom.

If Eric and Julia can speak about that same topic in about 30 seconds each?

MR. MARTINOT: Yeah. Thanks, Noel. I would say that, I mean, the range of opportunities that we're seeing in terms of use cases, in terms of policies that can affect those use cases, it was just enormous in the Working Group so many different opportunities across such a broad range of applications, sectors, types of control, V1G, V2G.

Maybe it doesn't matter so much where we focus first as long as we're focusing on more than just one or two things, you know, that we can manage to do right now, but really focus on the number but not necessarily say, well, this is the one or this has to be the one, but many different opportunities could be pursued simultaneously right now and they all provide

value. And you know, each type of stakeholder may have an interest in one particular one. But I think if we pursue a more broad approach to these and, you know, just thinking about, yes, everybody knows, customer bill management, time-of-use rates a lot of that's already in progress already, and the things that are not in progress right now, like really identifying what's missing in its absence from the policy landscape that, really, we need to address.

And I think that's part of the very large number of recommendations we had. But I think it would also point to things like Jackie was saying, integration with local renewable energy and integration with local energy management systems and buildings, et cetera, whether it's V1G or V2G, it doesn't matter so much, I can point to things like that.

So, anyway, thank you.

MR. CRISTOSTOMO: Julia, if you could open up you crystal ball and talk about future customers and what they could handle?

MS. SZINAI: Yeah. I was going to concur that in the literature and in focus groups that I have helped facilitate with smart charging, out

of the participants we found the up-front incentive is more important than the recurring small payments that customers could get. And first and foremost, it's really important to keep I mind that EVs are still meant for customer mobility. So we shouldn't expect programs to be super successful if we expect a big behavior change that sacrifices mobility.

So in addition to looking at values and incentives that we can provide for customers, it's really important to design programs that are really convenient for participation and, also, respect customer mobility needs, including, if it's smart charging, like setting minimum guarantees for charging loads and opt-out opportunities and things like that.

So just keeping the customers mobility needs in the forefront is really important, in addition to looking at designing incentives.

MR. CRISTOSTOMO: So, Jackie, to close, one final thought on how to continue to scale?

MS. PIERO: That's okay. I've talked a lot. I think I'm good. Thank you.

MR. CRISTOSTOMO: All right.

So with that, I really want to thank Tom,

Jackie, Julia, and Eric for their presentations and the excellent discussion and the questions from each of the Commissioners. We look forward to working with you on the updated Roadmap and would like to take a few public comments, so I'll turn the workshop back to Heather

Thanks Heather.

MS. RAITT: Great. Thank you, Noel, and thank you, panelists. That was really a great discussion.

And so now we're going to turn to public comments. And so if folks are interested in commenting and you're on the Zoom platform, you can click the raise-hand feature to let us know you'd like to comment. And for those on the phone, you can press star nine to -- and that will raise your hand from the phone to let us know you'd like to comment.

And we have RoseMary Avalos from the Public Advisor's Office at the Energy Commission here with us today to help conduct the public comment session, part of the session.

So go ahead, Mary -- RoseMary. Excuse me. Thank you.

MS. AVALOS: Hi. This is RoseMary Avalos

with the Public Advisor's Office. And I'll first call on folks using the raise-hand feature in Zoom. So I would like you to please state your name and your affiliation for the record, and also spell your first and last name after you are un-muted. And also, please, do not use speaker phone features when talking because we will not be able to hear you clearly.

And I'm going to call on Mark Roest.

Go ahead and speak. Mark?

MR. ROEST: Hello. Hi. It's Roest. It's Dutch, like Shira Canoe (phonetic). And --

MS. AVALOS: Oh. Thank you.

MR. ROEST: Okay. Jackie and Tom particularly, augmenting public policy, we can maximize flexibility by financing solar canopies and rooftop solar together with vehicle conversions and replacements to meet total usage levels most of the year, storing electricity in both vehicle and stationary batteries, which will cost $100 a kilowatt hour or less within two years if we get some more funding. As that spreads, it will actually reduce load demand and peak loads for stressed distribution resources.

Also, Jackie, as an aggregator, could you

put emergency demand data to the edge of the grid in a package which the onsite demand management system could rely on temporarily? Or even if you cannot communicate with them via the wires throughout the shutoff, could you communicate with them wirelessly and manage them in the emergency topology of those resources that are known to be available at that time?

And I guess I could continue. Yeah, well, yeah, I guess I could continue.

So we have technology that's in development, which is ceramic semiconductor batteries and, also, high-level, high-efficiency solar photovoltaic thin film that was originally developed in -- patented in 1983. So these resources, we're in the valley of death but, with some help, we can get these resources into mass production within a couple of years. And I can talk about that offline.

Thank you.

MS. PIERO: I'll let Tom go.

MS. AVALOS: Thank you.

MS. PIERO: I know you have a stop time.

MR. CRISTOSTOMO: Mark, could you please spell your first and last name for the record?

MR. ROEST: Yes. Mark Roest, M-A-R-K R-O-E, as in Edward, -S, as in Sam, -T, as in Tom.

MS. AVALOS: Okay. Next public commenter is Sara Rafalson.

Go ahead, Sara. Oh, okay.

Our next public comment is John Shears.

Go ahead and un-mute your line, Mr. Shears. Okay.

MR. SHEARS: Can you --

MS. AVALOS: There you go.

MR. SHEARS: -- can you hear me?

MS. AVALOS: Yes.

MR. SHEARS: All right. I'm actually using two machines and I used the one that's not necessarily the best audio.

Thanks to Noel and the Commissioners again for a great workshop. Sorry. I'm hearing an echo here.

I just wanted to raise a flag, and I've already contacted the Commissioners and Noel about this earlier, didn't include Commissioner Rechtschaffen because I didn't want to potentially cross wires on ex parte issues, but I just want to raise a flag that as we move forward, especially with the ACT rule, that we

need to be thinking about, also, how we could integrate renewable hydrogen into the picture, taking advantage of, you know, excess generation and avoiding curtailment issues, and also flattening out the belly or the neck of the duck curve.

So, again, just wanted to raise a flag on that, in that we need to sort of, you know, applying our initial thinking about how to integrate that into the further VGI integration.

And thanks again for a great workshop.

MS. AVALOS: Thank you, Mr. Shears.

The next public commenter is Sara Rafalson.

Go ahead.

MS. RAFALSON: Hi. Thanks. So this is Sara Rafalson from EVgo, S-A-R-A Rafalson from EVgo.

I just wanted to say, thanks for the presentation. Really impressed by how smooth these have been in COVID time, so thank you IEPR Admin Team.

Just one comment from Noel's presentation. I noticed on the Track 1 policy slide that there are several types of vehicles

that CARB is regulating and their various timelines. And just wanted to note that I saw that SB 1014 implementation, which is the Clean Mile Standard, wasn't included there. And given that that deals with the transportation networking companies, or TNCs, which is a really important VGI use case, as Eric mentioned in his presentation, I think that might be a good one to include. And it's also going to be really important for infrastructure planning under AB 127.

So thank you.

MS. AVALOS: Okay. Thank you, Sara.

The next public comment is Andy Campbell.

And please state your name and spell your first and last name. Thank you.

MR. CAMPBELL: Yes. Hi. Can you hear me?

MS. AVALOS: Yes.

MR. CAMPBELL: Okay. This is Andy Campbell,
A-N-D-Y C-A-M-P-B-E-L-L.

Commissioners and Mr. Cristostomo, I'm Andy Campbell, Executive Director of the Energy Institute at Haas at UC Berkeley. And thanks for

focusing on VGI issues. I really learned a lot during this workshop.

I'd like to highlight two projects we have ongoing at the Energy Institute to support the state's electric vehicle and VGI effort. Both are about understanding consumer behavior.

First, we have a project to understand residential charging patterns today. The vast majority of EV owners do not have separate EV meters, so our study is using utility smart meter data and vehicle registration data to estimate charging patterns using a machine learning method. The study could help provide a baseline for vehicle-to-grid scenarios.

And then the second project is focused on how the relative costs of electricity and gasoline may influence the decision to adopt an electric vehicle. This study looks at both the prices charged to consumers and the underlying costs. And that study is funded by the PUC.

So we'd like to support the CEC's and PUC's efforts on EV adoption and grid integration and wanted to make the Commissions and this audience aware of our research. We'd be happy to discuss this research with you further.

Thanks so much.

MS. AVALOS: Okay. Thank you, Mr. Campbell.

That concludes the comments from Zoom and, as well, on the phone lines, so I'll hand the meeting over to you, Heather.

MS. RAITT: Thanks RoseMary.

Commissioner Monahan, if you'd like to go ahead and we can move on to closing remarks.

COMMISSIONER MONAHAN: Yes. Well, thanks, everybody, for joining. And I've got to give kudos again to the IEPR Team because this really was a very smooth meeting, really no problems, which sometimes Zoom can be a little finicky and cause problems. So it's really nice when both the planning and the performance of the technology go hand in hand.

So I just want to encourage folks to join us on Wednesday. We're going to have two more sessions. Starting at 9:30 in the morning, we'll have a session on Charging Infrastructure Funding Program. And in the afternoon, we're going to have a session on Scaling VGI and Charging Infrastructure. So just encourage you all to join.

And this meeting -- oh and thank you to my fellow Commissioners for joining me on the virtual dais. It's been a pleasure seeing you. And hopefully we'll see each other again on Wednesday.

All right. Thanks everybody. Have a good rest of your day.

COMMISSIONER RECHTSCHAFFEN: Thank you.

COMMISSIONER DOUGLAS: Yeah. Thank you.

(The workshop concluded at 4:02 p.m.)

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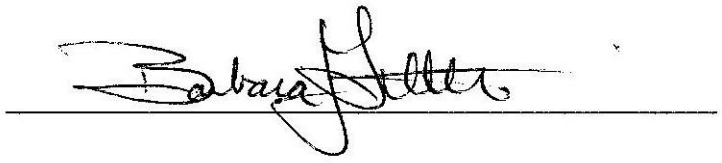

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